E. I. DU PONT DE NEMOURS & COMPANY

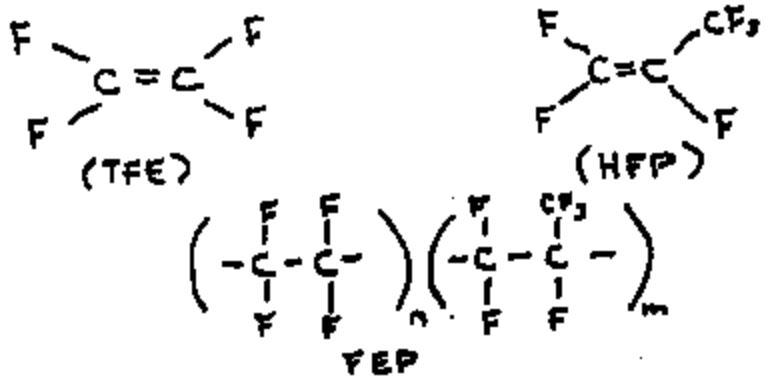
CIRCLEVILLE, OHIO 43113

November 15, 1990

Texas Instruments
Mail Station 12-02
PO Box 119
34 Forest St.
Attleboro, Ma 02703
attn: Jack Kearns

Dear Mr. Kearns,

Teflon™ FEP is a copolymer of tetrafluoroethylene and hexafluoropropylene.



Regards

R Beliveau

Robert L. Beliveau

cc: E. Mckenzie, Cn
M. Vunker

DD/NHTSA No. 4
00001

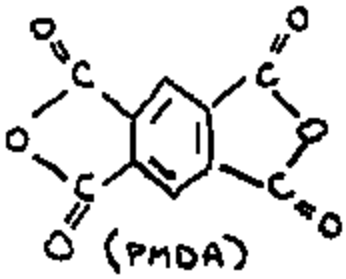
E. I. DU PONT DE NEMOURS & COMPANY
INCORPORATED
CIRCLEVILLE, OHIO 43113

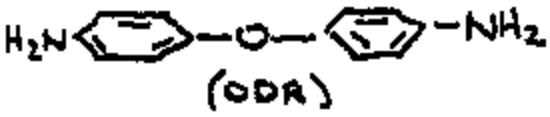
November 15, 1990

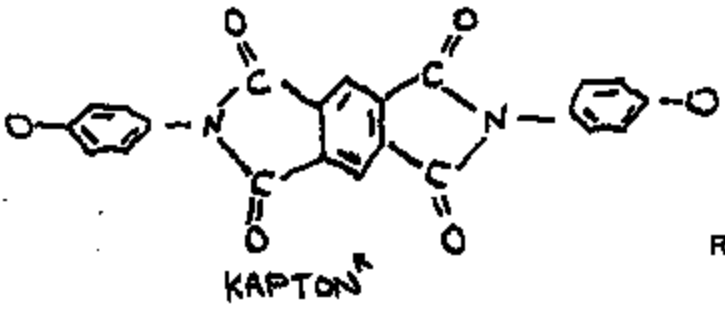
Texas Instruments
Mail Station 12-02
PO Box 119
34 Forest St.
Attleboro, Ma 02703
attn: Jack Kearns

Dear Mr. Kearns,

Kapton® polyimide is a result of a polycondensation reaction between pyromellitic dianhydride and 4,4'-diaminodiphenylether.







Regards

R Beliveau

Robert L. Beliveau

DD/NHTSA No. 4
60402

131
TEX INS.
480 COLD PEEL (MIN)
CPK
YIELD

	AS LAMINATED		AS STABILIZED	
	CPK	YIELD	CPK	YIELD
NORTH	-.63	2.9%	+.11	62.9%
SOUTH	-.20	24.2	+.39	88.1%

GOALS
CPK ≥ 1.33
YIELD > 99%

REL
3-21-91

G-46 REV. 1-77

ENGINEERING DUPONT COMPUTATION SHEET

SHEET NO

TITLE OF PROJ OR STUDY

PROJ OR STUDY NO

SUBJECT 500 FN 131 COLD PEELS

MEAS. IN LAM. AREA

WORK

COMPUTED

DATE 19

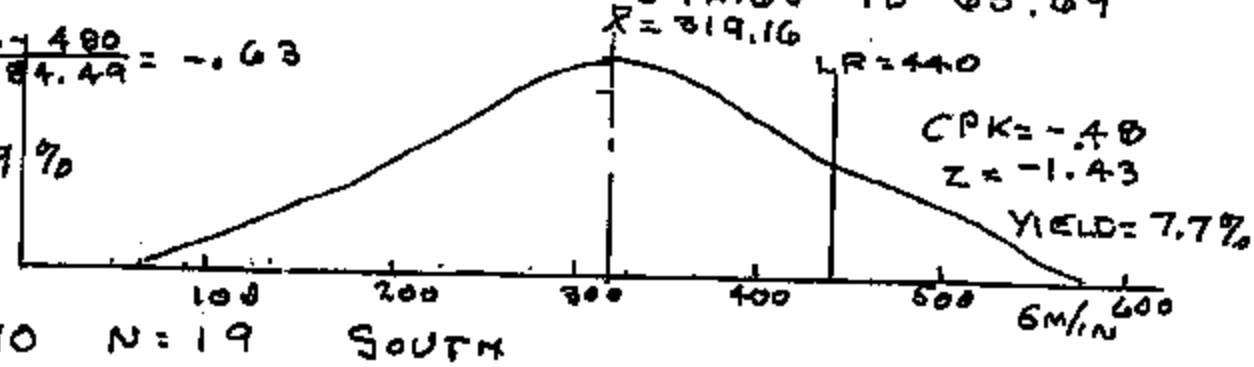
1990 N=19 NORTH NIP

$\bar{X}$ = 319.16 SD = 84.49 572.63 TO 65.69

CPK = $\frac{319.16 - 480}{3 \times 84.49}$ = -.63

Z = -1.90

YIELD = 2.9 %



CPK = -.48

Z = -1.43

YIELD = 7.7 %

1990 N = 19 SOUTH

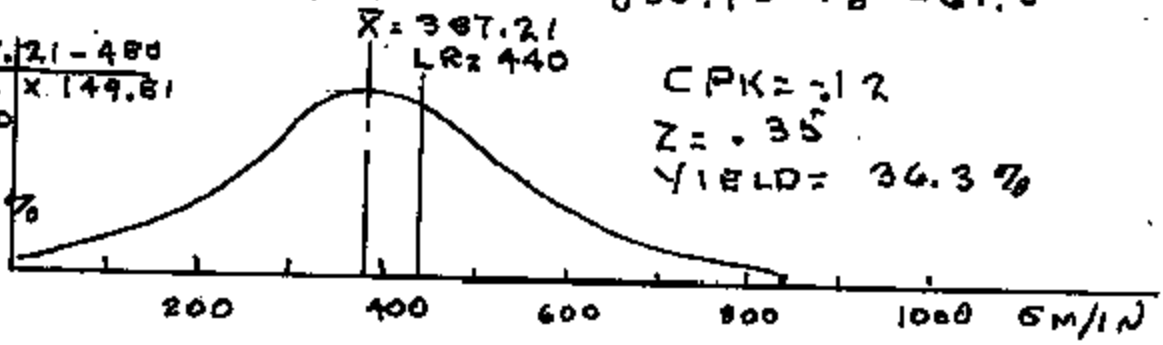
$\bar{X}$ = 387.21 SD = 149.51 835.73 TO -61.3

CPK = $\frac{387.21 - 480}{3 \times 149.81}$

= -.20

Z = -.60

YIELD = 24.2 %



CPK = .12

Z = .35

YIELD = 36.3 %

1990 N = 11 NORTH

AFTER (R)

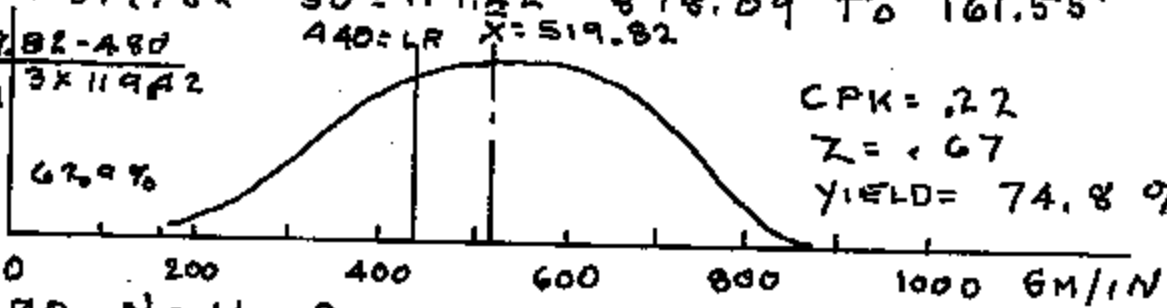
$\bar{X}$ = 519.82 SD = 119.42 878.09 TO 161.55

CPK = $\frac{519.82 - 480}{3 \times 119.42}$

CPK = .11

Z = .33

YIELD = 62.9 %



CPK = .22

Z = .67

YIELD = 74.8 %

1990 N = 11 SOUTH

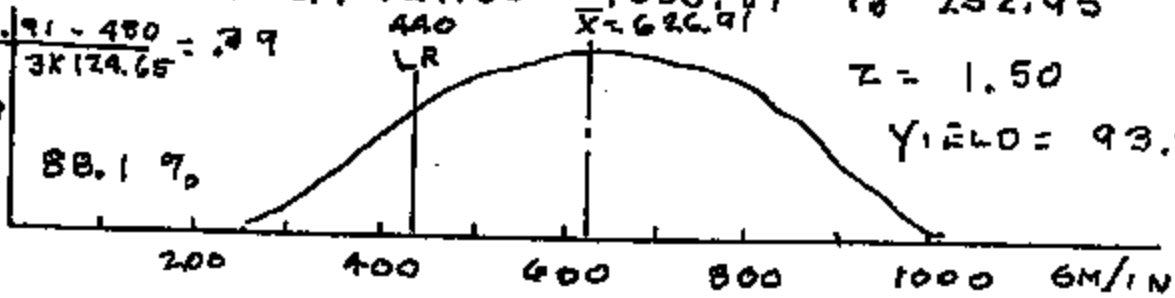
AFTER (R)

$\bar{X}$ = 626.91 SD = 124.65 1000.87 TO 252.95

CPK = $\frac{626.91 - 480}{3 \times 124.65}$ = .39

Z = 1.18

YIELD = 88.1 %



Z = 1.50

YIELD = 93.3 %

USE STANDARDS FOR MINIMUM ESSENTIAL INSTALLATIONS

DD/NHTSA No. 4
00904

PROCESS CAPABILITY

FILM TYPE 200HN
TI PART NO: 74224-1
DATA PERIOD:1991

PROPERTY	COUNT	SPEC. Min	LAB RELEASE DATA Avg	STDV	Avg+3*STDV	Avg-3*STDV	AVG+4*STDV	Avg-4*STDV	CPK
MD Tensile	211	24.00	36.20	2.19	42.77	29.63	44.96	27.44	1.86
TD Tensile	209	24.00	33.74	1.94	39.56	27.92	41.50	25.98	1.67
MD % Elong	215	45.00	80.89	5.79	98.26	63.52	104.05	57.73	2.07
TD % Elong	211	45.00	88.72	7.38	110.86	66.58	118.24	59.20	1.97

FILM TYPE 200HN
TI PART NO: 74224-1
DATA PERIOD:1992

PROPERTY	COUNT	SPEC. Min	LAB RELEASE DATA Avg	STDV	Avg+3*STDV	Avg-3*STDV	AVG+4*STDV	Avg-4*STDV	CPK
MD Tensile	93	24.00	36.33	2.86	44.91	27.75	47.77	24.89	1.44
TD Tensile	92	24.00	33.35	1.95	39.20	27.50	41.15	25.55	1.60
MD % Elong	94	45.00	79.54	7.01	100.57	58.51	107.58	51.50	1.64
TD % Elong	93	45.00	86.92	10.16	117.40	56.44	127.56	46.28	1.38

NO: SCPI-0031
Gage&Type:
Effective Date: 4/11/91
Expiration Date: 4/11/93

LABEL FOR TEXAS INSTRUMENTS, ATTLEBORO, PANCAKE ROLLS

COMMENTS: Because there is no way to permanently attach the core oval to each pancake roll core, Texas Instruments is not able to document and track the rolls through their process. This small stick-on label will allow for Texas Instruments to better track the rolls.

1. Operator, after the film is wound on the core, place the proper size label on the inside of the core.
2. Inspector, inspect to assure label is in place.

TEXAS INSTRUMENT EXAMPLES

31/32" **TI#27225-3**
.87 300FN029

3/4" **TI#27225-1**
.75 500FN131

15/16" **TI#74224-1**
.94 200HN

31/32" **TI#27225-2**
.87 500FN131

AUTHORIZED BY:

AREA SUPERINTENDENT, K-T FINISHING: R J Olson

TRAINING COORDINATOR, K-T FINISHING: L B Bailey

:dkh/smart no. 734

DUPONT

CIRCLEVILLE PLANT
P.O. Box 89
Circleville, OH 43113

CC: E.C.McKenzie,Conn.
M.T.Lewandowski,BMP191207,Wilm.

BCC: H.V.Gunn
File: E-5-A

July 7, 1992

Mr. Ken Berry
Texas Instruments
Attleboro, Mass. 02703

Dear Mr. Berry:

The rewind inspection system used for Kapton* uses a laser to detect either opaque objects or holes.

The equipment includes lane identifiers and lights to assist the operator in locating the object that activated the laser.

If an opaque object is larger than 50 mils in its largest dimension it is considered a defect.

As such it is marked and flagged so that it can be removed in a subsequent operation as the film is slit to customer's orders.

The black spot returned by Texas Instruments was only 15 mils in the largest dimension, so it is not considered a defect by existing standards.

If you have any further questions about the inspection method or the definition of a defect in Kapton* film, please do not hesitate to call Ed McKenzie at 203-871-7426 or me at 614-474-0127.

Sincerely,

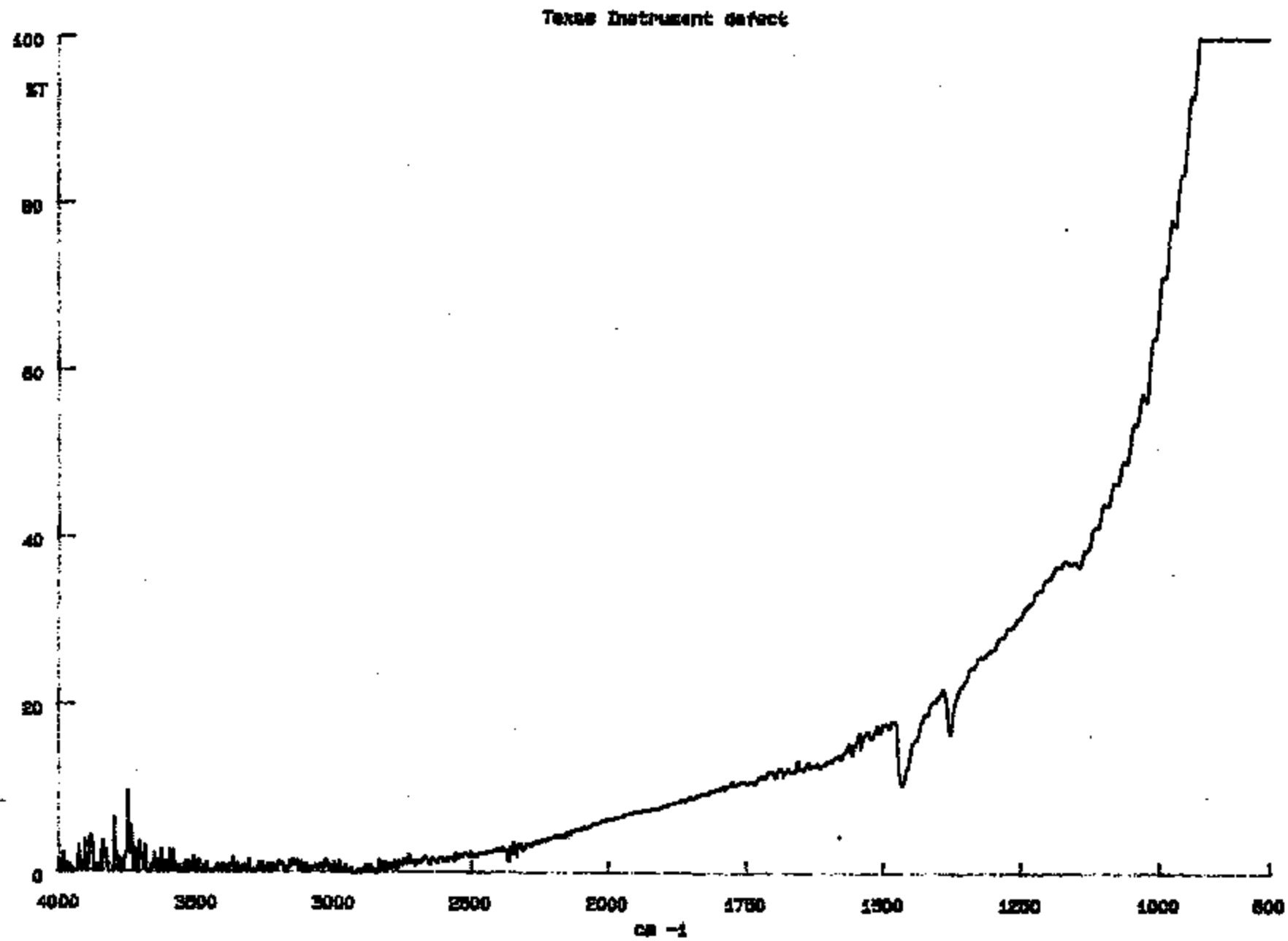
J. M. Yunker

:jkm

Mike,

Spectrum is of poor quality because of the heavy loading of carbon black but it is clearly that of a hydrocarbon elastomer such as poly butylene, isoprene or ethylene-propylene diene.

Ron Wilds


Texas Instrument defect
100
%T
80
60
40
20
0
4000
3500
3000
2500
2000
1750
1500
1250
1000
500
cm -1

Air Roll - Viton
Roller Rhs - Isoprene
Butylene

6/22/92

Mike:

Texas Instruments sent a rejected diaphragm made of 500FN131. I do not from what mill roll. The diaphragm was rejected due to the particle trapped in the laminate. The also took some photos of the enlarged particle.
I will need to respond to the corrective action request within 15 days. Would the inspection rewinder normally catch a particle of this size? Any other thoughts?

Thanks
Ed

10 mil in dia

07. 07. 92 11:00 AM P01

ROUTE TO

TEXAS INSTRUMENTS
ATTLEBORO, MASSACHUSETTS 02703

REPORT OF DISCREPANT IN-PROCESS MATERIAL

No. 007745

DWG. NO. & NAME		REV.	INSPECTOR	DATE	Mfg. Supervision Review:
27325-1 KAPTON STRIP	☐ SPC certified	1	27636	3/11/92	
SOURCE	DEVICE	PROD. CODE	QUANTITY		
DUPONT	63/65	045	1		

ITEM	ATTRIBUTE/REQUIREMENT	ACTUAL	#NSP	AC	RE	#DEF
01	WORKMANSHIP	CONTAMINATION				
		TRAPPED BETWEEN				
		LAYERS OF KAPTON				
	4-15-92					

MAT'L/PROD. CONTROL

☐ CHECK INV INTORY AT LOCATION
☐ PHONE MATERIAL IN SHORT SUPPLY

PRIORITY ☐ 1 ☐ 2 ☐ 3

COMMENTS:

3 pages

TO: [redacted]

FROM: KEN BERRY FAX# 505-699-3788

505-699-3930

DD/NHTSA No. 4
00013

TEXAS INSTRUMENTS - M & C

CORRECTIVE ACTION REQUEST

THIS RESPONSE IS DUE 15 WORKDAYS AFTER RECEIPT AT YOUR FACILITY

RETURN TO:
Ken Berry M/S 11-11
Texas Instruments Incorporated
34 Forest Street
Attleboro, MA 02703

DATE PREPARED:

SUPPLIER: E.I. DUPONT PART NUMBER: 27225-1

ATTENTION: MIKE YUNKER CAR/SCAR #: 007745

1. Do you understand the specification requirement(s) for the characteristic(s) rejected ? YES ☐ NO ☐

If no – describe concern:

If the requirement is not understood, what specific area of information needs clarification?

- TI print unclear ☐
- TI purchase order ☐
- Standards of acceptance ☐
- Other – ☐

2. Please identify the actions you have taken to contain or limit the non-conformance at your facility until a corrective action is in place. Include comments on your inventory, in-transit material, and TI inventory.

What was the Effectivity Date of this containment action ? _____

3. Has your process, machinery or operation been significantly changed since this part number was qualified by M & C ?

ID/NBTSA No. 4
00014

4. Have your measurement methods or inspection equipment significantly changed since this part number was qualified by M & C ? Please state your present measurement method.

5. What allowed this non-conformance to escape your facility ?

6. Other than "Increased Inspection," what specific action(s) will be taken to prevent the defect from recurring ?

What was the Effectivity Date of this corrective action ? _____

Have you audited or verified that the above corrective action(s) will be effective in correcting the problem ?

If your current process or quality system is no longer capable of meeting M & C's specifications, contact the TI Purchasing agent or Procurement Assurance Engineer .

SUPPLIER'S AGENT : _____ TITLE: _____
(please print)

DATE COMPLETED : _____

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
508-699-3800 • TELEX 210551 • CABLE TEXINS

DAVID CZARN 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
2) PLASTIC CORES ??
NEW 300 HIGH B

CIRCLEVILLE PLANT
P.O. Box 89
Circleville, OH 43113

CC: E. C. McKenzie, Conn.

File E-11

August 20, 1992

Mr. John E. Brennan, Ph.D.
Texas Instruments
34 Forest Street
Attleboro, Mass. 02703

Dear Mr. Brennan:

Thanks for sending the Kapton* film from four typical brake fluid pressure switch failures. You indicated the 500FN131 films rupture during cycle testing at 135°C.

Taping the three layers of Kapton* film used to make the diaphragm in its original stacking and orientation was extremely helpful in understanding the failure.

Our initial observations of the failure indicate (1) that the film is damaged in the same location on all three layers, (2) the size of the crack in the diaphragm is about the same on all three layers. The location of the failure in all four assemblies is in the same geographical area.

Based on these observations, I think the rupture is caused by higher stresses occurring at the failure site. If you could look at your design and find anything that might cause this localized pressure, we may be able to find a solution. Some things that might be involved would be thickness tolerances of pieces used in assembly, crimping pressures, or other processing parameters that could create this condition.

If I can be of further assistance, do not hesitate calling me at (614)474-0257.

Sincerely,

Harrison V. Gumm

Harrison V. Gumm
Senior Marketing Specialist
E I du Pont de Nemours & Co., Inc.

Charting a Course for Excellence

Ed ~~Jim~~ - A LIST OF
REWOUND + INSPECTED SMIL.
PLEASE CHECK TO SEE IF
YOU HAVE ANY CAMERA DATA
ON ANY OF THESE.

THANKS
Ed

TA HOLES

<50 + >50 + BUBBLES = TOTAL

Gage/Type	Mill Roll	TA Number	Run Number		End Use		Date	Holes & Bubbles	Holes Max Size
300HNH	8121804	0	0	0	0	TOC	79	04/13/93	0.00	0.00
300HNH	8121809	0	0	0	0	LAM	9000	04/15/93	0.00	0.00
300HNH	8121811	0	0	0	0	TOC	9400	04/15/93	0.00	0.00
300HNH	8121812	0	0	0	0	TOC	7062	04/16/93	0.00	
300HNH	8121926	0	0	0	0	gen	7000	05/31/93	0.00	0.00
300HNH	8121927	0	0	5	5	GEN	4300	05/31/93	1.00	
300HNH	8121928	0	0	8	8	GEN	7000	05/31/93	1.00	
300HNH	8121929	0	0	2	2	GEN	1550	06/01/93	2.00	
300HNH	8121930	6	0	14	14	GEN	4050	06/01/93	0.00	0.00
300HNH	8121933	0	0	13	13	FPC	4000	06/02/93	0.00	
300HNH	8121942	0	0	6	6	GEN	7000	06/05/93	0.00	0.00
300HNH	8121946	2	0	2	4	FPC	7000	06/08/93	0.00	0.00
300HNH	8121950					FPC		06/09/93	20.00	80.00
300HNH	8121951	0	0	5	5	TOC	7000	06/09/93	18.00	150.00
300HNH	8121952	0	0	11	11	FPC	7000	06/09/93	0.00	0.00
300HNH	8121960					GEN		06/13/93	1.00	
300HNH	8121961					FPC		06/13/93	0.00	0.00
300HNH	8121962					TOC		06/13/93	0.00	
300HNH	8121964					GEN		06/14/93	0.00	0.00
300HNH	8121969	0	0	7	7	GEN	4600	06/15/93	0.00	0.00

S S Cut	Outs	MAL Random
	0.00	7119.00
	0.00	3529.00
	1.00	2416.00
	0.00	1810.00
	0.00	604.00
	0.00	1210.00
	0.00	408.00
	0.00	267.00
	0.00	2400.00
	0.00	1800.00
	0.00	7095.00
	0.00	1978.00
	0.00	1566.00
	0.00	365.00
	0.00	1460.00
	0.00	450.00
	1.00	7950.00
	0.00	3600.00
	2.00	2436.00
	0.00	5500.00

DEFENDER No. 4
00021

Inspected Foota	Released As
7119.00	LAM
7059.00	LAM
	GEN
7240.00	TDC
7249.00	GEN
7265.00	GEN
7920.00	GEN
7500.00	GEN
7200.00	GEN
7200.00	FPC
7095.00	GEN
7891.00	FPC
7830.00	FPC
7300.00	GEN
7300.00	GEN
1800.00	GEN
7800.00	FPC
7200.00	TOW
7310.00	GEN
5500.00	GEN

"KAPTON" 300HN TYP 9/9/93

Gage/Type	Mill No.	Date	MD Modulus	MD Tensile	TD Tensile	MD Elongation	TD Elongation	Holes & Bubbles
300HN	8121806	04/14/93		36.100	34.100	77.00	84.00	
300HN	8121808	04/14/93		36.200	33.100	86.00	91.00	
300HN	8121810	04/15/93		39.900	35.00	86.00	90.00	
300HN	8121811	04/15/93		36.500	34.800	81.00	94.00	0.00
300HN	8121813	04/16/93		36.500	34.400	77.00	88.00	
300HN	8121815	04/16/93		36.700	32.600	84.00	86.00	
300HN	8121816	04/17/93		37.600	35.200	85.00	88.00	
300HN	8121924	05/30/93	461.00	39.00	34.500	80.00	89.00	
300HN	8121928	05/31/93	419.00	36.00	32.800	74.00	88.00	0.00
300HN	8121928	06/31/93	440.00	35.500	31.800	70.00	80.00	1.00
300HN	8121930	06/01/93	458.00	34.300	33.100	73.00	92.00	0.00
300HN	8121932	06/01/93	445.00	35.800	31.300	76.00	79.00	
300HN	8121933	06/02/93	443.00	37.300	32.700	81.00	86.00	0.00
300HN	8121936	06/03/93	454.00	38.200	31.400	79.00	85.00	
300HN	8121937	06/03/93	446.00	35.600	30.400	78.00	77.00	
300HN	8121938	06/03/93	416.00	35.200	31.700	78.00	86.00	
300HN	8121942	06/06/93	449.00	34.100	31.100	68.00	80.00	
300HN	8121943	06/06/93	399.00	34.600	29.700		75.00	
300HN	8121946	06/07/93		35.900	32.700	75.00	84.00	
300HN	8121947	06/08/93		36.800	33.00	84.00	87.00	
300HN	8121949	06/08/93		34.900	32.200	72.00	85.00	
300HN	8121950	06/09/93		35.100	31.100	71.00	78.00	
300HN	8121951	06/09/93		38.900	34.700	79.00	88.00	18.00
300HN	8121953	06/10/93		33.200	33.400	63.00	90.00	
300HN	8121959	06/12/93		38.900	34.800	81.00	88.00	
300HN	8121960	06/13/93		38.000	34.900	81.00	89.00	
300HN	8121961	06/13/93		34.300	32.300	88.00	82.00	
300HN	8121962	06/13/93		36.100	34.100	76.00	88.00	0.00
300HN	8121964	06/14/93		36.00	32.700	70.00	80.00	0.00
300HN	8121966	06/14/93		37.500	32.100	83.00	84.00	
300HN	8121968	06/14/93		32.500	34.400	84.00	73.00	
300HN	8222118	06/20/93		35.500	36.400	81.00	40.00	
300HN	8222119	06/20/93		36.300	36.200	86.00	88.00	0.00
300HN	8222121	06/21/93		34.500	34.000	77.00	90.00	
300HN	8222123	06/21/93		34.700	38.700	80.00	83.00	
300HN	8222125	06/22/93		35.600	33.00	87.00	85.00	0.00
300HN	8222127	06/23/93		35.100	34.000	82.00	90.00	
300HN	8222129	06/23/93		33.300	34.300	76.00	87.00	
300HN	8222131	06/23/93		35.300	33.500	86.00	84.00	0.00
300HN	8222133	06/24/93		37.000	33.400	95.00	82.00	
300HN	8222135	06/25/93		32.500	31.200	76.00	77.00	
300HN	8222137	06/25/93		36.00	32.800	86.00	76.00	
300HN	8222139	06/25/93		34.200	32.200	79.00	79.00	
300HN	8222141	06/26/93		36.500	34.800	83.00	83.00	
300HN	8222143	06/26/93		33.000	33.600	76.00	84.00	
300HN	8222145	06/27/93		36.300	35.100	88.00	86.00	
300HN	8222147	06/27/93		35.000	33.00	85.00	78.00	
300HN	8222171	07/06/93		34.500	34.900	79.00	89.00	
300HN	8222172	07/06/93		34.400	34.500	79.00	86.00	

"KAPTON" 500FN131 9/9/93

FILM TYPE 500FN131
TI PART NO: 27225-1, -2
DATA PERIOD: 1993

		SPEC.	LAB RELEASE DATA				
PROPERTY	COUNT	Min	AVG	STDV	AVG-3*STDV	AVG-4*STDV	CPK
MD Tensile	10	15.00	22.30	1.79	17.12	15.39	1.41
MD % Elong	10	35.00	71.50	17.20	19.90	2.70	0.71
Modulus	9		282.23	17.08	230.99	213.91	---

"KAPTON" 300HN YTD . 9/9/93

PROCESS CAPABILITY

FILM TYPE 300HN
TI PART NO: 27225-4
substrate for 27225-1, -2
DATA PERIOD: 1993 YTD

		SPEC.	LAB RELEASE DATA				
PROPERTY	COUNT	Min	Avg	STDV	Avg-3xSTDV	Avg-4xSTDV	CPK
MD Tensile	49	24.00 kpsi	35.87	1.69	30.81	29.12	2.34
TD Tensile	49	24.00 kpsi	33.49	1.66	28.50	26.83	1.90
MD % Elong	48	50.00	79.19	6.47	59.77	53.29	1.50
TD % Elong	49	50.00	83.64	8.11	59.51	51.40	1.39
Modulus	11	370.00 kpsi (typ)	438.27	18.33	383.28	364.95	---

DD/NBTSA No. 4
90025

Hole Performance: 500FN131 YTD

Gage/Type	Mill Roll	Date	Holes/Bubbles
500FN131	4118040	02/22/93	0
500FN131	4118041	02/23/93	0
500FN131	4118042	02/23/93	0
500FN131	4118043	02/23/93	0
500FN131	4118044	02/23/93	1
500FN131	4118194	05/23/93	0
500FN131	4118223	06/11/93	1
500FN131	4118224	06/17/93	0
500FN131	4118247	07/07/93	0
500FN131	4118248	07/08/93	1
500FN131	4118300	08/05/93	0
500FN131	4118301	08/05/93	0
500FN131	4118306	08/25/93	1

Setting specs for Cal.

Worksheet Analysis
tii Scohn

Property	Count	Average	Standard	+3 Std	-3 Std	Minimum	Maximum
End Use	No Data	No Data	No Dat	No Data	No Data	No Data	No Data
Date	No Data	No Data	No Dat	No Data	No Data	No Data	No Data
Holes & Bubbles	20	2.15	5.80	19.54	-15.24	0.00	20.00
Holes Max Size	14	16.43	43.96	148.31	-115.45	0.00	150.00
MAL Random	22	2515.73	2355.97	9583.64	-4552.19	267.00	7950.00
MAL Oriented	No Data	No Data	No Dat	No Data	No Data	No Data	No Data
Released As	No Data	No Data	No Dat	No Data	No Data	No Data	No Data

92.TOT

Gauge/Type	Mill Roll	Date	Unit Weight	Thickness Min	Thickness Max	Thickness Avg	Cold Peel Nort	Cold Peel South	MB Elongation
500FN131	4117641	01/07/92	213.700	4.96	5.14	5.04	272.00	524.00	85.00
500FN131	4117642	01/07/92	212.300	4.89	5.11	5.01	242.00	436.00	88.00
500FN131	4117643	01/07/92	211.900	4.94	5.12	5.03	236.00	230.00	82.00
500FN131	4117829	07/23/92	205.900	4.78	4.99	4.86	265.00	352.00	89.00
500FN131	4117830	07/23/92	206.00	4.75	4.900	4.83	301.00	379.00	84.00
500FN131	4117831	07/27/92	208.200	4.71	4.82	4.76	187.00	225.00	85.00
500FN131	4117832	07/28/92	209.700	4.73	4.84	4.79	404.00	409.00	94.00
500FN131	4117839	07/27/92					936.00	877.00	
500FN131	4117940	11/05/92	208.400	4.74	4.96	4.86	445.00	475.00	62.00
500FN131	4117941	11/05/92	210.300	4.81	4.92	4.88	422.00	317.00	90.00
500FN131	4117942	11/05/92	210.800	4.84	4.96	4.900	474.00	433.00	85.00
500FN131	4117943	11/06/92	205.800	4.73	4.91	4.81	434.00	411.00	81.00
500FN131	4117979	12/09/92	213.100	4.81	4.95	4.27	608.00	337.00	91.00
500FN131	4117980	12/09/92	214.300	4.800	4.91	4.85	621.00	459.00	98.00
500FN131	4117981	12/09/92	209.600	4.86	4.97	4.900	619.00	414.00	95.00

Worksheet Analysis
Y1500FN2

Property	Count	Average	Standard	+3 Std	-3 Std	Minimum	Maximum
Unit Weight	14	210.00	2.88	218.64	201.36	205.80	214.30
Thickness Min	14	4.81	0.08	5.05	4.57	4.71	4.96
Thickness Max	14	4.56	0.10	5.26	4.87	4.82	5.14
Thickness Ave	14	4.89	0.08	5.14	4.63	4.78	5.04
Cold Peel Nort	15	431.07	200.66	1033.04	-170.90	187.00	936.00
Cold Peel Sout	15	419.20	150.95	872.04	-33.64	230.00	877.00
MB Elongation	14	86.36	8.62	112.21	60.51	62.00	98.00

Worksheet Analysis
YTD300HN

Property	Count	Average	Minimum	Maximum
End Use				
Holes & Bubbles	20	2.15	0.00	20.00
Holes Max Size	14	16.43	0.00	150.00
MAL Random	22	2515.73	267.00	7950.00
Inspected Foots	21	6662.24	500.00	7891.00

TEXAS INST

DOCUMENTS No. 4
00430

DO/HEIBA No. 4
00031

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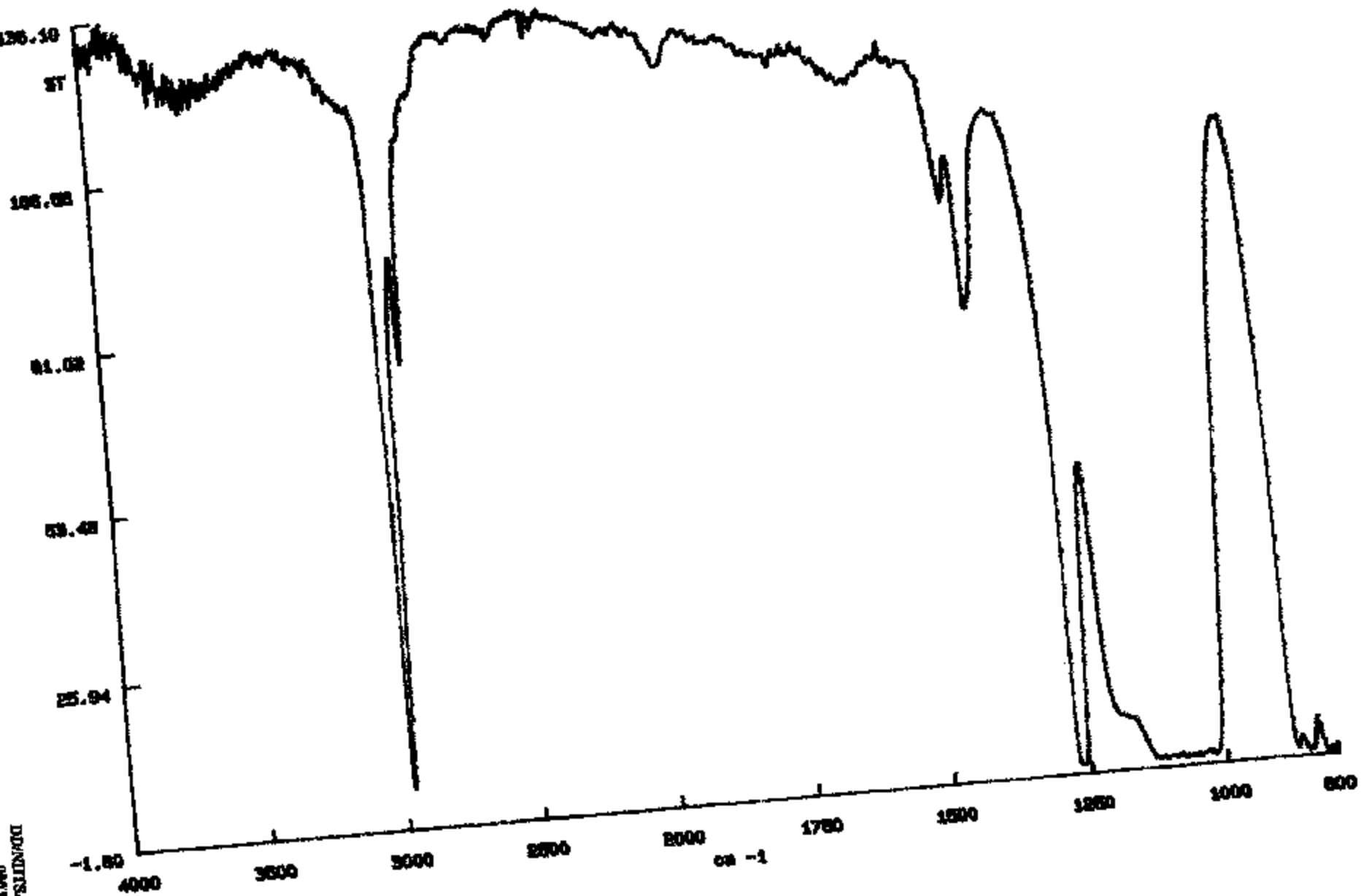
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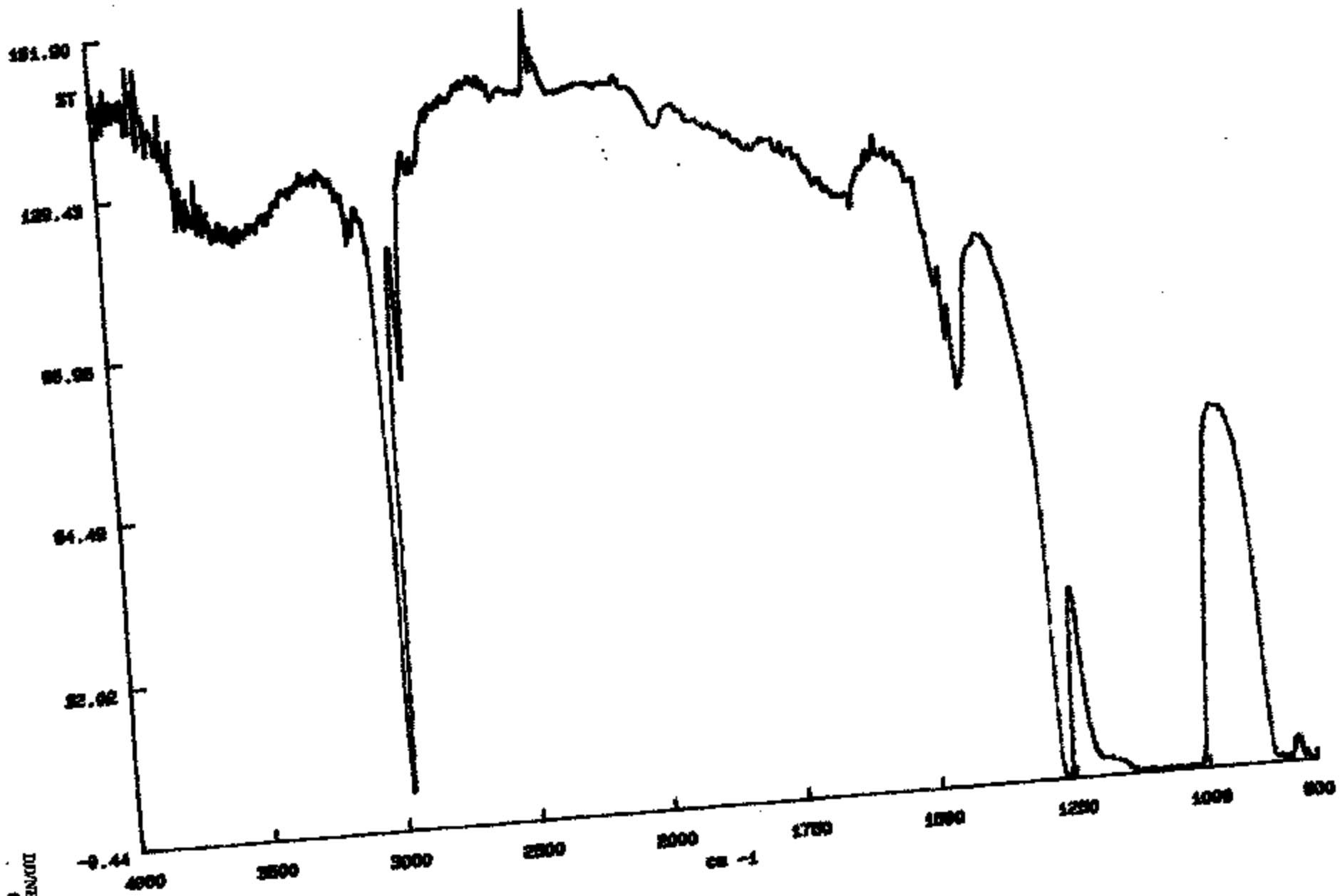
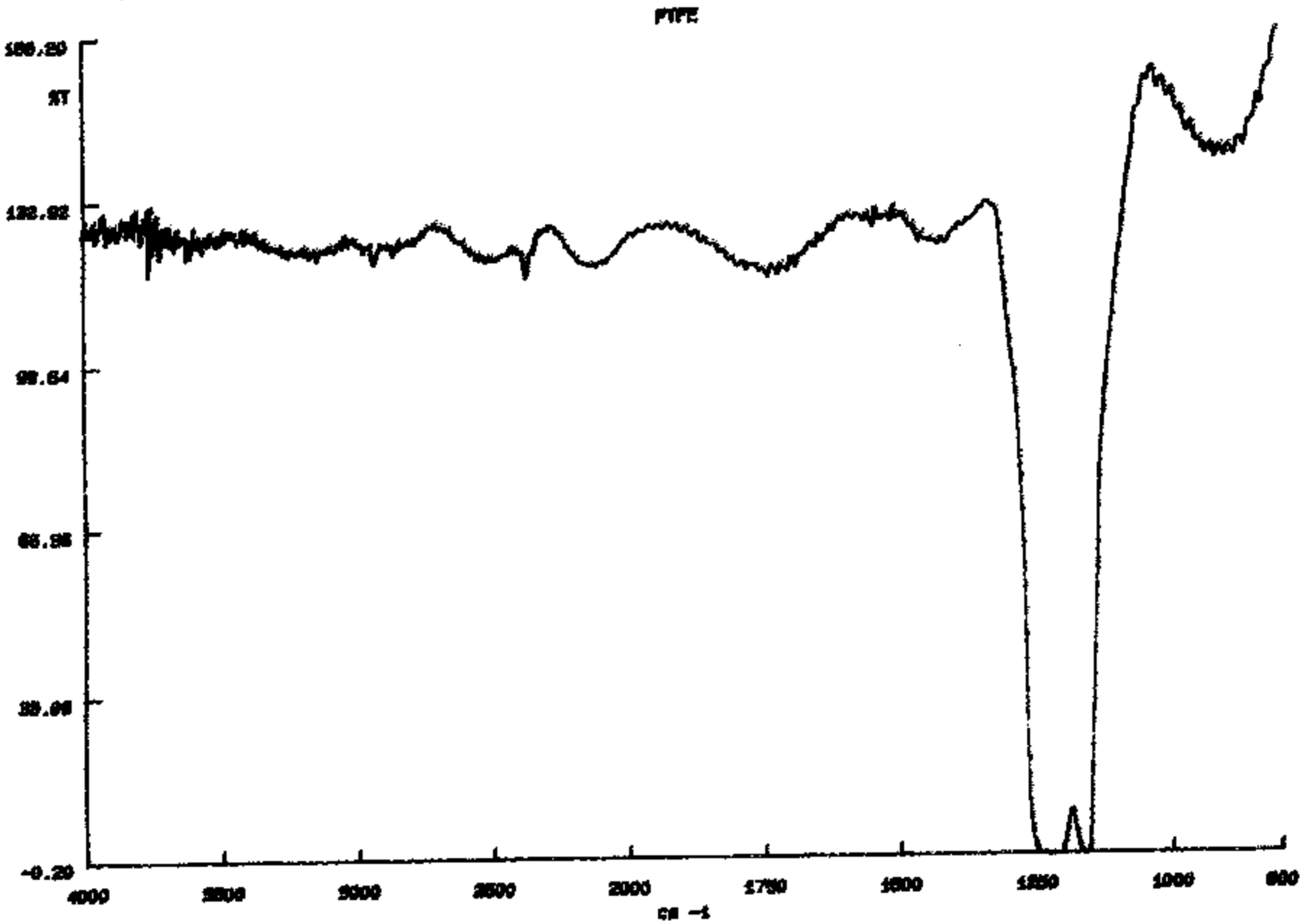
Kapton® tape adhesive

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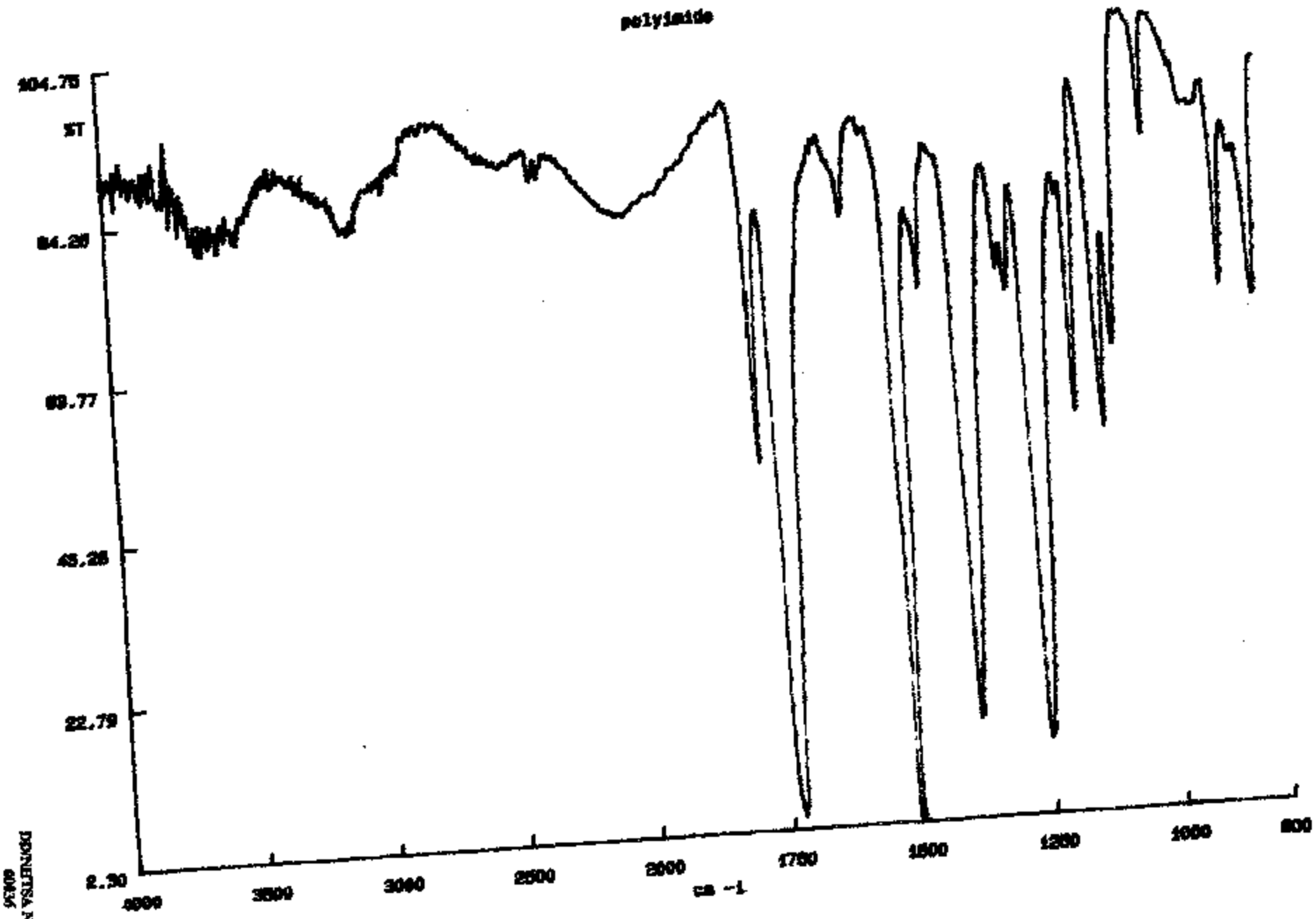


DIGNEITSA No. 4
60836

5/9/93

PROCESS CAPABILITY ANALYSIS
500FN131 (TI Part No. 27225-1)
DATE: 5/5/93

WIDTH (INCHES)

	COUNT:	169		
0.001 STD	0.003613	3STD		
0.751 AVG	0.754342	AVG+3STD	USL	0.766
0.748 MIN	0.747315	AVG-3STD	LSL	0.734
0.761 MAX				

CPU	4.171096
CPL	4.685318
>> CPK	4.171096

POINT THICKNESS (MILS)

	COUNT:	14		
0.080 STD	0.24	3STD		
4.890 AVG	5.13	AVG+3STD	USL	5.5
4.710 MIN	4.65	AVG-3STD	LSL	4.5
5.140 MAX				

CPU	2.541666
CPL	1.625
>> CPK	1.625

USL: Upper Specification Limit
LSL: Lower Specification Limit
CPK: Process Capability Index Measure
CPU: CPK Upper
CPL: CPK Lower
STD: Standard Deviation

PROCESS CAPABILITY ANALYSIS
300HN (TI Part No. 27225-4)
DATE: 5/24/93

POINT THICKNESS (MILS)

		COUNT:	40		
0.030	STD	0.090	3STD		
3.060	AVG	3.150	AVG+3STD	USL	3.300
2.920	MIN	2.970	AVG-3STD	LSL	2.700
3.180	MAX				

	CPU	2.667
	CPL	4.000
>>	CPK	2.667

USL: Upper Specification Limit
LSL: Lower Specification Limit
CPK: Process Capability Index Measure
CPU: CPK Upper
CPL: CPK Lower
STD: Standard Deviation

PROCESS CAPABILITY

FILM TYPE 300HN
TI PART NO: 27225-4
substrate for 27225-1, -2
DATA PERIOD: 1991

PROPERTY	COUNT	SPEC. Min	LAB RELEASE DATA Avg	STDV	Avg+3*STDV	Avg-3*STDV	AVG+4*STDV	Avg-4*STDV	CPK
MD Tensile	111	24.00	36.10	2.18	42.64	29.56	44.82	27.38	1.86
TD Tensile	110	24.00	32.58	2.08	38.82	26.34	40.90	24.36	1.97
MD % Elong	114	50.00	83.76	7.28	105.60	61.92	112.88	54.64	1.55
TD % Elong	114	50.00	97.81	8.66	123.79	71.83	132.45	63.17	1.84

FILM TYPE 300HN
TI PART NO: 27225-4
substrate for 27225-1, -2
DATA PERIOD: 1992

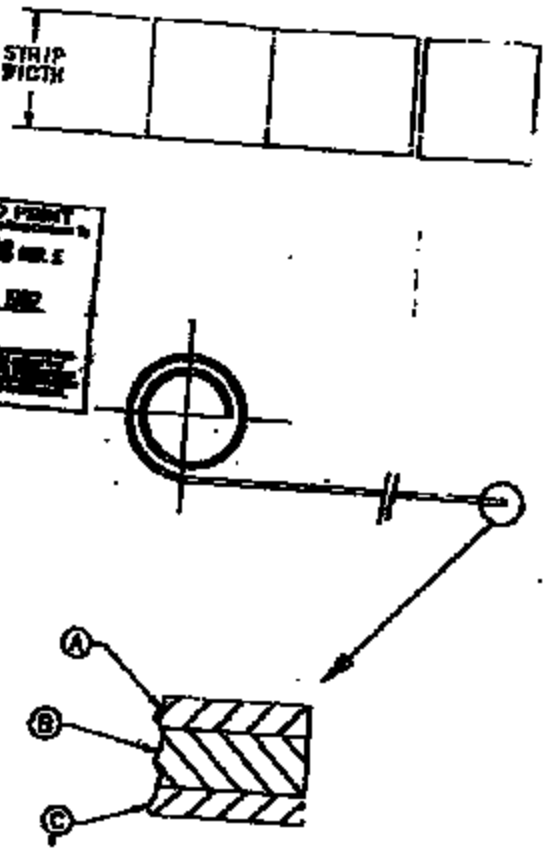
PROPERTY	COUNT	SPEC. Min	LAB RELEASE DATA Avg	STDV	Avg+3*STDV	Avg-3*STDV	AVG+4*STDV	Avg-4*STDV	CPK
MD Tensile	65	24.00	36.47	1.44	40.79	32.15	42.23	30.71	2.89
TD Tensile	63	24.00	33.43	1.29	37.30	29.56	38.59	28.27	2.44
MD % Elong	66	50.00	81.50	7.30	103.40	59.60	110.70	52.30	1.44
TD % Elong	63	50.00	91.67	8.28	116.51	66.83	124.79	58.55	1.68

93 YTD

Gage/Type	Mill Roll	Date	Unit Weight	Thickness Min	Thickness Max	Thickness Avg	Cold Peel NortCold	Peel SoutMD	Elongation
500FN131	4118040	02/23/93	206.800	4.86	4.99	4.93	437.00	625.00	70.00
500FN131	4118041	02/23/93	206.600	4.77	4.98	4.87	293.00	416.00	90.00
500FN131	4118042	02/23/93	212.300	4.88	5.01	4.95	396.00	713.00	58.00
500FN131	4118043	02/23/93	208.00	4.72	4.91	4.81	383.00	479.00	58.00
500FN131	4118044	02/23/93	204.800	4.78	4.86	4.83	471.00	451.00	50.00
500FN131	4118190	05/23/93	213.600	4.91	5.05	4.99	971.00	519.00	43.00
500FN131	4118223	06/11/93	212.400	4.88	5.01	4.93	860.00	878.00	87.00
500FN131	4118224	06/17/93	212.900	4.93	5.09	5.02	963.00	993.00	
500FN131	4118247	07/07/93	214.200	4.85	4.98	4.900	779.00	553.00	81.00
500FN131	4118248	07/08/93	211.300	4.900	5.08	4.98	685.00	451.00	

Worksheet Analysis
TI500FN

Property	Count	Average	Standard	+3 Std	-3 Std	Minimum	Maximum
Unit Weight	10	210.31	3.49	220.52	200.10	204.80	214.20
Thickness Min	10	4.85	0.07	5.06	4.64	4.72	4.93
Thickness Max	10	5.00	0.07	5.21	4.79	4.86	5.09
Thickness Avg	10	4.92	0.07	5.13	4.71	4.81	5.02
Cold Peel Nort	10	657.80	221.28	1321.63	-6.03	293.00	971.00
Cold Peel Sout	10	608.00	196.25	1196.74	19.26	416.00	993.00
MD Elongation	8	67.13	17.57	119.83	14.42	43.00	90.00



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. BENDING 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.

PART NO.	MATERIAL	THICKNESS (MILS)	DIMENSIONS (INCHES) A	B	C	CONTRACTING DIMENSIONS (SEE 2)	SCREW WIDTH (INCHES)	PER ROLL (LBS.)	SEE MATERIAL
27225-4	KAPTON 200HN (SINGLE FACED TEFLON)	3 ± 0.3 MILS	6.0	3	6.0	.375-.390	5 x 5 1/2		PLASTIC (WHITE)
27225-3	KAPTON 200 FILM	3 ± 0.4 MILS	6.0	2	6.0	.495-.510	3 x 5 1/2		PLASTIC (WHITE)
27225-2	KAPTON 200 FILM	6 ± 0.5 MILS	1	3	1	.500-.510	5 x 5 1/2		PLASTIC (WHITE)
27225-1	KAPTON 200 FILM	5 ± 0.5 MILS	1	3	1	.375-.390	5 x 5 1/2		PLASTIC (WHITE)

TEXAS INSTRUMENTS DALLAS, TEXAS					
TITLE KAPTON STRIP SPECIFICATION					
8	82547	27225			

DIMENSIONS No. 4

THIS DWG. SUPERSEDES 27225 REV. "F" DATED 7-5-82

5/19/93

PROCESS CAPABILITY ANALYSIS
500FN131 (TI Part No. 27225-1)
DATE: 5/5/93

WIDTH (INCHES)

	COUNT:	169		
0.001 STD	0.003613	3STD		
0.751 AVG	0.754542	AVG+3STD	USL	0.766
0.748 MIN	0.747315	AVG-3STD	LSL	0.734
0.761 MAX				

	CPU	4.171096
	CPL	4.685318
>>	CPK	4.171096

POINT THICKNESS (MILS)

	COUNT:	14		
0.080 STD	0.24	3STD		
4.890 AVG	5.13	AVG+3STD	USL	5.5
4.710 MIN	4.65	AVG-3STD	LSL	4.5
5.140 MAX				

	CPU	2.541666
	CPL	1.625
>>	CPK	1.625

USL: Upper Specification Limit
LSL: Lower Specification Limit
CPK: Process Capability Index Measure
CPU: CPK Upper
CPL: CPK Lower
STD: Standard Deviation

PROCESS CAPABILITY

FILM TYPE 200HN
TI PART NO: 74224-1
DATA PERIOD: 1991

PROPERTY	COUNT	SPEC. Min	LAB RELEASE DATA Avg	STDV	Avg+3*STDV	Avg-3*STDV	AVG+4*STDV	Avg-4*STDV	CPK
MD Tensile	211	24.00	36.20	2.19	42.77	29.63	44.96	27.44	1.86
TD Tensile	209	24.00	33.74	1.94	39.56	27.92	41.50	25.98	1.67
MD % Elong	215	45.00	80.89	5.79	98.26	63.52	104.05	57.73	2.07
TD % Elong	211	45.00	88.72	7.38	110.86	66.58	118.24	59.20	1.97

FILM TYPE 200HN
TI PART NO: 74224-1
DATA PERIOD: 1992

PROPERTY	COUNT	SPEC. Min	LAB RELEASE DATA Avg	STDV	Avg+3*STDV	Avg-3*STDV	AVG+4*STDV	Avg-4*STDV	CPK
MD Tensile	93	24.00	36.33	2.86	44.91	27.75	47.77	24.89	1.44
TD Tensile	92	24.00	33.35	1.95	39.20	27.50	41.15	25.55	1.60
MD % Elong	94	45.00	79.54	7.01	100.57	58.51	107.58	51.50	1.64
TD % Elong	93	45.00	86.92	10.16	117.40	56.44	127.56	46.28	1.38

E. I. DUPONT
DUPONT ROAD
CIRCLEVILLE OH.

Sample Identification: 2113506 Test Date: 13 Apr 1993

Out of 5 specimens, 0 excluded.

MD

Specimen Number	Stress at Max.Load (Kpsi)	% Strain at Max.Load (%)	Modulus (user lims) (Kpsi)	Load at Max.Load (lbs)
1	40.48	81.31	454.4	20.24
2	39.55	80.70	422.2	19.77
3	36.78	70.94	365.0	18.39
4	36.93	75.71	422.2	18.46
5	38.16	79.24	336.8	19.08
Mean:	38.38	77.58	400.1	19.19
Standard Deviation:	1.62	4.30	47.9	.81
Minimum:	36.78	70.94	336.8	18.39
Maximum:	40.48	81.31	454.4	20.24
Cof of Var:	4.23	5.54	11.97	4.23

$TD/MD = \frac{83.1}{77.6} = 1.07$

Sample Identification: 2113506 Test Date: 13 Apr 1993

Out of 5 specimens, 0 excluded.

TD

Specimen Number	Stress at Max.Load (Kpsi)	% Strain at Max.Load (%)	Modulus (user lims) (Kpsi)	Load at Max.Load (lbs)
1	36.38	93.11	466.6	18.19
2	34.11	78.91	382.2	17.05
3	31.83	70.84	347.9	15.92
4	37.02	88.69	366.6	18.51
5	32.87	84.11	251.1	16.44
Mean:	34.44	83.13	362.9	17.22
Standard Deviation:	2.23	8.66	77.2	1.11
Minimum:	31.83	70.84	251.1	15.92
Maximum:	37.02	93.11	466.6	18.51
Cof of Var:	6.46	10.42	21.29	6.46

FAX NO. 302-651-7964
508-699-3153

Date 5/19/93

CIRCLEVILLE PLANT
P.O. Box 89
Circleville, OH 43113

Kapton*-Teflon*-SP Resin

FACSIMILE TRANSMISSION COVER SHEET

ADDRESSEE(S):

Name	Company or Department	Location
DAVID CZARN MS 12-29	TEXAS INSTRUMENTS	ATTLEBORO MA

COPY:

SENDER:

Name	Business Sector	Location
ED MCKENZIE	TEXAS INSTRUMENTS	CIRCLEVILLE

Total Number of Pages (Including Cover Sheet) 8

SPECIAL INSTRUCTIONS/INFORMATION TO RECIPIENT:

DuPont, Circleville Kapton*-Teflon*-SP Resin Fax No. - 614-474-0680
Verification number - 614-474-0445

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Charting a Course for Excellence

DD/NHTSA No. 4
00047

DuPont High Performance Films
U.S. Route 23 & DuPont Road
P.O. Box 89
Circleville, OH 43113
Tel. (614) 474-8724
Fax: (614) 474-8722

DuPont High Performance Films

May 19, 1993

Mr. David Czarn
Texas Instruments
MS 12-29
34 Forest St.
Attleboro, MA 02703

Dear Dave,

In response to your request of May 13, enclosed you will find excerpts from the Quality Manual for our manufacturing facility for Kapton® polyimide and Teflon® fluoropolymer films. Section 3.1 is an introduction with product background, and section 4.8 describes the procedures by which we control our processes. Flow charts are also included depicting the basic steps involved in the manufacture of our film products.

A few additional comments:

Thickness - Kapton® 500FN131 (TI part #27225-1) is a laminate construction of 3 mil polyimide film with 1 mil of fluoropolymer film on each side. The thickness of each web is continuously measured on line and this information is used as feedback, through a proprietary computer control system to adjust the die lip openings. The three webs are then laminated in a separate process, with point thickness of the final laminate measured to assure conformance to specifications.

Attached is a copy of statistical data recently supplied to Texas Instruments Quality Assurance, regarding 500FN131 laminate. Results were derived from thickness measurements of samples taken from all production in calendar year 1992.

Film Inspection: All laminate films are 100% inspected using a rewind inspector equipped with electronic/optical detection equipment which is used to locate and "map" pinholes, debris and other film defects. The Finishing Area uses this map to locate and remove the defect. The inspection criteria are:

Holes: any detected hole is a defect, and flagged for removal during slitting. The inspection equipment is capable of detecting holes 5 miles or larger.

"Opaque objects": inclusions, and surface contaminate. The equipment detects any opaque object down to 25 mils, and alerts the operator to its location in the web. It is removed, if possible, in the case of a surface defect. Current specifications call for any opaque object in the film, 50 mils or larger to be flagged and removed during slitting.

DD/NHTSA No. 4
00048

4.8 PROCESS CONTROL

4.8.1 General

All Kapton*-Teflon* processes will be run under a state of controlled conditions. These processes are shown schematically on the following three pages. Functional areas are responsible for establishing these controlled conditions which include:

- Production schedules, based on orders and forecasts, are communicated by Production Control to the areas. The manufacturing areas use these schedules to plan product changes.

- Documented work instructions, Area Procedures (APs) and Operating Procedures (OPs), explain how tasks are to be performed where the lack of such instructions could significantly reduce the product's level of quality.

- Specified operating conditions, called Standard Operating Conditions (SOCs), which describe where process parameters should be set

- Control of process parameters to the greatest extent within specified ranges

- Operation of the processes outside of specified ranges only after obtaining authorization

- Routine monitoring of these processes to ensure process stability. Monitoring techniques include one or more of the following:

  - Automatic control loops
  - Manual controls
  - Computerized control systems
  - Statistical control charts

- Additional detail is given in QSP 0005 and Area Procedures

4.8.2 New Equipment or Process

Any product manufactured on new equipment or by a new process is produced under the plant TA (Test Authorization) system. This system provides the documentation and approval system for using a non-standard process. This system is described in more detail in QSP 0014.

I hope this information will prove useful in your efforts. Although many aspects of the manufacture of Kapton® films are proprietary, I'll do my best to answer any further questions you might have.

I look forward to the visit to Attleboro on May 25. Perhaps at this time we can discuss further ways in which DuPont can assist Texas Instruments in opening markets in Japan.

Sincerely,

Edward C. McKenzie

Edward C. McKenzie
Senior Technical Service Representative

cc: D. Reifschneider

/all
(EM.005)

MILLROLL #: 4116172
BASE/TYPE: 500FN 131
SEMINDER: WEST
TORAY OR NON-TORAY: NON-TORAY

No. 4

SUMMATION OF DEFECTS: LAMINATED

21's	71's	78's	SLE NAL
0	3	0	

NON-REMOVABLE DEFECTS

REMOVABLE AND NON-REMOVABLE DEF.

46 47 48 49 50 51 52 53 54 55 56 57 58 59 60 61 62 63 64 65 66 67 68

NOW TAG END

75

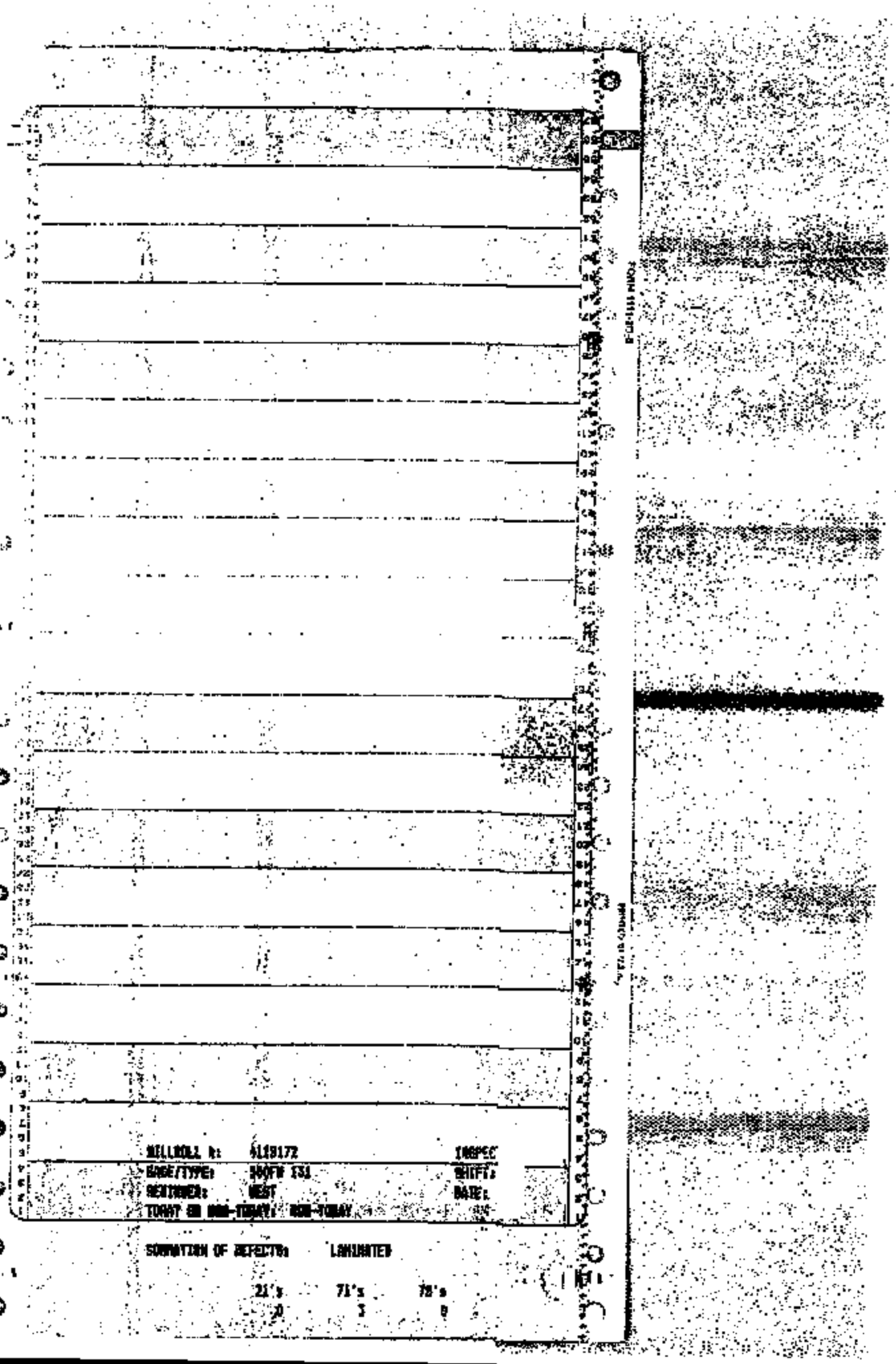
75

85

85

85

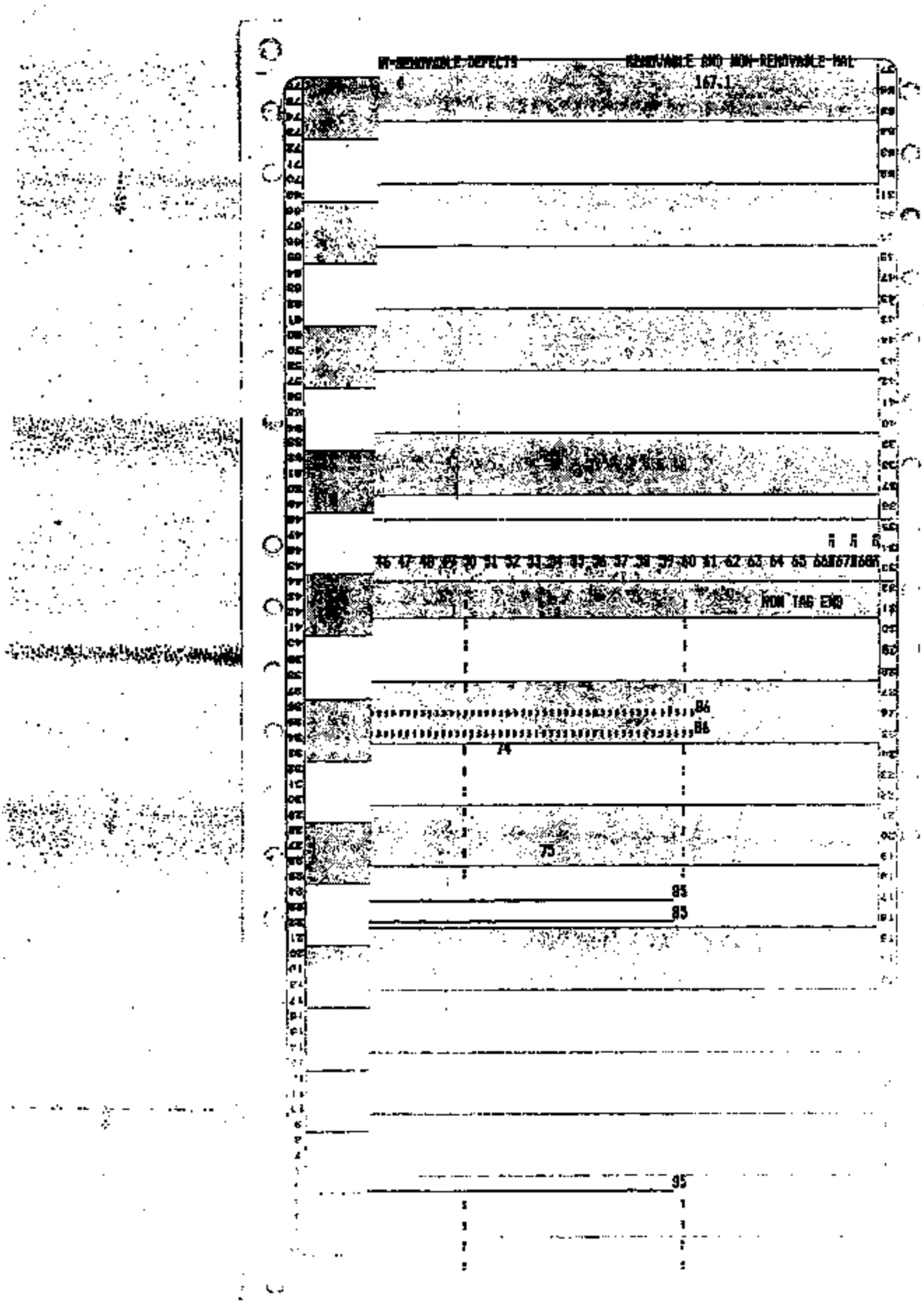
DD/NHTSA No. 4
00052



MILLROLL #: 4119172 INSPEC
BASE/TYPE: 900FW 131 SHIFT:
SEAMER: WEST DATE:
TOWAY OR NON-TOWAY: NON-TOWAY

SUMMATION OF DEFECTS: LAMINATED

21's	71's	78's
0	3	0


NON-REMOVABLE DEFECTS
REMOVABLE AND NON-REMOVABLE MAT
167.1
NON TAG END
74
75
85
85
85

DuPont High Performance Films
U.S. Route 23 & DuPont Road
P.O. Box 80
Circleville, OH 43113
Tel. (614) 474-0724
Fax: (614) 474-6722

DuPont High Performance Films

May 19, 1993

Mr. David Czarn
Texas Instruments
MS 12-29
34 Forest St.
Attleboro, MA 02703

Dear Dave,

In response to your request of May 13, enclosed you will find excerpts from the Quality Manual for our manufacturing facility for Kapton® polyimide and Teflon® fluoropolymer films. Section 3.1 is an introduction with product background, and section 4.8 describes the procedures by which we control our processes. Flow charts are also included depicting the basic steps involved in the manufacture of our film products.

A few additional comments:

Thickness - Kapton® 500FN131 (TI part #27225-1) is a laminate construction of 3 mil polyimide film with 1 mil of fluoropolymer film on each side. The thickness of each web is continuously measured on line and this information is used as feedback, through a proprietary computer control system to adjust the die lip openings. The three webs are then laminated in a separate process, with point thickness of the final laminate measured to assure conformance to specifications.

Attached is a copy of statistical data recently supplied to Texas Instruments Quality Assurance, regarding 500FN131 laminate. Results were derived from thickness measurements of samples taken from all production in calendar year 1992.

Film Inspection: All laminate films are 100% inspected using a rewind inspector equipped with electronic/optical detection equipment which is used to locate and "map" pinholes, debris and other film defects. The Finishing Area uses this map to locate and remove the defect. The inspection criteria are:

Holes: any detected hole is a defect, and flagged for removal during slitting. The inspection equipment is capable of detecting holes 5 miles or larger.

"Opaque objects": inclusions, and surface contaminate. The equipment detects any opaque object down to 25 mils, and alerts the operator to its location in the web. It is removed, if possible, in the case of a surface defect. Current specifications call for any opaque object in the film, 50 mils or larger to be flagged and removed during slitting.

I hope this information will prove useful in your efforts. Although many aspects of the manufacture of Kapton® films are proprietary, I'll do my best to answer any further questions you might have.

I look forward to the visit to Attleboro on May 25. Perhaps at this time we can discuss further ways in which DuPont can assist Texas Instruments in opening markets in Japan.

Sincerely,

Edward C. McKenzie

Edward C. McKenzie
Senior Technical Service Representative

cc: D. Reifschneider

/all
(EM.005)

4.8 PROCESS CONTROL

4.8.1 General

All Kapton*-Teflon* processes will be run under a state of controlled conditions. These processes are shown schematically on the following three pages. Functional areas are responsible for establishing these controlled conditions which include:

- Production schedules, based on orders and forecasts, are communicated by Production Control to the areas. The manufacturing areas use these schedules to plan product changes.

- Documented work instructions, Area Procedures (APs) and Operating Procedures (OPs), explain how tasks are to be performed where the lack of such instructions could significantly reduce the product's level of quality.

- Specified operating conditions, called Standard Operating Conditions (SOCs), which describe where process parameters should be set

- Control of process parameters to the greatest extent within specified ranges

- Operation of the processes outside of specified ranges only after obtaining authorization

- Routine monitoring of these processes to ensure process stability. Monitoring techniques include one or more of the following:

  - Automatic control loops
  - Manual controls
  - Computerized control systems
  - Statistical control charts

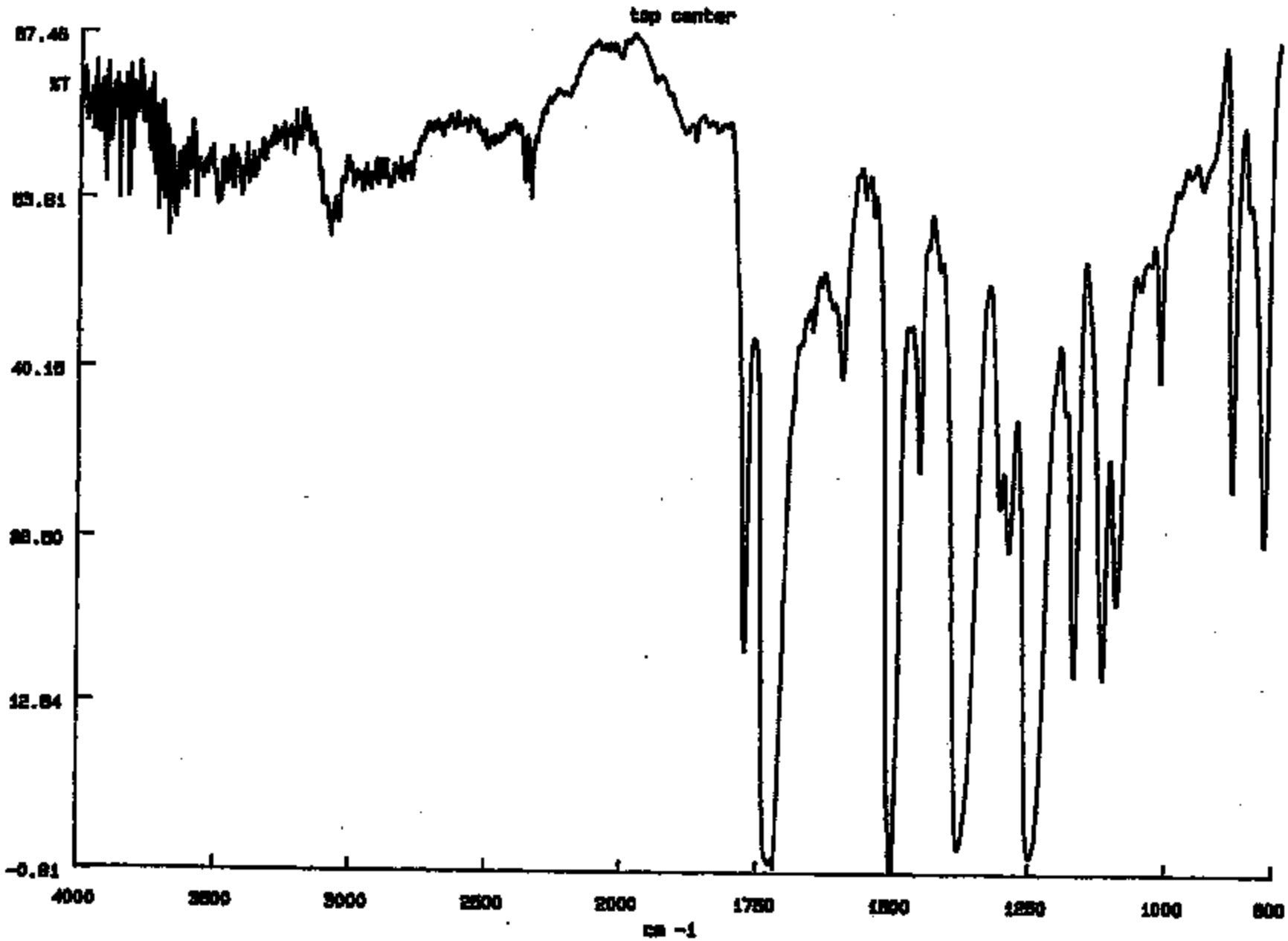
- Additional detail is given in QSP 0005 and Area Procedures

4.8.2 New Equipment or Process

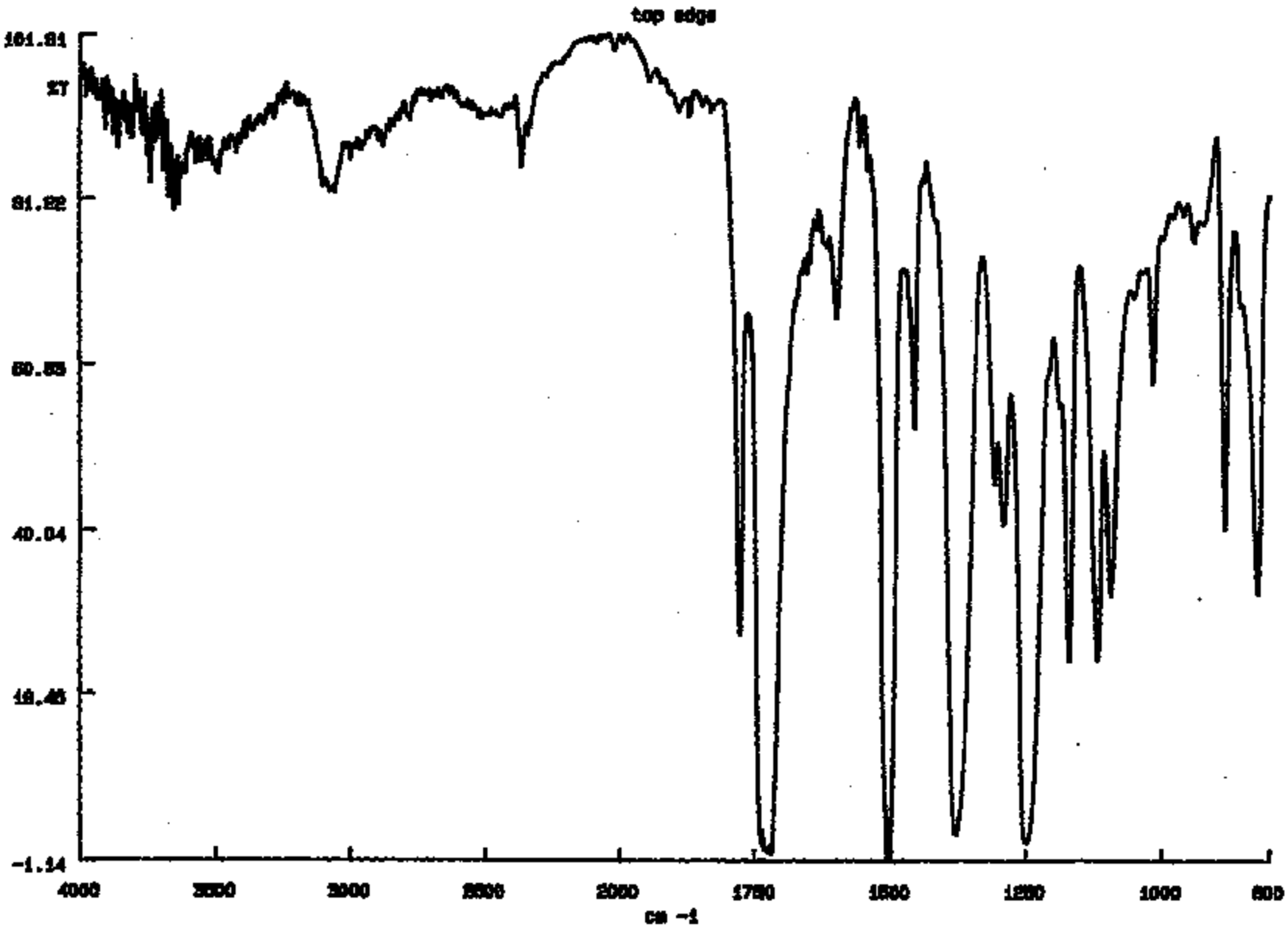
Any product manufactured on new equipment or by a new process is produced under the plant TA (Test Authorization) system. This system provides the documentation and approval system for using a non-standard process. This system is described in more detail in QSP 0014.

~~30~~ 300AN (From 131)
by Ron Webb.
From #11 Sample from TI
(TOP) 5 yrs service 120M+miles

10/15/93



IDANITSA No. 4
8659


top edge
101.81
27
81.22
60.63
40.04
18.45
-1.14
4000
3500
3000
2500
2000
1750
1500
1250
1000
800
cm -1

TEXAS INSTRUMENTS

FACSIMILE TRANSMITTAL

Note to Sender: Before sending any material via facsimile machine:

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

To:

NAME: [redacted]

COMPANY NAME/LOCATION: Dupiat

MAIL STATION:

TELEPHONE NUMBER: 614-474-0230

FACSIMILE PHONE NUMBER: 614-474-0680

From:

NAME: Dave Czaco

COMPANY NAME/LOCATION: Texas Instruments

MAIL STATION: 12-29

TELEPHONE NUMBER: 508-699-3558

FACSIMILE PHONE NUMBER: 508-699-3153

Total Number of Pages (Including Header Page): 46

Additional Information:

Ed,

Proposed Spec follows.

How are you doing on:

- USED KAPTON ANALYSIS
- 93 Production L color charting vs. mechanical properties
- 93 Production - 5 specimen actual data from sample rolls.

Please call.

Thanks, Dave Czan 11/5/93

Proposed Spec 11/5/93

Texas Instruments Material Specification for Kapton Film

SCOPE
This specification describes mechanical property, quality and inspection requirements for DuPont Type 300HN and 500FN131 Kapton film supplied to Texas Instruments, or to suppliers of Texas Instruments. Additional requirements may be specified on the engineering drawings for the reels of material or for the formed component.

TRACEABILITY
Material supplied to this specification must be traceable to the original mill roll. A mill roll is defined as a roll that is 60" wide and no more than 10,000 feet long.

PROCESS CHANGES
Texas Instruments is to be notified of any process changes which may affect appearance, tensile strength or ultimate elongation of the material before such changes are made.

STRENGTH AND ELONGATION (applies to Type 300HN only)
Tensile test specimens are to be taken at increments along the width of the roll including both outer edges and center. A minimum of 2 test specimens - 1 in the machine direction and 1 in the transverse direction - are to be tested from at each of 5 locations across the width of each mill roll. All test specimen data is to be maintained for each roll for a minimum of (57) years from manufacture. The certified minimum strength is to be the minimum of all specimens tested. It is DuPont's responsibility to increase the frequency of inspection, if parameter variation within the mill roll (10,000 feet maximum) may result in strength or elongation values at a lower value than that defined by the 10 specimens.

Test Specimens: a minimum of 2 specimens at each of 5 locations across the width of the mill roll, for a total of 10 minimum

5 specimens are to be oriented in the machine direction (MD) and 5 in the transverse direction (TD)

test specimens represent a maximum of 10,000 feet of material

Minimum Values:

Ultimate Tensile Strength	
Machine direction (MD)	24000 psi minimum
Transverse direction (TD)	24000 psi minimum
Ultimate Elongation	
Machine direction (MD)	50% minimum
Transverse direction (TD)	50% minimum

Notes: Testing performed per ASTM (xxxxxxx)
Reported values are minimum values of the 10 test specimens

Texas Instruments, Inc.

DEFECTS (Texas 300HN and 500EN131)

Material supplied to this specification must be taken from mill rolls that have been 100% inspected for pinholes, bubbles, and inclusions. On set-up, the detection system must be verified as capable of detecting the size defect that is being sought. It must also be verified that the operator will also be able to detect this same defect during the visual inspection step of the process. An inspection record must be maintained for each reel of material that is supplied to Texas Instruments that includes verification of the inspection equipment's ability to detect the defects.

All defects that exceed the size limitation below must be removed from the material before shipping:

HOLES or BUBBLES	NONE ALLOWED
INCLUSIONS OR CONTAMINANTS	(tbd)

Slit Roll #s

5569830
5569826
5569443 → 10.5
5569829
5569828 (26.5 29 Rem)

DD/NHTSA No. 4
80865

TEXAS INSTRUMENTS

May 25, 1993

E I DUPONT
US 23 South
P. O. Box 89
Circleville, OH 43113

Attention: Q. C. Manager

SUBJECT: RDM 014307

Attached please find our supplier corrective action request for the above referenced Quality Nonconformance Notice. The parts were rejected because they did not conform to the width requirements.

We are requesting that you respond to us within 15 days, in writing, as to your plans for meaningful corrective action. Your response will be reviewed by our Quality Assurance, Engineering and Purchasing managers for the adequacy of both a short and long term solution.

The diagnostic process and development of a long term corrective action plan may take longer than the 15 days you have been given to respond. In that case, please indicate that you are developing a corrective action plan and return the request form to us indicating the particulars, including your expected completion date.

We expect that, as a valued supplier, you will research the problem, identify the cause, indicate the specific corrective action and give us a date as to when the corrective action will be effective. If the tools are incapable, we expect you to fix them or notify us that you need to discuss the corrective actions. If you cannot make the part to print, please contact me as soon as possible and I will arrange for a meeting on the issues.

Along with other performance indicators, we measure the effectivity of supplier corrective action responses. We believe that these responses are perhaps the best indicator of the quality culture present today in our suppliers' plants. Please return the attached form to Lorraine Heroux, MS 11-11, at the address below.

Thank you for your support. Please contact me if you have any questions.

Sincerely,

Mark Godbout

Mark Godbout
Procurement Assurance Technician
MS 11-11 (508) 699-1434
Fax # (508) 699-3788

MG:nem

ROUTE TO_____

TEXAS INSTRUMENTS
ATTLEBORO, MASSACHUSETTS 02703

REPORT OF DISCREPANT IN-PROCESS MATERIAL

No. 014307

DWG NO. & NAME	☐ SPC CERTIFIED	REV.	INSPECTOR	DATE	Mfg. Supervision Review
27225-1 Kapton			67468	3/15/93	
SOURCE	DEVICE		PROD. CODE	QUANTITY	
Dupont 171011	52+57		60	1 Roll-3lbs.	

ITEM	ATTRIBUTE/REQUIREMENT	ACTUAL	#INSP	AC	RE	#DEF
	Width should be .734-.766	Oversized .776	entire Roll			
		for .75 SO OF N131				

SAMPLES MUST BE RETAINED FOR INSPECTOR

MAT'L/PROD. CONTROL

☒ CHECK INVENTORY AT (LOCATION)
☐ PART/MATERIAL IN SHORT SUPPLY

4215

PRIORITY ☐1 ☐2 ☐3

COMMENTS:

PLANNER: SIGNATURE Joe Lopez DATE 5-10-93

IDENTITY No. 4

TEXAS INSTRUMENTS – M & C

CORRECTIVE ACTION REQUEST

THIS RESPONSE IS DUE 16 WORKDAYS AFTER RECEIPT AT YOUR FACILITY

RETURN TO:
Lorraine Heroux MS 11-11
Texas Instruments Incorporated
34 Forest Street
Attleboro, MA 02703

DATE PREPARED: MAY 25, 1993

E I DUPONT	27225-1
Q.C. MANAGER	014907

1. Do you understand the specification requirement(s) for the characteristic(s) rejected ? YES ☑ NO ☐

If no – describe concern:

If the requirement is not understood, what specific area of information needs clarification?

- TI print unclear ☐
- TI purchase order ☐
- Standards of acceptance ☐
- Other – ☐

2. Please identify the actions you have taken to contain or limit the non-conformance at your facility until a corrective action is in place. Include comments on your inventory, in-transit material, and TI inventory.

What was the Effectivity Date of this containment action ? _____

3. Has your process, machinery or operation been significantly changed since this part number was qualified by M & C ?

DD/NdTSA No. 4
00048

3-781 Rev 11-87

AFTER FIVE DAYS RETURN TO

DU PONT

ESTABLISHED 1802

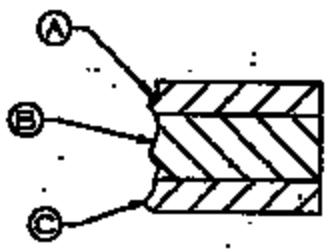
E. I. DU PONT DE NEMOURS & COMPANY
INCORPORATED
CIRCLEVILLE PLANT P. O. BOX 88
CIRCLEVILLE, OHIO 43113

Teresa Zempter

Lorraine Heroux, MS 11-11
Texas Instruments Inc.
34 Forest Street
Attleboro, MA 02703

DIAMETRA No. 4
6969

REVISIONS					
ZONE	LTR	ECN NO.	DESCRIPTION	DATE	APPROVED
	M	1: NOTE #10, ADDED "...8" SPACER TAPE..." CHANGED, ETC		9-13-94	G.V.



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 DIP OR JAGGED EDGES ON MATERIAL NOT ALLOWED.
8. ROLLS ARE TO BE SHIPPED WITH PROTECTIVE INSERT CORES IN THE PACKING BOX.
9. ROLLS TO BE SHIPPED IN CLOSED PLASTIC BAGS.
10. END OF REEL TO HAVE A 8" SPACER TAPE END-OF-REEL MARKER.

PART NO.	MATERIAL	THICKNESS (MILS)	CONSTRUCTION (MILS) (SEE NOTE 2)			STRIP WIDTH (IN.)	END CUT UP I.D. X (O.D.) (IN.)	CORE MATERIAL
			LENGTH (A)	WIDTH (B)	THICKNESS (C)			
[illegible]	DUPONT 500H MONOLITHIC KAPTON	5 ±.5 MILS	0.0	0	0.0	.832-.884	3 x 3 1/2	PLASTIC (WHITE)
[illegible]-4	DUPONT 300H MONOLITHIC KAPTON	3 ±.3 MILS	0.0	3	0.0	.734-.788	3 x 3 1/2	PLASTIC (WHITE)
[illegible]-3	DUPONT 300 FILM	3 ±.4 MILS	0.5	2	0.5	.832-.884	3 x 3 1/2	PLASTIC (WHITE)
[illegible] (NOTE 10)	DUPONT 500 FILM	5 ±.5 MILS	1	3	1	.832-.884	3 x 3 1/2	PLASTIC (WHITE)
[illegible]-1	DUPONT 500 FILM	5 ±.5 MILS	1	3	1	.734-.788	3 x 3 1/2	PLASTIC (WHITE)

THIS DWG. SUPERSEDES [illegible] REV. "V" DATED 8-3-94

[illegible]	DRAWN CHAS. FLAGGART	DATE 8-2-94	TEXAS INSTRUMENTS	[illegible]
[illegible]	[illegible]	8-2-94		
[illegible]	[illegible] J.H. DALE	8-2-94	TITLE KAPTON STRIP SPECIFICATION	

SCALE NONE | SHT 1 OF 1

DRAWING No. 4 00170

TEXAS INSTRUMENTS

FACSIMILE TRANSMITTAL

[redacted]: [redacted] any [redacted] via facsimile machine:

- Call the recipient to advise you will be transmitting material to them.
- Verify correct [redacted] number so the recipient will know where to [redacted] the material.
- Total number of [redacted] being sent.
- [redacted] to be used so adjustments can be made, if necessary.

To:

NAME: [redacted]

COMPANY NAME/LOCATION: Dupont

MAIL STATION:

TELEPHONE NUMBER: 614-424-0230

FACSIMILE PHONE NUMBER: 614-424-0680

From:

NAME: Dave Grace

COMPANY NAME/LOCATION: Texas Instruments

MAIL STATION: 12-29

TELEPHONE NUMBER: 508-699-8558

FACSIMILE PHONE NUMBER: 508-699-3153

Total Number of Pages (Including Header Page): 4

Additional Information:

TEXAS INSTRUMENTS INCORPORATED • 34 FORBES STREET • ATTLEBORO, MA 02703
508-699-3000 • TELEX 710401 • CABLE TEXINS

Ed,

Proposed Spec follows.

How are you doing on:

- USED KAPTON ANALYSIS
- 93 Production L color charting vs. mechanical properties
- 93 Production - 5 specimen actual data from sample rolls.

Please call.

Thanks, Dave Czar 11/5/93

Proposed Spec 11/5/93

Texas Instruments Material Specification for Kapton Film

SCOPE
This specification describes mechanical property, quality and inspection requirements for DuPont Type 300HN and 500FN131 Kapton film supplied to Texas Instruments, or to suppliers of Texas Instruments. Additional requirements may be specified on the engineering drawings for the reels of material or for the formed component.

TRACEABILITY
Material supplied to this specification must be traceable to the original mill roll. A mill roll is defined as a roll that is 60" wide and no more than 10,000 feet long.

PROCESS CHANGES
Texas Instruments is to be notified of any process changes which may affect appearance, tensile strength or ultimate elongation of the material before such changes are made.

STRENGTH AND ELONGATION (applies to Type 300HN only)
Tensile test specimens are to be taken at increments along the width of the roll including both outer edges and center. A minimum of 2 test specimens - 1 in the machine direction and 1 in the transverse direction - are to be tested from at each of 5 locations across the width of each mill roll. All test specimen data is to be maintained for each roll for a minimum of (37) years from manufacture. The certified minimum strength is to be the minimum of all specimens tested. It is DuPont's responsibility to increase the frequency of inspection, if parameter variation within the mill roll (10,000 feet maximum) may result in strength or elongation values at a lower value than that defined by the 10 specimens.

Test Specimens: a minimum of 2 specimens at each of 5 locations across the width of the mill roll, for a total of 10 minimum

5 specimens are to be oriented in the machine direction (MD) and 5 in the transverse direction (TD)

test specimens represent a maximum of 10,000 feet of material

Minimum Values:

Ultimate Tensile Strength	
Machine direction (MD)	24000 psi minimum
Transverse direction (TD)	24000 psi minimum
Ultimate Elongation	
Machine direction (MD)	50% minimum
Transverse direction (TD)	50% minimum

Notes: Testing performed per ASTM (xxxxxx)
Reported values are minimum values of the 10 test specimens

Texas Instruments, Inc.

DEFECTS (Texas [illegible] and [illegible])

Material supplied to this specification must be taken from mill rolls that have been 100% inspected for pinholes, bubbles, and inclusions. On set-up, the detection system must be verified as capable of detecting the size defect that is being sought. It must also be verified that the operator will also be able to detect this same defect during the visual inspection step of the process. An inspection record must be maintained for each reel of material that is supplied to Texas Instruments that includes verification of the inspection equipment's ability to detect the defects.

All defects that exceed the size limitation below must be removed from the material before shipping:

HOLES or BUBBLES	NONE ALLOWED
INCLUSIONS OR CONTAMINANTS	(tbd)

DuPont Films
U.S. Route 23 & DuPont Road
P. O. Box 89
Circleville, OH 43113
Tel. (614) 474-0724

DuPont Films

February 17, 1995

Mr. James Watt
Texas Instruments Incorporated
34 Forest St.
Attleboro, MA 02703-0964

Dear Mr. Watt,

Thank you for your letter describing the designation of TI part number 27225-1 as a Vital Safety Part. This designation imposes additional requirements on the Kapton® film supplied under this part number. DuPont Films' status versus these requirements follows:

1. Traceability

Kapton® film is shipped to TI in roll form. Several rolls are packaged together, within a polyethelene bag. Inside this bag is an identification label. In the section marked "Mill Roll No." is a seven digit number, beginning with 4 or 5. The mill roll number is the DuPont "lot" number from which the slit rolls were obtained. From this number, DuPont can identify date of manufacture, pertinent test and inspection data. Traceability to raw materials can also be provided. TI should track this number on route slips in order to assure this level of traceability.

2. Inspection and Test Data

Inspection and test data will be kept on the 500FN131 product for 5 years, and can be available within 14 days of request, per VSP requirements.

3. Thickness Dimension

The 500FN131 used to fill orders for TI part number 27225-1 is a laminate film composed of 3 mil thick Kapton® HN polyimide film with 1 mil of Teflon® FEP film on each side. Kapton® and Teflon® films are produced as a continuous film in roll form and the standard unit of production is the "mill roll" mentioned above. The thickness of both types of film is continuously monitored and under closed loop control. The calibration of these closed loop controls are under ISO control, at our ISO 9000 certified manufacturing facility in Circleville, Ohio. The base films are laminated together to produce 500FN131. The release specifications for this product give process capability measurements exceeding 1.33. Enclosed you will find thickness data for production mill rolls since 1992.

DD/NHTSA No. 4
#0075

Printed on Recycled Paper

If there are any questions or if I can be of further assistance please call me at 614-474-0730.

Sincerely,

Edward C. McKenzie

Edward C. McKenzie
Sr. Technical Service Representative

cc: Jon Mayer, TI MS 12-01
E. Miller, DuPont

2/15/95
500FN131 Production, 1992

Gage/Type	Mill Roll	Date	Thickness Min	Thickness Max	Thickness Avg
500FN131	4117641	01/07/92	4.96	5.14	5.04
500FN131	4117642	01/07/92	4.89	5.11	5.01
500FN131	4117643	01/07/92	4.94	5.12	5.03
500FN131	4117629	07/23/92	4.78	4.99	4.86
500FN131	4117630	07/23/92	4.75	4.900	4.83
500FN131	4117631	07/27/92	4.71	4.82	4.76
500FN131	4117632	07/28/92	4.73	4.84	4.79
500FN131	4117639	07/27/92	NA	NA	NA
500FN131	4117940	11/05/92	4.74	4.96	4.86
500FN131	4117941	11/05/92	4.81	4.92	4.86
500FN131	4117942	11/05/92	4.84	4.96	4.900
500FN131	4117943	11/05/92	4.73	4.91	4.81
500FN131	4117979	12/09/92	4.81	4.95	4.87
500FN131	4117979	12/15/92	NA	NA	NA
500FN131	4117980	12/09/92	4.800	4.91	4.85
500FN131	4117981	12/09/92	4.86	4.97	4.900

Analysis

Property	Count	Average	Standard	Minimum	Maximum
Thickness	14	4.89	0.08	4.78	5.04

Upper specification limit: 5.50 mils
Lower specification limit: 4.50 mils

CPK–U	CPK–L
2.42	1.53

CPK = 1.53

92fn131a

2/15/95
500FN131 Production, 1993

Gage/Type	Mill Roll	Date	Thickness Min	Thickness Max	Thickness Avg
500FN131	4118040	02/22/93	4.86	4.99	4.93
500FN131	4118041	02/23/93	4.77	4.96	4.87
500FN131	4118042	02/23/93	4.88	5.01	4.95
500FN131	4118043	02/23/93	4.72	4.91	4.81
500FN131	4118044	02/23/93	4.76	4.86	4.83
500FN131	4118194	05/23/93	4.91	5.05	4.99
500FN131	4118223	06/11/93	4.88	5.01	4.93
500FN131	4118224	06/17/93	4.95	5.09	5.02
500FN131	4118247	07/07/93	4.85	4.98	4.900
500FN131	4118248	07/08/93	4.900	5.08	4.98
500FN131	4118300	08/05/93	4.83	5.08	4.93
500FN131	4118301	08/05/93	4.800	5.13	4.93
500FN131	4118306	08/25/93	4.97	5.14	5.03
500FN131	4118321	09/21/93	4.84	4.96	4.86
500FN131	4118322	09/22/93	4.900	5.06	5.00
500FN131	4118323	09/22/93	4.76	4.96	4.86
500FN131	4118345	10/21/93	4.86	5.05	4.95
500FN131	4118346	10/21/93	4.85	5.01	4.93
500FN131	4118347	10/21/93	4.900	5.01	4.95
500FN131	4118377	11/30/93	4.93	5.06	5.00

Analysis

Property	Count	Average	Standard	Minimum	Maximum
Thickness	20	4.94	0.06	4.81	5.03

Upper Specification limit: 5.50 mils
Lower Specification limit: 4.50 mils

CPK–U	CPK–L
3.03	2.34

CPK = 2.34

93fn131a

2/15/95
500FN131 Production, 1994

Gage/Type	Mill Roll	Date	Thickness Min	Thickness Max	Thickness Avg
500FN131	4116392	01/03/94	4.79	4.89	4.85
500FN131	4116393	01/04/94	4.81	5.00	4.95
500FN131	4116394	01/04/94	4.79	5.03	4.91
500FN131	4116415	01/31/94	4.86	5.11	4.99
500FN131	4116416	01/31/94	4.900	5.04	5.00
500FN131	4116417	02/01/94	4.92	5.100	5.00
500FN131	4116456	03/03/94	4.89	5.09	4.99
500FN131	4116457	03/03/94	4.75	4.95	4.86
500FN131	4116460	03/03/94	4.85	5.08	5.00
500FN131	4116518	05/10/94	4.77	4.900	4.84
500FN131	4116519	05/10/94	4.87	5.13	5.00
500FN131	4116609	08/09/94	4.800	4.98	4.86
500FN131	4116610	08/09/94	4.91	5.04	4.97
500FN131	4116611	08/09/94	4.84	5.02	4.95
500FN131	4116612	08/09/94	4.86	5.03	4.93
500FN131	4116624	08/16/94	4.83	4.96	4.92
500FN131	4116625	08/16/94	4.91	5.04	5.00
500FN131	4116677	10/03/94	4.74	4.900	4.81
500FN131	4116678	10/03/94	4.75	4.91	4.84
500FN131	4116715	10/31/94	4.84	4.95	5.08
500FN131	4116716	10/31/94	4.82	4.99	4.93
500FN131	4116736	11/09/94	4.79	4.98	4.88
500FN131	4116737	11/09/94	4.49	4.95	4.76
500FN131	4116738	11/10/94	4.76	4.98	4.87
500FN131	4116739	11/10/94	4.82	4.83	4.87

Analysis

Property	Count	Average	Standard	Minimum	Maximum
Thickness	25	4.92	0.08	4.76	5.08

Upper specification limit: 5.50 mils
Lower Specification limit: 4.50 mils

CPK–U	CPK–L
2.53	1.85

CPK = 1.85

94fn131a

DD/NHTSA No. 4
80979

2/15/95
500FN131 Production, 1995 YTD

Gage/Type	Mill Roll	Date	Thickness Min	Thickness Max	Thickness Avg
500FN131	4116794	01/09/95	4.81	5.01	4.900
500FN131	4116795	01/09/95	4.87	5.00	4.94
500FN131	4116796	01/09/95	4.900	5.06	5.00
500FN131	4116797	01/10/95	4.83	5.05	4.94

95fn131a

DuPont Films
U.S. Route 23 & DuPont Road
P. O. Box 89
Circleville, OH 43113
Tel. (614) 474-6724

DuPont Films

May 25, 1995

Keith Rosiello
Texas Instruments, Inc.
MS 12-29
34 Forest St.
Attleboro, MA 02703

Dear Keith,

Thank you for the opportunity to review the final draft of the specification for Kapton* film products. We can accept the specification as written, with no changes required. For our customer files, could you arrange to have a copy of the drawings sent to my attention? My address is:

Ed McKenzie
DuPont Films
PO Box 89
Route 23 South and DuPont Road
Circleville, OH 43113

Please let me know if you have any additional questions regarding DuPont's KAPTON* film products.

Sincerely,

Edward C. McKenzie

Edward C. McKenzie
Technical Specialist

* DuPont Registered Trademark

E. I. du Pont de Nemours and Company

Printed on Recycled Paper
DN-426 Rev. 7/94

DUPONT

FAX NO.: _____

CIRCLEVILLE PLANT

Date & Time: 11:55 5/25/95

P.O. Box 89
Circleville, OH 43113

FACSIMILE TRANSMISSION COVER SHEET

ADDRESSEE(S):

Name	Company or Department	Location
KEITH ROSIELLO	TEXAS INSTR.	ATTLEBORO MA

COPY:

SENDER:

Name	Business Sector	Location
ED MCKENZIE	DUPONT FILMS	CIRCLEVILLE OH

*** 1 PAGE(S) TO FOLLOW THIS COVER SHEET ***

Special Instructions/Information to Recipient:

CIRCLEVILLE FAX NUMBER FOR THIS TRANSMISSION IS 1-800-879-4431.
SHOULD PROBLEMS OCCUR WHILE SENDING, CONTACT 1-800-947-5687.

*** CONFIDENTIALITY NOTE ***

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(FAX.AII)

Charting a Course for Excellence

DD/NHTSA No. 4
60852

Texas Instruments Material Specification for Kapton® Film

1.0 SCOPE

This specification defines mechanical property, quality and inspection requirements for DuPont Type 300HN, 500HN and 500FN131 Kapton® and Teflon® laminated Kapton® film supplied to Texas Instruments. This specification applies when it is referenced on the print for the material or finished component.

2.0 TRACEABILITY

Material supplied to this specification must be traceable to the original mill roll. A mill roll is defined as a roll that is 50-60 inches wide and no longer than 10,000 feet. For the purpose of certifying strength and elongation, a new mill roll should be designated after any process changes that may affect the certified minimum strength and elongation values.

3.0 PROCESS CHANGES

Process changes that could affect the strength, ultimate elongation, or physical appearance of the film must have prior review and approval by Texas Instruments.

4.0 STRENGTH AND ELONGATION CERTIFICATION

4.1 Types 300HN and 500HN Kapton® Film

Tensile test specimens are to be taken from locations along the width of the roll including locations at both outer edges and the center. A minimum of 10 specimens are to be tested - 1 in the machine direction (MD) and 1 in the transverse direction (TD) from each of 5 locations across the width of the mill roll. The certified minimum strength is to be the minimum value recorded for all of the test specimens. Tensile testing is to be conducted upon start-up of a production run, then on every other mill roll. It is DuPont's responsibility to increase the frequency of inspection if there are process changes or other factors within a production run that may result in strength or elongation values that are lower than those certified by the test specimens.

Minimum Values	
Ultimate Tensile Strength	Type 300HN & 500HN
Machine Direction (MD)	24000 psi minimum
Transverse Direction (TD)	24000 psi minimum
Ultimate Elongation	
Machine Direction (MD)	50% minimum
Transverse Direction (TD)	50% minimum

Testing to be conducted per the latest revision of ASTM D882.

May 24, 1995

TEXAS INSTRUMENTS

FACSIMILE TRANSMITTAL

TO:	Name:	Ed McKenzie
	Location:	DuPont High Performance Films
	Mail Station:	
	Phone Number:	614-474-8730
	FAX Number:	614-474-8680
FROM:	Keith Rosiello	
	TEXAS INSTRUMENTS MS 12-29	
	Phone Number:	(508) 236-1284
	FAX Number:	(508) 236-3153

Total number of pages (including header page): 5

COMMENTS:

Ed,

I am a design engineer in Dave's group. He has given me the responsibility to finish off the Kapton spec. Basically I have put the spec. as discussed between yourself and Dave, on a TI print. Could you give it a once over, nothing has changed. I included a copy of the agreed upon spec for comparison. Please let me know if I may close this issue or if you want to discuss any further changes.

Thanks,
Keith

TEXAS INSTRUMENTS INCORPORATED * PO BOX 2964 * 34 FOREST STREET * ATTLEBORO, MA 02703

DD/NHTSA No. 4
80484

DEVICE #87PS
PROJ. #3423

TITLE: MATERIAL SPECIFICATION FOR KAPTON ® FILM

REV A

75951 SH.1

75951 SH.1

1.0 SCOPE
THIS SPECIFICATION DEFINES MECHANICAL PROPERTY, QUALITY AND INSPESTION REQUIREMENTS FOR DUPONT TYPE 300HN, 500HN AND 500FN131 KAPTON ® AND TEFLON ® LAMINATED KAPTON ® FILM SUPPLIED TO TEXAS INSTRUMENTS. THIS SPECIFICATION APPLIES WHEN IT IS REFERENCED ON THE PRINT FOR THE MATERIAL OR FINISHED COMPONENT.

2.0 TRACEABILITY
MATERIAL SUPPLIED TO THIS SPECIFICATION MUST BE TRACEABLE TO THE ORIGINAL MILL ROLL. A MILL ROLL IS DEFINED AS A ROLL THAT IS 30 - 60 INCHES WIDE AND NO LONGER THAN 10,000 FEET. FOR THE PURPOSE OF CERTIFYING STRENGTH AND ELONGATION, A NEW MILL ROLL SHOULD BE DESIGNATED AFTER ANY PROCESS CHANGES THAT MAY AFFECT THE CERTIFIED MINIMUM STRENGTH AND ELONGATION VALUES.

3.0 PROCESS CHANGES
PROCESS CHANGES THAT COULD AFFECT THE STRENGTH, ULTIMATE ELONGATION, OR PHYSICAL APPEARANCE OF THE FILM MUST HAVE PRIOR REVIEW AND APPROVAL OF TEXAS INSTRUMENTS.

4.0 STRENGTH AND ELONGATION CERTIFICATION
4.1 TYPES 300HN AND 500HN KAPTON ® FILM

TENSILE TEST SPECIMENS ARE TO BE TAKEN FROM INCREMENTS ALONG THE WIDTH OF THE ROLL INCLUDING LOCATIONS AT BOTH OUTER EDGES AND THE CENTER. A MINIMUM OF 10 SPECIMENS ARE TO BE TESTED - 1 IN THE MACHINE DIRECTION (MD) AND 1 IN THE TRANSVERSE DIRECTION (TD) FROM EACH OF 5 LOCATIONS ACROSS THE WIDTH OF THE MILL ROLL. THE CERTIFIED MINIMUM STRENGTH IS TO BE THE MINIMUM VALUE RECORDED FOR ALL OF THE TEST SPECIMENS. TENSILE TESTING IS TO BE CONDUCTED UPON START-UP OF A PRODUCTION RUN, THEN ON EVERY OTHER MILL ROLL. IT IS DUPONT'S RESPONSIBILITY TO INCREASE THE FREQUENCY OF INSPECTION IF THERE ARE PROCESS CHANGES OR OTHER FACTORS WITHIN A PRODUCTION RUN THAT MAY RESULT IN STRENGTH OR ELONGATION VALUES THAT ARE LOWER THAN THOSE CERTIFIED BY THE TEST SPECIMINES.

MINIMUM VALUES

ULTIMATE TENSIL STRENGTH	TYPE 300HN & 500HN
MACHINE DIRECTION (MD)	24000 PSI MINIMUM
TRANSVERSE DIRECTION (TD)	24000 PSI MINIMUM
ULTIMATE ELONGATION	
MACHINE DIRECTION (MD)	50% MINIMUM
TRANSVERSE DIRECTION (TD)	50% MINIMUM

TESTING TO BE CONDUCTED PER THE LATEST REVISION OF ASTM D882

1ST ISSUE 5-19-95 CRN22827 OFF

REV A

BY CHAS.FLEURANT 5-19-95
CK.
APL.

TEXAS INSTRUMENTS
ATTLEBORO, MASSACHUSETTS 02703

KLIXON CONTROL PRODUCTS DIVISION

SIZE A

DWG. NO. 75951 SH.1

DEVICE #87PS PROJ. #3423	TITLE MATERIAL SPECIFICATION FOR KAPTON ® FILM	REV A	75951 SH.2

75951 SH.2

4.2 TYPE 500FN131 TEFLON ® LAMINATED KAPTON ®
TENSILE TESTING 500FN131 FILM IS NOT REQUIRED PROVIDED THE 300HN KAPTON ® SUBSTRATE FILM HAS BEEN TESTED AND CERTIFIED TO MEET THE MINIMUM STRENGTH AND ELONGATION VALUES. THE REASONING IS THAT

A.) THE MECHANICAL PROPERTIES OF THE 500FN131 FILM ARE DERIVED MORE FROM THE 300HN SUBSTRATE FILM RATHER THAN THE TEFLON ® LAMINATE.

B.) THE TEFLON ® LAMINATING PROCESS ACCORDING TO DUPONT DOES NOT NEGATIVELY AFFECT STRENGTH OR ELONGATION PROPERTIES.

IT IS DUPONT'S RESPONSIBILITY TO TEST TYPE 500FN131 FILM IF EITHER

A.) THE 300HN CERTIFICATION DATA IS UNAVAILABLE OR

B.) THERE IS REASON TO BELIEVE THE LAMINATION PROCESS MAY HAVE AFFECTED THE CERTIFIED MINIMUM VALUES OF THE 300HN SUBSTRATE. IN THIS CASE IT IS ACCEPTABLE TO FIRST REMOVE THE TEFLON ® FILM FROM THE KAPTON ® SUBSTRATE TO GET A MORE ACCURATE AND REPEATABLE TENSILE TEST. THE MINIMUM STRENGTH AND ELONGATION VALUES FOR THE TYPE 300HN FILM SHALL APPLY.

5.0 DEFECTS (ALL FILM TYPES)
MATERIAL SUPPLIED TO THIS SPECIFICATION MUST BE 100% INSPECTED FOR DEFECTS INCLUDING BUBBLES, PINHOLES AND INCLUSIONS. THE CONTROL PLAN MUST INCLUDE A MEANS FOR PERIODICALLY VERIFING THAT THE INSPECTION EQUIPMENT IS CAPABLE OF LOCATING DEFECTS.

CRITERIA:

A. INSPECTION IS REQUIRED TO DETECT HOLES AND BUBBLES IN ALL 300HN AND 500HN FILM, AS WELL AS THE 300HN USED AS THE SUBSTRATE FOR 500FN131 FILM USING AN ON LINE CAMERA INSPECTION SYSTEM. HOLES OF ANY SIZE ARE NOT ACCEPTABLE IN FINISHED PRODUCT SHIPPED TO T.I., AND THEREFORE NEEDS TO BE ADDRESSED THROUGH APPROPRIATE PREVENTION CONTROLS IN THE MANUFACTURE OF THE FILM. AS A PRACTICAL DETECTION CONTROL, THE SYSTEM MUST BE ABLE TO DETECT HOLES AND BUBBLES OF .025" OR GREATER, AND MATERIAL FOUND TO HAVE HOLES OR BUBBLES OF THIS SIZE IS NOT ACCEPTABLE.

B. INSPECTION IS REQUIRED TO DETECT INCLUSIONS OF FOREIGN MATTER IN ALL 300HN AND 500HN FILM, AS WELL AS THE 300HN USED AS THE SUBSTRATE FOR 500FN131 FILM USING AN ON LINE CAMERA INSPECTION SYSTEM. INCLUSIONS OF .025" OR GREATER MUST BE DETECTABLE BY THE SYSTEM AND ARE NOT ALLOWED IN FINISHED PRODUCT SHIPPED TO T.I

6.0 CERTIFICATION AND DATA RETENTION
WHEN THE PRINT SPECIFIES THAT MATERIAL CERTIFICATION IS REQUIRED, THE SUPPLIER CERTIFIES THAT THE MATERIAL WAS PRODUCED IN ACCORDANCE WITH THIS SPECIFICATION.

ALL STRENGTH TEST DATA AND SPECIMENS ARE TO BE MAINTAINED BY DUPONT FOR A MINIMUM OF (5) YEARS FROM THE DATE OF MANUFACTURE.

REV	1ST ISSUE 5-19-95 DWG2807	OF
A		

BY CHAS. FLEURANT 5-19-95	TEXAS INSTRUMENTS ATTLEBORO, MASSACHUSETTS 02703	KLIXON CONTROL PRODUCTS DIVISION	DWG. SIZE A	DWG. NO. 75951 SH.2
CH.				
ENG.				

4.2 Type 500FN131 Teflon® laminated Kapton®

Tensile testing of 500FN131 film is not required provided the 300HN Kapton® substrate film has been tested and certified to meet the minimum strength and elongation values. The reasoning is that a.) the mechanical properties of the 500FN131 film are derived more from the 300HN substrate film rather than the Teflon® laminate and b.) the Teflon® laminating process according to DuPont does not negatively affect strength or elongation properties.

It is DuPont's responsibility to test Type 500FN131 film if either a.) the 300HN certification data is unavailable or b.) there is reason to believe the lamination process may have affected the certified minimum values of the 300HN substrate. In this case, it is acceptable to first remove the Teflon® film from the Kapton® substrate to get a more accurate and repeatable tensile test. The minimum strength and elongation values for the Type 300HN film shall apply.

5.0 DEFECTS (All film types)

Material supplied to this specification must be 100% inspected for defects including bubbles, pinholes and inclusions. The control plan must include a means for periodically verifying that the inspection equipment is capable of locating defects.

Criteria:

A. Inspection is required to detect holes and bubbles in all 300HN and 500HN film, as well as the 300HN used as the substrate for 500FN131 film using an on line camera inspection system. Holes of any size are not acceptable in finished product shipped to TI, and therefore needs to be addressed through appropriate Prevention controls in the manufacture of the film. As a practical Detection control, the system must be able to detect holes and bubbles of .025" or greater, and material found to have holes or bubbles of this size is not acceptable.

B. Inspection is required to detect inclusions of foreign matter in all 300HN and 500HN film, as well as the 300HN used as the substrate for 500FN131 film using an on line camera inspection system. Inclusions of .025" or greater must be detectable by the system and are not allowed in finished product shipped to TI.

6.0 CERTIFICATION AND DATA RETENTION

When the print specifies that material certification is required, the supplier certifies that the material was produced in accordance with this specification.

All strength test data and specimens are to be maintained by DuPont for a minimum of (5) years from the date of manufacture.

DuPont Films
U.S. Route 23 & DuPont Road
P. O. Box 89
Circleville, OH 43113
Tel. (614) 474-0724

DuPont Films

May 25, 1995

Keith Rosiello
Texas Instruments, Inc.
MS 12-29
34 Forest St.
Attleboro, MA 02703

Dear Keith,

Thank you for the opportunity to review the final draft of the specification for Kapton* film products. We can accept the specification as written, with no changes required. For our customer files, could you arrange to have a copy of the drawings sent to my attention? My address is:

Ed McKenzie
DuPont Films
PO Box 89
Route 23 South and DuPont Road
Circleville, OH 43113

Please let me know if you have any additional questions regarding DuPont's KAPTON* film products.

Sincerely,

Edward C. McKenzie

Edward C. McKenzie
Technical Specialist

* DuPont Registered Trademark

TITLE: MATERIAL SPECIFICATION FOR KAPTON ® FILM

REV A

75951 SH.1

75951 SH.:

1.0 SCOPE
THIS SPECIFICATION DEFINES MECHANICAL PROPERTY, QUALITY AND INSPESTION REQUIREMENTS FOR DUPONT TYPE 300HN, 500HN AND 500FN131 KAPTON ® AND TEFLON ® LAMINATED KAPTON ® FILM SUPPLIED TO TEXAS INSTRUMENTS. THIS SPECIFICATION APPLIES WHEN IT IS REFERENCED ON THE PRINT FOR THE MATERIAL OR FINISHED COMPONENT.

2.0 TRACEABILITY
MATERIAL SUPPLIED TO THIS SPECIFICATION MUST BE TRACEABLE TO THE ORIGINAL MILL ROLL. A MILL ROLL IS DEFINED AS A ROLL THAT IS 50 - 60 INCHES WIDE AND NO LONGER THAN 10,000 FEET. FOR THE PURPOSE OF CERTIFYING STRENGTH AND ELONGATION, A NEW MILL ROLL SHOULD BE DESIGNATED AFTER ANY PROCESS CHANGES THAT MAY AFFECT THE CERTIFIED MINIMUM STRENGTH AND ELONGATION VALUES.

3.0 PROCESS CHANGES
PROCESS CHANGES THAT COULD AFFECT THE STRENGTH, ULTIMATE ELONGATION, OR PHYSICAL APPEARANCE OF THE FILM MUST HAVE PRIOR REVIEW AND APPROVAL OF TEXAS INSTRUMENTS.

4.0 STRENGTH AND ELONGATION CERTIFICATION
4.1 TYPES 300HN AND 500HN KAPTON ® FILM

TENSILE TEST SPECIMENS ARE TO BE TAKEN FROM INCREMENTS ALONG THE WIDTH OF THE ROLL INCLUDING LOCATIONS AT BOTH OUTER EDGES AND THE CENTER. A MINIMUM OF 10 SPECIMENS ARE TO BE TESTED - 1 IN THE MACHINE DIRECTION (MD) AND 1 IN THE TRANSVERSE DIRECTION (TD) FROM EACH OF 5 LOCATIONS ACROSS THE WIDTH OF THE MILL ROLL. THE CERTIFIED MINIMUM STRENGTH IS TO BE THE MINIMUM VALUE RECORDED FOR ALL OF THE TEST SPECIMENS. TENSILE TESTING IS TO BE CONDUCTED UPON START-UP OF A PRODUCTION RUN, THEN ON EVERY OTHER MILL ROLL. IT IS DUPONT'S RESPONSIBILITY TO INCREASE THE FREQUENCY OF INSPECTION IF THERE ARE PROCESS CHANGES OR OTHER FACTORS WITHIN A PRODUCTION RUN THAT MAY RESULT IN STRENGTH OR ELONGATION VALUES THAT ARE LOWER THAN THOSE CERTIFIED BY THE TEST SPECIMINES.

MINIMUM VALUES

ULTIMATE TENSIL STRENGTH	TYPE 300HN & 500HN
MACHINE DIRECTION (MD)	24000 PSI MINIMUM
TRANSVERSE DIRECTION (TD)	24000 PSI MINIMUM
ULTIMATE ELONGATION	
MACHINE DIRECTION (MD)	50% MINIMUM
TRANSVERSE DIRECTION (TD)	50% MINIMUM

TESTING TO BE CONDUCTED PER THE LATEST REVISION OF ASTM D882

1ST ISSUE 5-19-95 CHAS.FLEURANT

REV A

REV

BY CHAS.FLEURANT 5-12-95
CK.
APP.

TEXAS INSTRUMENTS
ATTLEBORO, MASSACHUSETTS 02703

CONTROL PRODUCTS DIVISION

SIZE A

DWG. NO. 75951 SH.1

DDVNBTSA No. 4

DUP 000088

4.2 TYPE 500FN131 TEFLON (R) LAMINATED KAPTON (R)
TENSILE TESTING 500FN131 FILM IS NOT REQUIRED PROVIDED THE 300HN KAPTON (R) SUBSTRATE FILM HAS BEEN TESTED AND CERTIFIED TO MEET THE MINIMUM STRENGTH AND ELONGATION VALUES. THE REASONING IS THAT

A.) THE MECHANICAL PROPERTIES OF THE 500FN131 FILM ARE DERIVED MORE FROM THE 300HN SUBSTRATE FILM RATHER THAN THE TEFLON (R) LAMINATE.

B.) THE TEFLON (R) LAMINATING PROCESS ACCORDING TO DUPONT DOES NOT NEGATIVELY AFFECT STRENGTH OR ELONGATION PROPERTIES.

IT IS DUPONT'S RESPONSIBILITY TO TEST TYPE 500FN131 FILM IF EITHER

A.) THE 300HN CERTIFICATION DATA IS UNAVAILABLE OR

B.) THERE IS REASON TO BELIEVE THE LAMINATION PROCESS MAY HAVE AFFECTED THE CERTIFIED MINIMUM VALUES OF THE 300HN SUBSTRATE. IN THIS CASE IT IS ACCEPTABLE TO FIRST REMOVE THE TEFLON (R) FILM FROM THE KAPTON (R) SUBSTRATE TO GET A MORE ACCURATE AND REPEATABLE TENSILE TEST. THE MINIMUM STRENGTH AND ELONGATION VALUES FOR THE TYPE 300HN FILM SHALL APPLY.

5.0 DEFECTS (ALL FILM TYPES)
MATERIAL SUPPLIED TO THIS SPECIFICATION MUST BE 100% INSPECTED FOR DEFECTS INCLUDING BUBBLES, PINHOLES AND INCLUSIONS. THE CONTROL PLAN MUST INCLUDE A MEANS FOR PERIODICALLY VERIFING THAT THE INSPECTION EQUIPMENT IS CAPABLE OF LOCATING DEFECTS.

CRITERIA:

A. INSPECTION IS REQUIRED TO DETECT HOLES AND BUBBLES IN ALL 300HN AND 500HN FILM, AS WELL AS THE 300HN USED AS THE SUBSTRATE FOR 500FN131 FILM USING AN ON LINE CAMERA INSPECTION SYSTEM. HOLES OF ANY SIZE ARE NOT ACCEPTABLE IN FINISHED PRODUCT SHIPPED TO T.I., AND THEREFORE NEEDS TO BE ADDRESSED THROUGH APPROPRIATE PREVENTION CONTROLS IN THE MANUFACTURE OF THE FILM. AS A PRACTICAL DETECTION CONTROL, THE SYSTEM MUST BE ABL. TO DETECT HOLES AND BUBBLES OF .025" OR GREATER, AND MATERIAL FOUND TO HAVE HOLES OR BUBBLES OF THIS SIZE IS NOT ACCEPTABLE.

B. INSPECTION IS REQUIRED TO DETECT INCLUSIONS OF FOREIGN MATTER IN ALL 300HN AND 500HN FILM, AS WELL AS THE 300HN USED AS THE SUBSTRATE FOR 500FN131 FILM USING AN ON LINE CAMERA INSPECTION SYSTEM. INCLUSIONS OF .025" OR GREATER MUST BE DETECTABLE BY THE SYSTEM AND ARE NOT ALLOWED IN FINISHED PRODUCT SHIPPED TO T.I

6.0 CERTIFICATION AND DATA RETENTION
WHEN THE PRINT SPECIFIES THAT MATERIAL CERTIFICATION IS REQUIRED, THE SUPPLIER CERTIFIES THAT THE MATERIAL WAS PRODUCED IN ACCORDANCE WITH THIS SPECIFICATION.

ALL STRENGTH TEST DATA AND SPECIMENS ARE TO BE MAINTAINED BY DUPONT FOR A MINIMUM OF (5) YEARS FROM THE DATE OF MANUFACTURE.

REV		
A	1ST ISSUE 5-19-95 DWG2867	CFF

BY CHAS. FLEURANT 5-19-95	TEXAS INSTRUMENTS ATTLEBORO, MASSACHUSETTS 02703	KLIXON CONTROL PRODUCTS	SIZE A	DWG. NO. 75951 SH.2
CK.				
ENG.				

EXAMPLE 10.2.2

PRESENT CERT

SUPPLIER LETTERHEAD

MATERIAL CERTIFICATION

DATE:

CUSTOMER:

NOT REQUIRED

CUSTOMER ORDER NO. _____ ①
CUSTOMER PART NO. & REV. _____ ②
QUANTITY THIS SHIPMENT _____ ③
SHIPMENT DATE _____ ④

SUPPLIER ORDER NO.* _____
SUPPLIER PART NO.* _____
PART DESCRIPTION* _____

WE CERTIFY THAT THE MATERIAL USED TO PRODUCE THE PRODUCT IN THIS SHIPMENT, NAMELY (SPECIFIC NAME/NUMBER OF MATERIAL), CONFORMS TO TI DRAWING AND TI PURCHASE ORDER REQUIREMENTS. ⑤

SIGNED: _____ ⑥
SUPPLIER REPRESENTATIVE

_____ ⑦
TITLE

*OPTIONAL

DUP 000072
DD/NHTSA No. 4
99091

10.1.1 SCOPE: TEXAS INSTRUMENTS MAY REQUIRE PAPERWORK CERTIFICATIONS DUE TO CUSTOMER/MILITARY REQUIREMENT OR LACK OF TI TEST CAPABILITY. THE REQUIREMENT FOR SUCH A CERTIFICATION WILL BE IN THE FORM OF A NOTE ON THE TI DRAWING OR A CLAUSE ON THE TI PURCHASE ORDER. THE WORDING OF THE NOTE OR CLAUSE WILL DETERMINE THE TYPE OF CERTIFICATION REQUIRED BY TI. DESCRIPTIONS AND EXAMPLES ARE PROVIDED IN SECTIONS 10.2.1 THROUGH 10.2.6. UNLESS OTHERWISE NOTED, THE CERTIFICATION MUST ACCOMPANY EACH LOT.

FOR THE PURPOSE OF CERTIFICATION, A LOT IS DEFINED AS A SHIPMENT ON A SINGLE PACKING SLIP OF A SINGLE PART NUMBER AGAINST A SINGLE PURCHASE ORDER. THE CERTIFICATION PAPERWORK MUST BE ATTACHED TO THE PACKING SLIP.

10.2.1 CERTIFICATE OF CONFORMANCE: (ALSO ENTITLED CERTIFICATE OF COMPLIANCE.) A DOCUMENT STATING THAT THE LOT IN QUESTION CONFORMS TO THE REQUIREMENTS OF THE APPLICABLE DRAWING AND PURCHASE ORDER AND THAT TEST DATA IS ON FILE IN THE SUPPLIER'S FACILITY TO SUBSTANTIATE THE STATEMENT OF CONFORMANCE. THE DOCUMENT MUST BE DATED, MUST IDENTIFY THE LOT BY TI PART NUMBER, PURCHASE ORDER NUMBER, QUANTITY AND SHIPMENT DATE, AND MUST BE SIGNED BY A RESPONSIBLE SUPPLIER REPRESENTATIVE. (SEE EXAMPLE 10.2.1).

PRESENT CERT

10.2.2 MATERIAL CERTIFICATION: A DOCUMENT STATING THAT THE MATERIALS USED TO PRODUCE THE PARTS IN THE LOT IN QUESTION CONFORM TO THE DRAWING AND PURCHASE ORDER REQUIREMENTS. THE DOCUMENT MUST CONTAIN THE SPECIFIC MATERIAL CALLOUT, BUT ACTUAL TEST RESULTS ARE NOT REQUIRED. A CERTIFICATION OF MATERIAL ANALYSIS (WITH ACTUAL TEST RESULTS) OR A LABORATORY VERIFICATION WILL ALSO FULFILL MATERIAL CERTIFICATION REQUIREMENTS. THE DOCUMENT MUST BE DATED, MUST IDENTIFY THE LOT BY TI PART NUMBER, PURCHASE ORDER NUMBER, QUANTITY AND SHIPMENT DATE, AND MUST BE SIGNED BY A RESPONSIBLE SUPPLIER REPRESENTATIVE (SEE EXAMPLE 10.2.2).

10.2.3 CERTIFICATION OF MATERIAL ANALYSIS: A DOCUMENT STATING THAT THE MATERIALS USED TO PRODUCE THE PARTS IN THE LOT IN QUESTION CONFORM TO THE DRAWING AND PURCHASE ORDER REQUIREMENTS. THE DOCUMENT MUST CONTAIN ACTUAL TEST RESULTS ON THE CHEMICAL AND MECHANICAL PROPERTIES AND SHOW THAT THE RESULTS CONFORM TO SPECIFICATION. THE DOCUMENT MUST BE DATED, MUST IDENTIFY THE LOT BY TI PART NUMBER, PURCHASE ORDER, QUANTITY AND SHIPMENT DATE, AND MUST BE SIGNED BY A RESPONSIBLE SUPPLIER REPRESENTATIVE. (SEE EXAMPLE 10.2.3).

DD/NHTSA No. 4
00092
DUP 000073

10.2.4 CERTIFIED TEST REPORT: A DOCUMENT STATING THAT THE LOT IN QUESTION HAS BEEN SUBJECTED TO CERTAIN TESTS AND THAT THE PRODUCT CONFORMS TO REQUIREMENTS FOR THESE TESTS AS OUTLINED IN THE APPLICABLE DRAWING AND PURCHASE ORDER. THE DOCUMENT SHALL STATE THE ACTUAL TESTS PERFORMED AND THE INSPECTION LEVEL USED TO ASSURE CONFORMANCE. IN ADDITION, THE DOCUMENT MUST IDENTIFY THE TI PART NUMBER, PURCHASE ORDER NUMBER, QUANTITY AND SHIPMENT DATE, AND MUST BE SIGNED BY A RESPONSIBLE SUPPLIER REPRESENTATIVE (SEE EXAMPLE 10.2.4).

10.2.5 LABORATORY VERIFICATION: A DOCUMENT DEMONSTRATING THE SAME CONFORMANCE AS "CERTIFICATE OF MATERIAL ANALYSIS" (SEE 10.2.3 ABOVE), BUT PERFORMED BY AN INDEPENDENT TESTING LABORATORY. IN SOME CASES, THERE MAY BE RESTRICTIONS IMPOSED BY TI CUSTOMERS AS TO WHO CAN PERFORM THE TESTING. THE LAB PERFORMING THE TEST MUST BE IDENTIFIED (SEE EXAMPLE 10.2.5). IF THE LABORATORY VERIFICATION SHOWS A NONCONFORMANCE, THE TESTING MUST BE REDONE AFTER CORRECTIVE ACTION IS IMPLEMENTED.

10.2.6 BLANKET CERTIFICATE OF CONFORMANCE: A DOCUMENT STATING THE SAME CONFORMANCE AS "CERTIFICATE OF CONFORMANCE" (SEE 10.2.1 ABOVE), BUT EXTENDING OVER MANY SHIPMENTS. BLANKET CERTIFICATIONS USUALLY APPLY TO A TIME PERIOD (NORMALLY ONE YEAR), BUT MAY ALSO APPLY TO ALL SHIPMENTS AGAINST A SPECIFIC PURCHASE ORDER. THE APPLICATION (TIME PERIOD OR P.O.) SHALL BE SPECIFIED IN THE BLANKET CERTIFICATION. THE TIME PERIOD SHALL BE NO GREATER THAN ONE YEAR, AND THE CERTIFICATION MUST ACCOMPANY THE FIRST SHIPMENT DURING THE PERIOD. BLANKET CERTIFICATIONS MAY ONLY BE USED WHEN APPROVED BY TI OR SPECIFIED ON THE TI DRAWING OR PURCHASE ORDER (SEE EXAMPLE 10.2.6).

FUTURE CERT ?

FUTURE CERT?

EXAMPLE 10.2.6

SUPPLIER LETTERHEAD

BLANKET CERTIFICATE OF CONFORMANCE

DATE:

CUSTOMER:

CUSTOMER PART NO.(S) & REV(S) _____

_____

_____

TIME PERIOD OF CERTIFICATION
OR
PURCHASE ORDER OF CERTIFICATION _____

WE CERTIFY THAT ALL PRODUCTS SHIPPED DURING THE PERIOD/ON THE PURCHASE ORDER NOTED ABOVE CONFORM TO THE TI PURCHASE ORDER AND TI DRAWING/SPECIFICATION REQUIREMENTS IN ALL RESPECTS.

RESULTS OF REQUIRED MECHANICAL, VISUAL, FUNCTIONAL, AND CHEMICAL TESTS WILL BE ON FILE IN OUR QUALITY CONTROL DEPARTMENT FOR A PERIOD OF _____ YEARS AND WILL BE AVAILABLE FOR YOUR REVIEW.

SIGNED: _____
SUPPLIER REPRESENTATIVE

_____
TITLE

DIN/NHTSA No. 4
08094

DUP 000075

DuPont Films
U.S. Route 23 & DuPont Road
P. O. Box 89
Circleville, OH 43113
Tel. (614) 474-0724

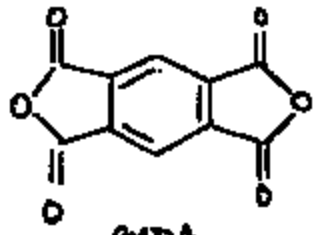
DuPont Films

July 14, 1995

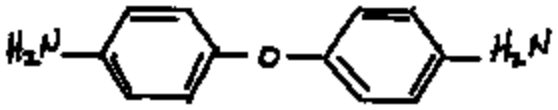
Mr. Ken Andrews
Texas Instruments
Mail Station-12-01
34 Forest St.
Attleboro, MA 02703

Dear Mr. Andrews,

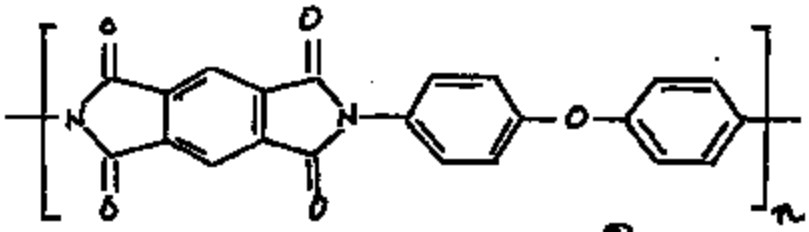
Kapton* polyimide film is a result of a polycondensation reaction between pyromellitic dianhydride and 4,4' - diaminodiphenylether.



PMDA



4,4'-ODA



KAPTON®

Please let me know if you have any questions or if I can be of further assistance.

Sincerely,

Edward C. McKenzie

Edward C. McKenzie
Technical Specialist

* Du Pont Registered Trademark

DuPont Films
U.S. Route 23 & DuPont Road
P. O. Box 89
Circleville, OH 43113
Tel. (614) 474-0724

DuPont Films

July 14, 1995

John Mayer
Texas Instruments
34 Forest St.
Attleboro, MA 02703

Dear Mr. Mayer,

For many years, Kapton* Type FN films, were used almost exclusively as electrical insulations for motors and cable. Over the past decade, the growth of type 500FN131 as a diaphragm material, primarily for the automotive industry, has steadily increased. As the requirements for these disparate end uses have been further defined, we feel it is necessary to differentiate between them, in order to focus on the film characteristics important to each. This is especially apparent after review of the most recent version of the TI specification for Kapton* films.

As a result of many discussions with TI representatives over the past year, Du Pont is using the designation 500FN131L to identify product intended for TI's use in fabrication of automotive pressure switches. 500FN131L meets all the requirements of 500FN131, and features tighter specifications than film produced for electrical insulation. These include bond strength between the Kapton* and Teflon* layers, and occurrence of defects such as holes, bubbles, or debris.

To assist us in this effort, we would ask Texas Instruments to begin ordering 5 mil FN laminate as:

Kapton* 500FN131L.

This name change will allow DuPont to fully integrate the product name and install controls to completely differentiate and segregate type FN131 laminates by the intended end use.

Please let me know if you have any questions, or if I can be of further assistance.

Sincerely,

Edward C. McKenzie

Edward C. McKenzie

* DuPont Registered Trademark

DM/NHTSA No. 4
60896

DuPont Films
U.S. Route 23 & DuPont Road
P. O. Box 89
Circleville, OH 43113
Tel. (614) 474-0724

DuPont

DuPont Films

July 31, 1995

John Mayer
Texas Instruments
34 Forest St.
Attleboro, MA 02703

Dear Mr. Mayer,

For many years, Kapton* Type FN films were used almost exclusively as electrical insulations for motors and cable. Over the past decade, use of type 500FN131 as a diaphragm material, primarily for the automotive industry, has steadily increased. As the requirements for these disparate end uses have been further defined, we feel it is necessary to differentiate between them and focus on the film characteristics important to each. This is especially apparent after review of the most recent version of the TI specification for Kapton* films.

As a result of many discussions with TI representatives over the past year, Du Pont is using the designation 500FN131L to identify internally product for TI's use in fabrication of automotive pressure switches. 500FN131L meets all the requirements of 500FN131, and features tighter specifications than film produced for electrical insulation. These specifications include bond strength between the Kapton* and Teflon* layers, and occurrence of defects such as holes, bubbles, or debris.

To assist us in this effort, we would ask Texas Instruments to begin ordering 5 mil FN laminate as:

Kapton* 500FN131L.

This name change will allow DuPont to fully integrate the product name in our systems, and install controls to completely segregate type FN131 laminates by the intended end use.

Please let me know if you have any questions, or if I can be of further assistance.

Sincerely,

Edward C. McKenzie

Edward C. McKenzie

* DuPont Registered Trademark

DEWNETSA No. 4
00097

DUPONT

FAX NO.: _____

CIRCLEVILLE PLANT

Date & Time: 9/22/95 9:19AM

P.O. Box 89
Circleville, OH 43113

FACSIMILE TRANSMISSION COVER SHEET

ADDRESSEE(S):

Name	Company or Department	Location
JON MAYER	TEXAS INSTRUMENTS	ATTLEBORO

COPY:

EMMETT MILLER	DUPONT	

SENDER:

Name	Business Sector	Location
ED McKENZIE	DUPONT - KAPTON® FILM	CIRCLEVILLE, OHIO

*** 1 PAGE(S) TO FOLLOW THIS COVER SHEET ***

Special Instructions/Information to Recipient:

Emmett - what we sent to Jon Mayer.
This will probably result in further conversations in the future...
Ed

CIRCLEVILLE FAX NUMBER FOR THIS TRANSMISSION IS 1-800-879-4481.
SHOULD PROBLEMS OCCUR WHILE SENDING, CONTACT 1-800-967-5607.

***** CONFIDENTIALITY NOTE *****

The documents accompanying this telecopy transmission contain information from DuPont Films which is confidential and/or legally privileged. The information is intended only for the use of the individual or entity named on this transmission sheet. If you are not the intended recipient, you are hereby notified that any disclosure, copying, distribution, or the taking of any action in reliance on the contents of the telecopied information is strictly prohibited, and that the documents should be returned to DuPont Films immediately. In this regard, if you have received this telecopy in error, please notify us by telephone (1-800-967-5607) immediately so that we can arrange for the return of the original documents to us at no cost to you.

(FAX.All)

DD/NHTSA No. 4
60098

Charting a Course for Excellence

Richard Standen

TI, Attleboro, MA

7/31 95

1. QS9000 std. - end of '96 pursue TI cert. 3rd party registered

→ GM requires supply base to be QS9000 Tier I, end of '97 GM mid '97 Cry. self-assess Ford

Define A vs. ISO.

2. Farrelly - XP.

Ruptured diaphragms

Specs - 500,000 cycles. → 1MM @ >5% H_2O in brake fluid.

3 layers 131

→ all 3 ~~outside~~ layer fractures of 131

numerous fractures in FEP inside layers.

delam FEP

cracks in outer radial layer

Start w/ FEP fracture → low fracture toughness vs. PFA

Pressure low 0 - 276 KPa (0 - 40 psi)

high 10,000 ± 345 KPa (1450 ± 50 psi)

DOT 3 & 4 brake fluid

FEP PFA

10,000 vs. 100,000 MIT

ASTM D-2176

In film FEP MIT sign higher

Jack Krey report -

DD/NHTSA No. 4
00099

Bryce Dague
Tom Mayer.

Sent 10 yr. old 500XP131 - Favorably.

What is flex for 300 JP, cycles?

Becoming a high priority -

Dynamic hydraulic vs. static. Flexural modulus.

XP - use 1 or 2 layers vs. 3 × 131 ??

2 Price 500XP131?

3. Helium perm - from leak test. A/C systems.
Straight Kapton - Summ. of Prop info to Bryan.

4. Versailles, KY part of same division, diff. dept.

5. % peel str. of PFA.

6. Nissan - wouldn't accept Kapton. Go back in ¥/$ & local content.

From: CLYDETE --ISCDCVM5 Date and time 08/02/95 09:14:01
To: MCKENZEC--ISCDCVM5 Edward C. McKenzie

From: Thomas E. Clyde
Subject: JP MIT

Re Texas Instruments, here is some info to discuss with Dague and Stander. JP has clearly higher flex endurance vs HN plus better moisture absorption. HA is also an option based on flex life;I'm not sure about the moisture absorption. As we discussed, an HA laminate might make more sense than a JP one. Of course, if the JP moisture absorption is low enough, maybe they wouldn't need a laminate.I can't see TI doing that though.

I suggest they run 3 mil HN, JP, and HA side by side in their flex test with hot brake fluid under pressure plus evaluate the XP. I think their test is more meaningful than us getting better MIT data now.

;Your contact at FLEXcon is Roland Castonguay, Customer Development/Electronic Printing, 508-885-8265.

*** Forwarding note from PARISHDJ--ISCDCVM5 08/02/95 08:49 ***
To: CLYDETE --ISCDCVM5

*** Reply to note of 08/01/95 16:32
Salutations!
Subject: JP MIT
300 HN IS ABOUT 17000 CYCLES, BUTTHESE ARE APPROXIMATE BEING BASED ON 3 MEASUR EMENTS. I HAVE MORE INFO ON 1-MIL WHERE THE MIT DATA ARE: 1.2MM CYCLES FOR HA. 580M CYCLES FOR JP AND 25M CYCLES FOR HN. THUS, IT WOULD APPEAR THAT HA WOULD B E BEST IF MIT IS THE ONLY CRITERIA. IF YOU ARE CONTEMPLATING A SPECIFICATION AGREEMENT, LET ME KNOW AND I WILL START MORE TESTS TO GENERATE A PERFORMANCE BASE. BEAR IN MIND THE TIME TO COMPLETE TESTS(ABOUT 6 WKS FOR 1MM CYCLES) IF YOU WANT TO INCLUDE THIS AS A SPEC; THE SOONER WE START, THE SOONER WE ARE READY TO TALK.

Thank You and
Keep Smilin',
Joe Parish

Texas Instruments Incorporated

TEXAS INSTRUMENTS

34 Forest Street
P.O. Box 2964
Attleboro, MA 02703-0964
(508) 236-1600

E I DUPONT DE NEMOURS & CO.
US ROUTE 23 PO BOX 89
CIRCLEVILLE, OH 43113

August 18 , 1995

ATTENTION: EDWARD C. MCKENZIE

SUBJECT: NONCONFORMANCE NOTICE # 019011

Attached, please find our Corrective Action Request for the referenced Quality Nonconformance Notice. This product or material was rejected because it did not fully meet drawing or purchase order requirements. Texas Instruments Incorporated is requesting that you respond to this request within fifteen days, in writing, with your plans for containment; your definition and verification of root cause; actions taken to prevent recurrence; and, an outline of permanent corrective actions. Your response will be reviewed by Procurement Quality Assurance, Quality Engineering, Design and Manufacturing Engineering, Purchasing, and appropriate Managers for the adequacy of your actions, and the effectiveness of your long term solutions.

The diagnostic process and development of a permanent corrective action plan may take longer than the fifteen days this corrective action procedure allows. If so, please submit your interim corrective action plan and return the attached forms to Texas Instruments Incorporated indicating your plans for permanent corrective action and expected completion date.

Texas Instruments Incorporated expects that as a valued Supplier, you will research the problem, identify the cause, indicate the specific corrective action plan and effectivity date, and submit your response in a timely manner. If your manufacturing process or tooling is incapable of meeting our product specifications, it is expected that you will notify your Texas Instruments Incorporated Purchasing representative immediately, and so indicate this on your response to Procurement Quality Assurance.

In addition to other performance indicators, Texas Instruments Incorporated measures the effectivity of Supplier corrective action responses. It is believed that such responses are perhaps the best indicator of the Quality culture present today in our Supplier's facility. Therefore, within the allotted fifteen days, please return the attached two page form to:

Texas Instruments Incorporated • Lorraine Heroux, MS: 11-11, • P.O. Box 2964, • Attleboro, Ma. 02703-0964

Thank you for your continued support and your commitment to our partnership in Quality.

Sincerely,

MATERIALS & CONTROLS GROUP
Procurement Quality Assurance

Mark Godbout

Mark L. Godbout, PQA Technician
MS: 11-11 (508) 236-1434
Fax #: (508) 236-3788

Copy: Peter A. Foley, PQA Supervisor

MLG:lh

DD/NHTSA No. 4
06192

111015

ROUTE TO [redacted]

TEXAS INSTRUMENTS
ATTLEBORO, MASSACHUSETTS 02703

REPORT OF DISCREPANT IN-PROCESS MATERIAL

No. 019013

DWG NO. & NAME: 74334-1 Kapton Tape		REV. E	INSPECTOR	DATE 7/31/95	Mfg. Supervision Review
SOURCE: Dupont	DEVICE 37/87	PROD. CODE 888	QUANTITY		

ITEM	ATTRIBUTE/DOCUMENT	ACTUAL	MINOR	AC	DE	SCRP
1	Workmanship	[illegible]	1	0	[illegible]	[illegible]
	I.D. 6.00	[illegible]				
	O.D. 14.00	[illegible]				
		[illegible]				
	PO #5000114825	[illegible]				
	Suppl#-12/all	[illegible]				

MAT'L/PROD. CONTROL

☐ ONHOK INVENTORY AT (LOCATION)
☐ PART/MATERIAL IN SHOP AREA

[illegible]

COMMENTS: [illegible]

PLANNER: SIGNATURE DATE

MRB ENGINEERING DISPOSITION

RETURN TO SUPPLIER	COMMENTS:	MRB SIGNATURES	DATE
☐ REWORK ATTI	CENTER ROLL [illegible]	[illegible]	7/31/95
☒ SCRP ATTI	& INSPECT FIT ON FRAME [illegible]	[illegible]	8/16/95
☐ SCRAP	PLEASE RETURN TO SUPPLIER		
☐ REWRITE (U.A.)			

NOTE—IF DISP. OTHER THAN ATTI – MRB CORRECTIVE ACTION MUST BE COMPLETED

REWORK PROCEDURE: (INFO./REQ.)

MH# 687377

By eh 5040 Def code [illegible]

INSPECTION AFTER REWORK	MINOR	AC	DE	SCRP	INSPECTOR	DATE	REWORK INSPECTOR

MRB CORRECTIVE ACTION

TI
— CHANGE OWNERSHIPS (CHANGE MUST BE ATTACHED) ☐
— USE ENCLOSED SAMPLES AS ACCEPTABLE VISUAL STANDARDS ☐
— OTHER (EXPLAIN)

SUPPLIER
— PROVIDE CORRECTIVE ACTION WITH FORMAL RESPONSE ☐
— SUBMIT INSPECTION DATA WITH FUTURE SHIPMENTS ☐
— CONDUCT CAPABILITY STUDY AND SUBMIT TO ENGINEERING ☐
— OTHER (EXPLAIN) ☐

COMMENTS: PLEASE [illegible]

RECEIVING INSPECTION

RECEIVING NO.	SUP. CODE	BIN	LOCATION
9981	RTS	P	B-26

REJECT VALIDATION: DO 8/16/95

SUPPLIER NOTIFIED: METH. DATE

ID/NHTSA No. 4
08103

PROCUREMENT ASSURANCE

☐ FOR INFO ONLY - SUPPLIER
☒ EXTERNAL Q.A.R.
☐ FOR INFO ONLY - INTERNAL
☐ INTERNAL Q.A.R.

[illegible] 8/16/95

REJECT DO 8/16/95

Texas Instruments Incorporated
Materials & Controls Group
CORRECTIVE ACTION REQUEST

YOUR CORRECTIVE ACTION RESPONSE IS DUE 15 WORKDAYS AFTER RECEIPT OF THIS REQUEST AT YOUR FACILITY.

RETURN TO:
Lorraine Harvey MS: 11-11
Texas Instruments Incorporated
34 Forest St. P.O. Box 2964
Attleboro, Ma. 02703-0964

PREPARATION DATE: AUGUST 18, 1995

[redacted]	[redacted]
[redacted]	[redacted]

PLEASE ANSWER APPROPRIATE CATEGORIES BELOW. * INDICATES SUPPLIER TO ADDRESS

1. a.) TEXAS INSTRUMENTS INCORPORATED MSB MEMBERS & APPROPRIATE MANAGERS:

Buyer: JULIE FOMBO MS: 23-04 ◆ MS:
◆ MS: ◆ MS:
◆ MS: ◆ MS:
◆ MS: ◆ MS:

*1. b.) SUPPLIER IDENTIFIED SUB-TIER SUPPLIERS: (WRITE NONE, IF NONE)

NAME: NONE ADDRESS:

*2. DESCRIPTION OF NONCONFORMANCE: MLF8123903

MANUFACTURING DATE: 3/17/95 LOT NUMBER(IF APPLICABLE): 7 #03, 7#04

ATTRIBUTE / SPECIFICATION: ± ACTUAL:

OTHER INFORMATION: CORE OUT OF ROUND

*3. CONTAINMENT: (WHAT SPECIFIC ACTIONS HAVE BEEN TAKEN AT YOUR FACILITY TO IDENTIFY AND ISOLATE THIS NONCONFORMING PRODUCT?)

1). CHECK WAREHOUSE FOR ANY REMAINING INVENTORY FROM THIS LOT NO'S.
NONE FOUND - ALL HAD BEEN SHIPPED TO TI. 8-24-95 [illegible]

*4. DEFINE AND VERIFY ROOT CAUSE: EXAMINATION OF RETURNED ROLL:
A) FOUND CORE INDEED OUT OF ROUND
B). ROLL WAS WOUND "TOO HARD" EXCESSIVE TENSION DEFORMED PLASTIC CORE
C). A TEMPLATE IS USED TO VERIFY INSIDE DIAMETER. - WE REINSERTED THIS ROLL AND IT DID NOT FREE PASS.
D) OPERATOR/INSPECTOR DID NOT CHECK VS. TI TEMPLATE.

TI FORMAT FORM REV. 8/8/95

DD/NHTSA No. 4
08184

5. PERMANENT CORRECTIVE ACTIONS (FOR EACH CAUSE, WITH POTENTIAL IMPLEMENTATION)

1. EACH TIE SHIT ROLL TO BE CHECK FOR TOLERANCE AND CORRECT INSIDE DIAMETER USING PLASTIC TEMPLATE
- REJECT ROLLS WHICH DO NOT COMPLY.
- EXPECT 100% EFFECTIVENESS
2). CONTACTS MADE WITH INSPECTOR AND OPERATOR INDIVIDUAL AND TO ALL AS A GROUP, REINFORCING PROCEDURE FOR TIE.

6. VERIFICATION: (DESCRIBE WHAT YOU HAVE DONE TO VERIFY THE EFFECTIVENESS OF YOUR CORRECTIVE ACTION)

1) TOOK SERVICE TO VERIFY DIMENSIONS OF PLASTIC TEMPLATE — COMPLETE 9-11-95 ECM
2). CONFIRMED CONTACT WAS MADE TO OPERATOR ABOUT NON-CONFORMING MATERIAL — COMPLETED 9-11-95 ECM

7. PREVENTION: (DESCRIBE ACTIONS TAKEN TO PREVENT RECURRENCE)

1). REVIEWED PROCEDURES WITH AREA - 8/31/95 ECM, CH. HAGGER
2). AUDIT NEXT WAREHOUSE SHIPMENT DUPONT ITEM # E1493 DUE 10/5/95

NOTE: IF THIS CHANGES THE CONTROL PLAN ON AN SQC CERTIFIED PART, PLEASE ATTACH A COPY OF THE REVISED CONTROL PLAN FOR OUR CERTIFIED PARTS RECORDS.

SUPPLIER'S AGENT: EDWARD C. MCKENZIE (PLEASE PRINT) TITLE: TECHNICAL ASSOCIATE

AGENT SIGNATURE: Edward C. McKenzie DATE COMPLETED: 9-11-95

8. TEXAS INSTRUMENTS INCORPORATED PQA REVIEW & TEAM CONGRATULATIONS:

☐ THIS SUPPLIER CORRECTIVE ACTION RESPONSE HAS BEEN APPROVED BY PROCUREMENT QUALITY ASSURANCE, AND HAS BEEN DISTRIBUTED TO ALL IDENTIFIED IN SECTION 1.a.
Congratulations to all participants for this accomplishment!

☐ THIS SUPPLIER CORRECTIVE ACTION RESPONSE HAS NOT BEEN APPROVED BY PROCUREMENT QUALITY ASSURANCE, BECAUSE:

☐ A SECOND RESPONSE HAS BEEN REQUESTED ON: _____

☐ THE MRB DOES NOT ACCEPT THIS CORRECTIVE ACTION AND HEREBY REQUEST THAT PQA ISSUE AN ADDITIONAL REQUEST FOR CORRECTIVE ACTION. Requested by: _____

☐ THE MRB IS HEREBY ALERTED TO A LESS THAN 100% EFFECTIVE CORRECTIVE ACTION, AND MAY REQUEST AN ADDITIONAL SUPPLIER RESPONSE THROUGH THE APPROPRIATE BUYER.

FedEx. *USA Airbill* 6419879384

Sender's Copy

99 300 A1449648 51770

From (please print)

Date 9-11-95 Sender's FedEx Account Number 0432-2040-3

Sender's Name EDWARD C. MCKENZIE Phone (614) 474-0730

Company E I DUPONT Dept/Floor

Address ROUTE 23 SOUTH

City CIRCLEVILLE State OH Zip 4 3 1 1 3

Your Internal Billing Reference Information (Optional. Max 24 characters will appear on invoice) 110520

To (please print)

Recipient's Name LORAINE HEBOUX Phone ( )

Company TEXAS INSTRUMENTS Dept/Floor MS 11-11

Address 34 FOREST ST.

City ATTLEBORO State MA Zip 02703-0964

For "HOLD" Shipments check here ☐ Weekday ☐ Saturday

For Saturday Delivery check here ☐ Saturday

Service

☒ FedEx Priority Overnight ☐ FedEx Standard Overnight ☐ FedEx 2Day ☐ FedEx Express Saver ☐ FedEx Overnight Freight ☐ FedEx 2Day Freight

Packaging

☒ FedEx Envelope ☐ FedEx Pak ☐ FedEx Box ☐ FedEx Tube ☐ Other Packaging

Special Handling

☒ None ☐ Hold Weekday ☐ Hold Saturday ☐ Saturday Delivery ☐ Dangerous Goods Only

Payment

☒ Sender's FedEx Account ☐ Recipient ☐ Third Party ☐ Credit Card ☐ Cash/Check

Total Packages Total Weight Total Declared Value $

Recipient Signature

194

Questions? Call 1-800-Go-FedEx.

The World On Time

DÍVNEITSA No. 4
00186

Texas Instruments Incorporated

TEXAS INSTRUMENTS

34 Forest Street
P.O. Box 2964
Attleboro, MA 02703-0964

(508) 236-3800

E I DUPONT DE NEMOURS & CO.
US ROUTE 23 PO BOX 89
CIRCLEVILLE, OH 43113

August 18 , 1995

ATTENTION: EDWARD C. MCKENZIE

SUBJECT: NONCONFORMANCE NOTICE # 019011

Attached, please find our Corrective Action Request for the referenced Quality Nonconformance Notice. This product or material was rejected because it did not fully meet drawing or purchase order requirements. Texas Instruments Incorporated is requesting that you respond to this request within fifteen days, in writing, with your plans for containment; your definition and verification of root causes; actions taken to prevent recurrence; and, an outline of permanent corrective actions. Your response will be reviewed by Procurement Quality Assurance, Quality Engineering, Design and Manufacturing Engineering, Purchasing, and appropriate Managers for the adequacy of your actions, and the effectiveness of your long term solutions.

The diagnostic process and development of a permanent corrective action plan may take longer than the fifteen days this corrective action procedure allows. If so, please submit your interim corrective action plan and return the attached forms to Texas Instruments Incorporated indicating your plans for permanent corrective action and expected completion date.

Texas Instruments Incorporated expects that as a valued Supplier, you will research the problem, identify the cause, indicate the specific corrective action plan and effectivity date, and submit your response in a timely manner. If your manufacturing process or tooling is incapable of meeting our product specifications, it is expected that you will notify your Texas Instruments Incorporated Purchasing representative immediately, and so indicate this on your response to Procurement Quality Assurance.

In addition to other performance indicators, Texas Instruments Incorporated measures the effectivity of Supplier corrective action responses. It is believed that such responses are perhaps the best indicator of the Quality culture present today in our Supplier's facility. Therefore, within the allotted fifteen days, please return the attached two page form to:

Texas Instruments Incorporated • Lorraine Harour, MS: 11-11, • P.O. Box 2964, • Attleboro, Ma. 02703-0964

Thank you for your continued support and your commitment to our partnership in Quality.

Sincerely,

MATERIALS & CONTROLS GROUP
Procurement Quality Assurance

Mark Godbout

Mark L. Godbout, PQA Technician
MS: 11-11 (508) 236-1434
Fax #: (508) 236-3788

Copy: Peter A. Foley, PQA Supervisor

ML/G:lfh

DIV/NHTSA No. 4
00108

11/01/5

ROUTE TO: [redacted]

TEXAS INSTRUMENTS
ATTLEBORO, MASSACHUSETTS 02703

REPORT OF DISCREPANT IN-PROCESS MATERIAL

No. 019013

DWG NO. & NAME	REV.	INSPECTOR	DATE	Mfg. Supervision Review
74234-1 Kapton Tape	E	75261	7-21-95	[illegible]

SOURCE	DEVICE	PROD. CODE	QUANTITY
Dupont	77/17	886	[illegible]

ITEM	ATTRIBUTE/REQUIREMENT	ACTUAL	SNMP	AO	RE	DISP
1	Workmanship	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	I.D. 6.00	[illegible]				
	O.D. 14.00	[illegible]				
		M.M. [illegible]				
	PO # 5003169925	[illegible]				
	Supp # 12101	[illegible]				

MAT'L/PROD. CONTROL

☐ CHECK INVENTORY AT (LOCATION)
☐ PART/MATERIAL IN SHORT SUPPLY

SAMPLES MUST BE RETAINED FOR DISPUTES

COMMENTS:

PLANNER: SIGNATURE: DATE:

MRB ENGINEERING DISPOSITION

	COMMENTS:	MRB SIGNATURE	DATE
☒ RETURN TO SUPPLIER	CENTER ROLL [illegible]	[illegible]	7/21/95
☐ REWORK AT TI	& WON'T FIT ON FEEDER	[illegible]	7/21/95
☐ SORT AT TI	PLEASE RETURN TO SUPPLIER	[illegible]	[illegible]
☐ SCRAP		[illegible]	
☐ DEVIATE (U A S)		[illegible]	

NOTE — IF DISP. OTHER THAN RTS - MRB CORRECTIVE ACTION MUST BE COMPLETED.

REWORK PROCEDURE: (MFG./ENG.)

MH# 687377

Byer 5010 Def code 27

INSPECTION AFTER REWORK	SNMP	AO	RE	DISP	INSPECTOR	DATE

REWORK COMPLETE: [illegible]
BY: [illegible]
ACTUAL HRS. HOURS: [illegible]
WORK FOR REWORK: [illegible]

MRB CORRECTIVE ACTION

TI
- CHARGE DRAWING/PO (CORRECTION MUST BE ATTACHED) ☐
- USE ENCLOSED SAMPLES AS ACCEPTABLE VISUAL STANDARDS ☐
- OTHER (EXPLAIN) ☐

SUPPLIER
- PROVIDE CORRECTIVE ACTION WITH FORMAL RESPONSE ☐
- SUBMIT INSPECTION DATA WITH FUTURE SHIPMENTS ☐
- CONDUCT CAPABILITY STUDY AND SUBMIT TO ENGINEERING ☐
- OTHER (EXPLAIN) ☐

COMMENTS: PLEASE PUT MATL ON DEVICE

RECEIVING INSPECTION

RI SEQUENCE NO.	DISP. CODE	AREA	LOCATION
9981	RTS	P	B-16

REJECT VALIDATION: INITIAL DO DATE 8/16/95

SUPPLIER NOTIFIED: INITIAL: DATE:

DD/NHTSA No. 4
09109

PROCUREMENT ASSURANCE

DO NOT WRITE BELOW THIS LINE

☐ FOR INFO ONLY - SUPPLIER
☒ EXTERNAL C.A.R.
☐ FOR INFO ONLY - INTERNAL
☐ INTERNAL C.A.R.

[illegible] 8/16/95

REJECT DO 8/16/95

Texas Instruments Incorporated
Materials & Controls Group
CORRECTIVE ACTION REQUEST

YOUR CORRECTIVE ACTION RESPONSE IS DUE 15 WORKDAYS AFTER RECEIPT OF THIS REQUEST AT YOUR FACILITY.

RETURN TO:
Lorraine Heroux MS: 11-11
Texas Instruments Incorporated
34 Forest St. P.O. Box 2964
Attleboro, Ma. 02703-0964

PREPARATION DATE: AUGUST 18, 1995

H.I. DUPONT DE NEMOURS & CO	74224-1
EDWARD C. MCKENZIE	019011

PLEASE ADDRESS APPROPRIATE CATEGORIES BELOW. * INDICATES SUPPLIER TO ADDRESS

1. a.) TEXAS INSTRUMENTS INCORPORATED MRB MEMBERS & APPROPRIATE MANAGERS:

Buyer: JULIE POMBO MS: 23-04 ◆ MS:
◆ MS: ◆ MS:
◆ MS: ◆ MS:
◆ MS: ◆ MS:

*1. b.) SUPPLIER IDENTIFIED SUB-TIER SUPPLIERS: (WRITE NONE, IF NONE)

NAME: NONE ADDRESS:

*2. DESCRIPTION OF NONCONFORMANCE: MLN#123305

MANUFACTURING DATE: 3/17/95 LOT NUMBER(IF APPLICABLE): 7#03, 7#04

ATTRIBUTE / SPECIFICATION: ± ACTUAL:

OTHER INFORMATION: CORE OUT OF ROUND

*3. CONTAINMENT: (WHAT SPECIFIC ACTIONS HAVE BEEN TAKEN AT YOUR FACILITY TO IDENTIFY AND ISOLATE THIS NONCONFORMING PRODUCT?)

D. CHECK WAREHOUSE FOR ANY REMAINING INVENTORY FROM THIS LOT NO'S.
NONE FOUND - ALL HAD BEEN SHIPPED TO TI. 8-24-95 [illegible]

*4. DEFINE AND VERIFY ROOT CAUSE: EXAMINATION OF RETURNED ROLL:
A) FOUND CORE INDEED OUT OF ROUND
B). ROLL WAS WOUND "TOO HARD" EXCESSIVE TENSION DEFORMED PLASTIC CORE
C). A TEMPLATE IS USED TO VERIFY INSIDE DIAMETER. - WE REINSPECTED THIS ROLL AND IT DID NOT PASS.
D) OPERATOR/INSPECTOR DID NOT CHECK VS. TI TEMPLATE.

TI FORM 10, FORM REV. 8/2/95

DD/NHTSA No. 4
00110

***5. PERMANENT CORRECTIVE ACTION: (FOR EACH CAUSE, WITH POTENTIAL % EFFECTIVENESS)**

1. EACH TI SLIT ROLL TO BE CHECK FOR TOLERANCE AND CORRECT INSIDE DIAMETER USING PLASTIC TEMPLATE
   - REJECT ROLLS WHICH DO NOT COMPLY
   - EXPECT 100 % EFFECTIVENESS
2). CONTACTS MADE WITH INSPECTOR AND OPERATOR, INDIVIDUAL AND TO ALL AS A GROUP, REINFORCING PROCEDURE FOR TI.

***6. VERIFICATION: (DEFINE WHAT YOU HAVE DONE TO VERIFY THE EFFECTIVENESS OF YOUR CORRECTIVE ACTION)**

1) TECH SERVICE TO VERIFY DIMENSIONS OF PLASTIC TEMPLATE — COMPLETE 9-11-95 ECM
2). CONFIRMED CONTACT WAS MADE TO OPERATOR ABOUT NON-CONFORMING MATERIAL — COMPLETED 9-11-95 ECM

***7. PREVENTION: (DEFINE ACTIONS TAKEN TO PREVENT RECURRENCE)**

1). REVIEWED PROCEDURES WITH AREA - 8/31/95 ECM, CA. HAGGER
2). AUDIT NEXT WAREHOUSE SHIPMENT DUPONT ITEM # 82453 DUE 10/5/95

NOTE: IF THIS CHANGES THE CONTROL PLAN ON AN IRC CERTIFIED PART, PLEASE ATTACH A COPY OF THE REVISED CONTROL PLAN FOR OUR CERTIFIED PARTS RECORDS.

*

SUPPLIER'S AGENT: EDWARD C. MCKENZIE (PLEASE PRINT) TITLE: TECHNICAL ASSOCIATE

AGENT SIGNATURE: Edward C. McKenzie DATE COMPLETED: 9-11-95

8. TEXAS INSTRUMENTS INCORPORATED FQA REVIEW & TEAM CONGRATULATIONS:

☐ THIS SUPPLIER CORRECTIVE ACTION RESPONSE HAS BEEN APPROVED BY PROCUREMENT QUALITY ASSURANCE, AND HAS BEEN DISTRIBUTED TO ALL IDENTIFIED IN SECTION 1.a.
Congratulations to all participants for this accomplishment!

☐ THIS SUPPLIER CORRECTIVE ACTION RESPONSE HAS NOT BEEN APPROVED BY PROCUREMENT QUALITY ASSURANCE, BECAUSE;

☐ A SECOND RESPONSE HAS BEEN REQUESTED ON: _____

☐ THE MRB DOES NOT ACCEPT THIS CORRECTIVE ACTION AND HEREBY REQUEST THAT FQA ISSUE AN ADDITIONAL REQUEST FOR CORRECTIVE ACTION. Requested by: _____

☐ THE MRB IS HEREBY ALERTED TO A LESS THAN 100% EFFECTIVE CORRECTIVE ACTION, AND MAY REQUEST AN ADDITIONAL SUPPLIER RESPONSE THROUGH THE APPROPRIATE BUYER.

FedEx. *USA Airbill* 6419879384

Sender's Copy

99 300 43669469 5177N

1 From (please print)

Date 9-11-95 Sender's FedEx Account Number 0432-2040-3

Sender's Name EDWARD C. MCKENZIE Phone (604) 474-0730

Company E I DUPONT Dept./Floor/Suite/Room

Address ROUTE 23 SOUTH

City CIRCLEVILLE State OH Zip 4 3 1 1 3

Your Internal Billing Reference Information (Optional) First 24 characters will appear on invoice 110320

2 To (please print)

Recipient's Name LORRAINE HEBOUX Phone ( )

Company TEXAS INSTRUMENTS Dept./Floor/Suite/Room MS 11-11

Address 34 FOREST ST. (Do Not Deliver to PO Boxes or PO Zip Codes)

City ATTLEBORO State MA Zip 02703-0964

For "HOLD" Service check here ☐ Monday ☐ Saturday

For Saturday Delivery check here ☐

3 Service*

☒ FedEx Priority Overnight ☐ FedEx Standard Overnight ☐ FedEx 2Day

☐ FedEx First Overnight

☐ FedEx Overnight Freight ☐ FedEx 2Day Freight

*Delivery commitment may be later in some areas.

4 Packaging

☒ FedEx Letter* ☐ FedEx Pak* ☐ FedEx Box ☐ FedEx Tube ☐ Other Packaging

*Declared value limit $100.

5 Special Handling

Does this shipment contain dangerous goods? ☒ No ☐ Yes Shipper's Declaration ☐ Yes Dry Ice

☐ Dry Ice Dry Ice weight ____ kg. Shipper's Declaration not required

CA ☐ Cargo Aircraft Only

6 Payment

Bill to: ☒ Sender's FedEx Account No. ☐ Recipient ☐ Third Party ☐ Credit Card ☐ Cash/Check

FedEx Account No.

Exp. Date Sign. Date

Total Packages Total Weight Total Declared Value* $ .00 Total Charges

*Declared value limit for FedEx Express services is $100,000 except for certain destinations. For additional information, see the FedEx Service Guide.

7 Release Signature

Your signature authorizes Federal Express to deliver this shipment without obtaining a signature and agrees to indemnify and hold harmless Federal Express from any resulting claim.

194

Questions?
Call 1-800-Go-FedEx

The World On Time

FedEx Corp. Stock • NYSE Symbol FDX
On U.S. 30 Fortune • Fortune 500 in U.S.A.

DD/NHTSA No. 4
00112

Terms And Conditions

Definitions: On this airbill, we, our and us refer to Federal Express Corporation, its employees, and agents. You and your refer to the sender, its employees, and agents.

Agreement To Terms: By giving us your package to deliver, you agree to all the terms in our current Service Guide, which is available on request. You also agree to these terms on behalf of any third party with an interest in the package. If there is a conflict between the Service Guide and this Airbill, the Service Guide will control. No one is authorized to change the terms of our Agreement.

Responsibility For Packaging And Completing Airbill: You are responsible for adequately packaging your goods and properly filling out this airbill. If you omit the number of packages and/or weight per package, our billing will be based on our best estimate of the number of packages we received and/or an estimated "default" weight per package as determined by us.

Responsibility For Payment: Even if you give us different payment instructions, you will always be primarily responsible for all delivery costs, as well as any costs incur in either returning your package to you or warehousing it pending disposition.

Limitations On Our Liability And Liabilities Not Assumed

- Our liability for loss or damage to your package is limited to your actual damage or $100, unless you declare a higher value, pay an additional charge, and document your actual loss in a timely manner. You may pay an additional charge for each additional $100 of declared value. The declared value does not constitute, nor do we provide cargo liability insurance.
- In any event, we will not be liable for any damage, whether direct, incidental, special, or consequential in excess of the declared value of a shipment, whether or not Federal Express had knowledge that such damages might be incurred including but not limited to loss of income or profits.
- We won't be liable:
  - for your acts or omissions including but not limited to improper or insufficient packing, securing, marking, or addressing, or those of the recipient or anyone else with an interest in the package
  - if you or the recipient violate any of the terms of an Agreement
  - for loss or damage to shipments of prohibited items
  - for loss, damage, or delay caused by events we cannot control, including but not limited to acts of God, perils of the air, weather conditions, acts of public enemies, war strikes, civil commotions, or acts of public authorities with actual or apparent authority.

Declared Value Limits

- The highest declared value allowed for FedEx Letter and FedEx Pak shipments is $100.
- For other shipments, the highest declared value allowed is $50,000 unless your package contains items of "extraordinary value," in which case the highest declared value allowed is $500.
- Items of "extraordinary value" include shipments containing such items as artwork, jewelry, furs, precious metals, negotiable instruments, and other items listed in our Service Guide.
- You may send more than one package on this airbill and fill in the total declared value for all packages, not to exceed the $100, $500 or $50,000 per package limit described above. Example: 5 packages can have a total declared value of up to $500,000 in that case, our liability is limited to the actual value of the package(s) lost or damaged, but may not exceed the maximum allowable declared value(s) or the total declared value, whichever is less. You are responsible for proving the actual loss or damage.

Filing A Claim: YOU MUST MAKE ALL CLAIMS IN WRITING and notify us of your claim within strict time limits set out in the current Service Guide.

We'll consider your claim filed if you notify our Customer Service Department at 800 Go FedEx and make your claim in writing as soon as possible.

Within 60 days after you notify us of your claim, you must send us all the information you have about it. We aren't obligated to act on any claim until you have paid all transportation charges, and you may not deduct the amount of your claim from those charges.

If the recipient accepts your package without noting any damage on the delivery record, we will assume the package was delivered in good condition. For us to process your claim, you must make the original shipping carton and packing available for inspection.

Right To Inspect: We may at our option open and inspect your packages before or after you give them to us to deliver.

Right Of Rejection: We reserve the right to reject a shipment when such shipment would be likely to cause delay or damage to other shipments, equipment, or personnel or if an shipment is prohibited by law; or if the shipment would violate any terms of our Agreement or our current Service Guide.

C.O.D. Services: C.O.D. SERVICE IS NOT AVAILABLE WITH THIS AIRBILL. If C.O.D. Service is required, please use a Federal Express C.O.D. airbill.

Air Transportation Tax Included: Our basic rate includes a federal tax required by Internal Revenue Code Section 4271 on the air transportation portion of this service.

Money-Back Guarantee: In the event of untimely delivery, Federal Express will at your request and with some limitations, refund or credit all transportation charges. See current Service Guide for more information.

Part #146152/146153
Rev. 5/98

DD/NHTSA No. 4
00113

Bill C. McDonald
DuPont Imaging Systems/
Medical Products
High Performance Films
Tel. (814) 474-0700
Fax: (814) 474-6000

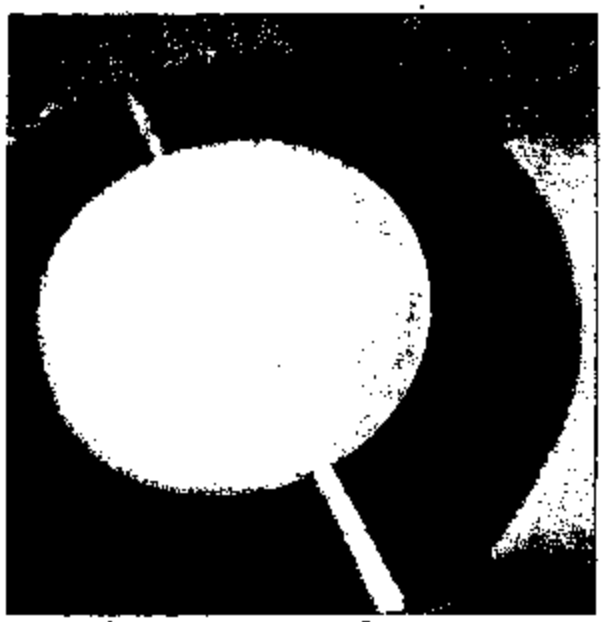
DuPont Imaging Systems/
Medical Products

TI - collapsed core.
8123305

74404
74403 } any left in the warehouse

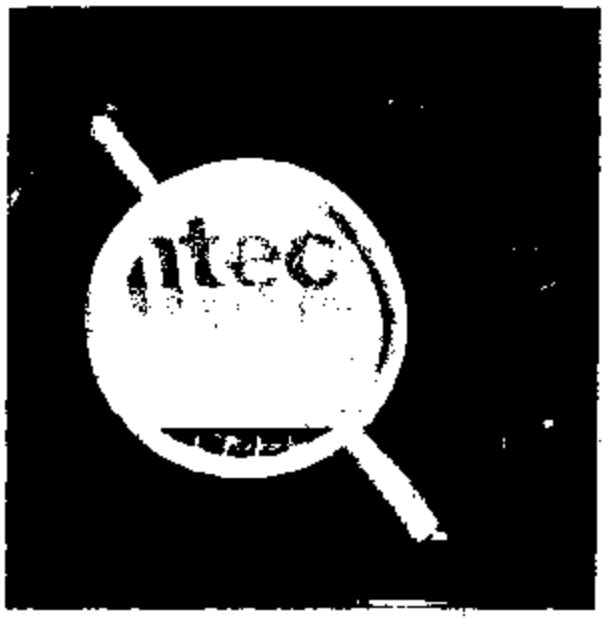
9-28-95

Checked to see if any from this lot in warehouse - none.

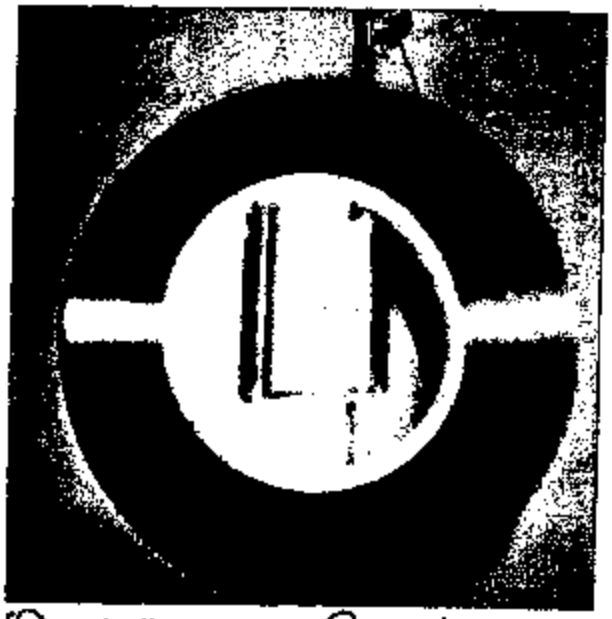


Part# Rej #
74224-1 0190U

Part# Rej#
74224-1 0190 11



Part# Ref#
74224-1 019011



Part# Ref#
74224-1 019011

Texas Instruments Incorporated
Materials and Controls Group

TEXAS INSTRUMENTS

34 Forest Street
P.O. Box 2964
Attleboro, MA 02703-0964

(508) 236-3800

E I DUPONT DE NEMOURS & CO
US ROUTE 23 PO BOX 89
CIRCLEVILLE OH 43113

DECEMBER 23, 1997

ATTENTION: EDWARD C. McKENZIE

SUBJECT: NONCONFORMANCE NOTICE # 2026

Attached, please find our Corrective Action Request for the referenced Quality Nonconformance Notice. This product or material was rejected because it did not fully meet drawing or purchase order requirements. Texas Instruments Incorporated is requesting that you respond to this request within fifteen days, in writing, with your plans for containment; your definition and verification of root causes; actions taken to prevent recurrence; and, an outline of permanent corrective actions. Your response will be reviewed by Procurement Quality Assurance, Quality Engineering, Design and Manufacturing Engineering, Purchasing, and appropriate Managers for the adequacy of your actions, and the effectiveness of your long term solutions.

The diagnostic process and development of a permanent corrective action plan may take longer than the fifteen days this corrective action procedure allows. If so, please submit your interim corrective action plan and return the attached forms to Texas Instruments Incorporated indicating your plans for permanent corrective action and expected completion date. *(Please submit your response on the enclosed form.)*

Texas Instruments Incorporated expects that as a valued Supplier, you will research the problem, identify the cause, indicate the specific corrective action plan and effectivity date, and submit your response in a timely manner. If your manufacturing process or tooling is incapable of meeting our product specifications, it is expected that you will notify your Texas Instruments Incorporated Purchasing representative immediately, and so indicate this on your response to Procurement Quality Assurance.

In addition to other performance indicators, Texas Instruments Incorporated measures the effectivity of Supplier corrective action responses. It is believed that such responses are perhaps the best indicator of the Quality culture present today in our Supplier's facility. Therefore; within the allotted fifteen days, please return the attached two page form to:

Texas Instruments Incorporated • Lorraine Heroux, MS: 11-11, • P.O. Box 2964, • Attleboro, Ma. 02703-0964

Thank you for your continued support and your commitment to our partnership in Quality.

Sincerely,

MATERIALS & CONTROLS GROUP
Procurement Quality Assurance

Lorraine F. Heroux

Lorraine F. Heroux, PQA Clerk
MS: 11-11 (508) 236-3457
Fax #: (508) 236-3788

Copy: Mark L. Godbout, PQA Technician

DIVNHTSA No. 4
00117

DuPont Films

DUPONT FILMS
P.O. BOX 89
CIRCLEVILLE, OH 43113
TEL. 800-967-5607
FAX. 800-879-4481

FACSIMILE TRANSMISSION SHEET
DATE:

ADDRESSEE(S): NAME	COMPANY/BUSINESS GROUP	FAX NUMBER
LORRAINE HEROUX	TI	508-236-3788

SENDER: NAME	BUSINESS SECTOR	LOCATION
Ed McKenzie	DuPont HPF	Circleville

- 2 PAGES TO FOLLOW THIS SHEET

SPECIAL INSTRUCTIONS/INFORMATION TO RECIPIENT:

Apologize for Delay - as I am currently changing assignments. Please send future correspondence to

MARK McALLISTER
SR. TECHNICAL SERVICE REPRESENTATIVE

DUPONT
RT 23 SOUTH AND DUPONT RD
P.O. BOX 89
CIRCLEVILLE OH 43113
PH. 614-474-0725
FAX 614-474-0680

Thanks,
Ed

CIRCLEVILLE FAX NUMBER FOR THIS TRANSMISSION IS 1-800-879-4481
SHOULD PROBLEMS OCCUR WHILE SENDING, CONTACT 1-800-967-5607

CONFIDENTIALITY NOTE

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DD/NHTSA No. 4
08118

Materials & Controls
Supplier Corrective Action Request

NOTE: YOUR CORRECTIVE ACTIVE RESPONSE IS DUE 15 WORKDAYS AFTER RECEIPT OF THIS REQUEST AT YOUR FACILITY.

RETURN TO:
Lorraine Hersey MS: 11-11
Texas Instruments Incorporated
34 Forest St. P.O. Box 2964
Attleboro, Ma.
027830964

PREPARATION DATE: DECEMBER 23, 1997

[illegible]	E I DUPONT DE NEMOURS & CO	[illegible]	74224-1
[illegible]	EDWARD C. McKENZIE	[illegible]	2026

PLEASE ADDRESS APPROPRIATE CATEGORIES BELOW: * INDICATES SUPPLIER TO ADDRESS

1. A.) TEXAS INSTRUMENTS INCORPORATED MRB MEMBERS & APPROPRIATE MANAGERS

BUYER: JULIE POMBO MS: 23-4 ◆ _____ MS:
◆ _____ MS: ◆ _____ MS:
◆ _____ MS: ◆ _____ MS:

* 1. b.) SUPPLIER IDENTIFIED SUB-TIER SUPPLIERS: (WRITED NONE, IF NONE

NAME: NONE ADDRESS (IF APPLICABLE): _____

*2. **DESCRIPTION OF NONCONFORMANCE:**

MANUFACTURING DATE: 11/25/97 LOT NUMBER (IF APPLICABLE): ITEM 44672

ATTRIBUTE SPECIFICATION POOR EDGE CUT/RIPPLE +/- _____ ACTUAL: _____

OTHER: _____

*3. **CONTAINMENT:** SHORT TERM FIX PROBLEM, ISOLATE PRODUCT & DATE

1. REVIEWED STATUS OF FINISHED PRODUCT INVENTORY - ALL CONFORMED TO SPEC.
2. REVIEWED COMPLAINT W/ PROD SUPERVISION AND OPERATORS
COMPLETE ON 1/6/98

*4. **DEFINE AND VERIFY ROOT CAUSE:** ANALYZE AND PROPOSE SOLUTION

POOR EDGE CUT, RIPPLE CAN BE CAUSED BY SEVERAL MACHINE/EQUIPMENT CONDITIONS, SUCH AS TOO MUCH TENSION, DULL KNIVES, CUTTING SURFACE TOO DEEP, ALL SET BY THE OPERATOR.
MOST LIKELY CAUSE - OPERATOR DID NOT FOLLOW SOC'S AND/OR BEST PRACTICES; OPERATOR TRAINING NOT COMPLETE.

RETRAIN OPERATOR ON BEST PRACTICES AND STANDARD MACHINE CONDITIONS FOR TI ROLLS, PART NO. 74224-1

DIMNITSA No. 4
00119

*5. **PERMANENT CORRECTIVE ACTION:** SOLUTION THAT ADDRESSES CORRECTIVE ACTION, DATE TO BE IMPLEMENTED, AND DATE CORRECTED PART TO BE SHIPPED OR PROCESS TO BE FOLLOWED.

1) BEST PRACTICES EXIST, AS WELL AS STANDARD MACHINE CONDITIONS (BUPLIT SOC # 0004)
2) PUBLICIZE AND RETRAIN AS NEEDED. - 1/28/98 COMPLETE
3) ADD CRITICAL CUSTOMER MESSAGE, TO EACH PLANT ORDER TO REMIND OPERATORS & INSPECTORS OF CUSTOMER REQUIREMENTS
4) ADD "NO EDGE RIPPLE ALLOWED" SPECIFICATION.

*6. **VERIFICATION:** DEFINE TEST / ANALYSIS OF ROOT CAUSE TO ENSURE CORRECTIVE ACTION

1. INCREASED AUDIT BY FINISHING SUPERVISOR AND TECHNICAL SERVICE THRU 1998.

*7. **CONTROL:** ENSURE CORRECTIVE ACTION REMAINS IN EFFECT (MONITOR PROCESS)

1. INCREASED INSPECTION.

*8. **PREVENTION:** EXPLAIN ACTIONS TAKEN TO PREVENT REOCCURANCE

1. AS EDGE WAVE/RIPPLE IS VISUAL DEFECT IN SINGLE SHEET (NOT VISIBLE IN ROLL) ACTIONS TAKEN ABOVE ARE TO RETRAIN OPERATORS & INSPECTORS TO TAKE ADDITIONAL CARE IN SET UP AND INSPECTION OF PRODUCT.

SUPPLIER'S AGENT: EDWARD C. MCKENZIE **TITLE:** TECHNICAL SPECIALIST

AGENT'S SIGNATURE: Edward C. McKenzie **DATE COMPLETED:** 2/9/98

TEXAS INSTRUMENTS INCORPORATED PQA & MRB REVIEW:

☐ *THIS SUPPLIER CORRECTIVE ACTION RESPONSE HAS BEEN APPROVED BY PROCUREMENT QUALITY ASSURANCE, AND HAS BEEN DISTRIBUTED TO ALL IDENTIFIED IN SECTION* 1.a

Congratulations to all participants for this accomplishment!

PQA INITIALS & DATE: _____

☐ THIS SUPPLIER CORRECTIVE ACTION RESPONSE HAS NOT BEEN APPROVED BY PROCUREMENT QUALITY ASSURANCE, BECAUSE:

☐ A SECOND RESPONSE HAS BEEN REQUESTED ON: _____

☐ THE MRB DOES NOT ACCEPT THIS CORRECTIVE ACTION AND HEREBY REQUEST THAT PROCUREMENT QUALITY ASSURANCE ISSUE AN ADDITIONAL REQUEST FOR CORRECTIVE ACTION.

REQUESTED BY: _____

☐ THE MRB IS HEREBY ALERTED TO A LESS THAN 100% EFFECTIVE CORRECTIVE ACTION, AND MAY REQUEST AN ADDITIONAL SUPPLIER RESPONSE THROUGH THE APPROPRIATE BUYER.

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 DICG	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. - 614-474-9680, Verification No. 614-474-9445

SPECIAL INSTRUCTIONS/INFORMATION TO RECIPIENT:

**** *CONFIDENTIALITY NOTE* ****

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DD/NHTSA No. 4
60121

DuPont Circleville
P.O. Box 69
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 McAleer
Sr. Tech Service Rep. Kapton®
740-474-0725

mam 2/23/99

DD/NHTSA No. 4
06122

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. - 614-474-9680, Verification No. 614-474-8445

SPECIAL INSTRUCTIONS/INFORMATION TO RECIPIENT:

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(rev.4/98)

CHEMICAL EXPOSURE DATA ON KAPTON

CHEMICAL EXPOSURE DATA ON 100KN AND 200 KN

CHEMICAL		TIME	TEMP.	% PROP. RETAINED		
				TENSILE	ELONG.	MODULUS
ACETONE		1 YR.	RM.	87	72	100
ACETONE		84 DAYS	80 C	100	100	100
ANILINE		34 DAYS	118 C	88	69	102
AMMONIA/HYDROX.		2 DAYS	RM		SUBMERGED	
AMMONIA	(4).	1 YR	200 C	100	83	112
BENZENE		1 YR	RM	100	83	100
BENZENE		84 DAYS	80 C	100	100	104
CHLOROFM		34 DAYS	138 C	100	93	103
CHLOROBENZENE		1 YR	RM	85	85	100
CHLOROBENZENE		84 DAYS	130 C	100	100	98
CHLOROFORM		1 YR	RM	98	74	84
CHLOROFORM		84 DAYS	60 C	100	100	100
DIBUTYL PHTHAL		8 DAYS	100 C	81	86	102
DMF		1 YR	RM	81	88	88
DMF		1 WK DMF	153 C	0	0	0
DOW SILICONE-VARSOL 1492		48 HRS	350 C	VARSOL DEGRADES		
DOW SILICONE-VARSOL 1492		96 HRS	350 C	100	98	114
H2O4 PHOSPHOR.		1 YR	RM	91	77	130
H2O4 PHOSPHOR.		7 DAYS	100 C	83	10	134
FERRIC CHLORIDE	(3).	28 DAYS	30 C	99	94	99
GLACIAL ACETIC		34 DAYS	118 C	88	82	105
HEXANE		1 YR	RM	97	89	100
HEXANE		84 DAYS	66 C	100	100	114
JP-4 JET FUEL	(2)	181 DAYS	RM	84	88	94
JP-4 JET FUEL		30 DAYS	100 C	84	70	112
KEROSENE		1 YR	RM	100	73	140
KEROSENE		84 DAYS	66 C	100	100	100
P-CRESOL		32 DAYS	100 C	100	77	102
SPD. HYDRAT. 104		2 DAYS	RM		DISSOLVES	
HYDROX.	(1).	181 DAYS	RM	86	90	88
HYDROX.		14 DAYS	200 C	76	93	76
HYDROX.- DECOMPOSED		2 DAYS	315 C	81	10	92
SULFURIC ACID 104		181 DAYS	RM	78	71	83
TOLUENE		1 YR	RM	84	68	87
TOLUENE		28 DAYS	110 C	83	72	88
TRANSF. OIL	(5).	6 MOS	150 C	100	100	100
WATER		28 DAYS	138 C	100	83	109
WATER DS-1		108 HRS	100 C		81	
WATER DS-18		108 HRS	100 C		48	

** IN AIR AND IN DEG VERSION OF WATER
IF WATER AND AIR ARE REMOVED, LIFE IS EXPECTED CONSIDERABLY
(95 % RETA @ 180 C)

(1) REPRESENTS FLUID (UNSPECIFIED)

(2) NOVEMBER 1962, JET FUEL

(3) SATURATED SOLUTION OF FeCl3 + 6.3% DOWTHERM SOLVENT

(4) CHLORINATED DIPHENYL (TRANSFORMER OIL)

(5) HYDROGENATED 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), 50% 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	Cyclohexanone	Hydrofluoric acid	Phthalic acid
Acetic acid	Dibutyl phthalate	Hydrogen peroxide	Pinene
Acetic anhydride	Dibutyl sebacate	Lead	Piperidene
Acetone	Diethyl carbonate	Magnesium chloride	Polyacrylonitrile
Acetophenone	Diethyl ether	Mercury	Potassium acetate
Acrylic anhydride	Dimethyl formamide	Methyl ethyl ketone	Potassium hydroxide
Allyl acetate	Di-isobutyl adipate	Methacrylic acid	Potassium permanganate
Allyl methacrylate	Dimethylformamide	Methanol	Pyridine
Aluminum chloride	Dimethylhydrazine, unsymmetrical	Methyl methacrylate	Soap and detergents
Ammonia, liquid	Dioxane	Naphthalene	Sodium hydroxide
Ammonium chloride	Ethyl acetate	Naphthols	Sodium hypochlorite
Aniline	Ethyl alcohol	Nitric acid	Sodium peroxide
Benzonitrile	Ethyl ether	Nitrobenzene	Solvents, aliphatic and aromatic**
Benzoyl chloride	Ethyl hexoate	2-Nitro-butanol	Stannous chloride
Benzyl alcohol	Ethylene bromide	Nitromethane	Sulfur
Borax	Ethylene glycol	Nitrogen tetroxide	Sulfuric acid
Boric acid	Ferric chloride	2-Nitro-2-methyl propanol	Tetrabrom ethane
Bromine	Ferric phosphate	n-Octadecyl alcohol	Tetrachlorethylene
n-Butyl amine	Fluoronaphthalene	Oils, animal and vegetable	Trichloroacetic acid
Butyl acetate	Fluoronitrobenzene	Ozone	Trichlorethylene
Butyl methacrylate	Formaldehyde	Perchlorethylene	Tricresyl phosphate
Calcium chloride	Formic acid	Pentachloro-benzamide	Triethanolamine
Carbon disulfide	Furane	Perfluoroxylene	Vinyl methacrylate
Cetane	Gasoline	Phenol	Water
Chlorine	Hexachlorethane	Phosphoric acid	Xylene
Chloroform	Hexane	Phosphorus pentachloride	Zinc chloride
Chlorosulfonic acid	Hydrazine		
Chromic acid	Hydrochloric acid		
Cyclohexane			

*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

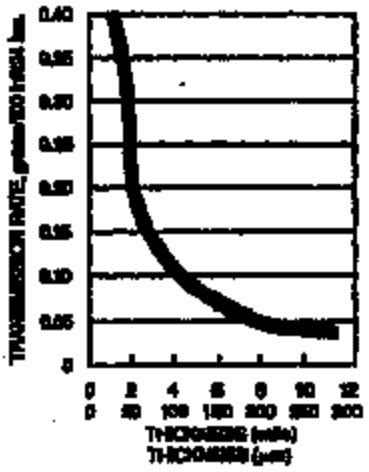
Many gases and vapors permeate FEP films at a much lower rate than for other thermoplastics (see Figure 13). In general, permeation increases with temperature, pressure, and surface contact area and decreases with increased film thickness. Table 6 lists rates at which various gases are transmitted through 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* $cm^3/(m^2 \cdot 24\ h \cdot atm)$
Carbon Dioxide	25.9×10^3
Hydrogen	34.1×10^3
Nitrogen	5.0×10^3
Oxygen	11.8×10^3

*To convert to $cm^3/(100\ in^2 \cdot 24\ h \cdot atm)$, multiply by 0.0646.

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 in^2 to those for 1 m^2, 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	Temperature °F	Vapor Transmission Rate SI Units ($g/m^2 \cdot d$)	Vapor Transmission Rate English Units ($g/100\ in^2 \cdot d$)
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^{-6}
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.

DD/NHTSA No. 4
00127

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), 50% 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	Cyclohexanone	Hydrofluoric acid	Phthalic acid
Acetic acid	Dibutyl phthalate	Hydrogen peroxide	Pine oil
Acetic anhydride	Dibutyl sebacate	Lead	Piperidine
Acetone	Diethyl carbonate	Magnesium chloride	Polyacrylic acids
Acetophenone	Diethyl ether	Mercury	Potassium acetate
Acrylic anhydride	Dimethyl formamide	Methyl ethyl ketone	Potassium hydroxide
Allyl amine	Di-isobutyl adipate	Methacrylic acid	Potassium permanganate
Allyl methacrylate	Dimethylformamide	Methanol	Pyridine
Aluminum chloride	Dimethylhydrazine, unsymmetrical	Methyl methacrylate	Soap and detergents
Ammonia, liquid	Dioxane	Naphthalene	Sodium hydroxide
Ammonium chloride	Ethyl acetate	Naphthol	Sodium hypochlorite
Aniline	Ethyl alcohol	Nitric acid	Sodium peroxide
Benzonitrile	Ethyl ether	Nitrobenzene	Solvents, aliphatic and aromatic**
Benzoyl chloride	Ethyl hexane	2-Nitro-butanol	Stannous chloride
Benzyl alcohol	Ethylene bromide	Nitromethane	Sulfur
Borax	Ethylene glycol	Nitrogen tetroxide	Sulfuric acid
Boric acid	Ferric chloride	2-Nitro-2-methyl propanol	Tetrairon octaoxide
Bromine	Ferric phosphate	n-Octadecyl alcohol	Tetrachloroethylene
n-Butyl amine	Fluoronaphthalene	Oils, animal and vegetable	Trichloroacetic acid
Butyl acetate	Fluoronitrobenzene	Ozone	Trichloroethylene
Butyl methacrylate	Formaldehyde	Pentachloroethylene	Triaryl phosphate
Calcium chloride	Formic acid	Pentachloro-benzamide	Triethanolamine
Carbon disulfide	Furane	Perfluorocyclene	Vinyl methacrylate
Cesane	Gasoline	Phenol	Water
Chlorine	Hepachlorethane	Phosphoric acid	Xylene
Chloroform	Hexane	Phosphorus pentachloride	Zinc chloride
Chlorosulfonic acid	Hydrazine		
Chromic acid	Hydrochloric acid		
Cyclohexane			

*Based on experience conducted up to the boiling point 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.

TI-001467

Page 1

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

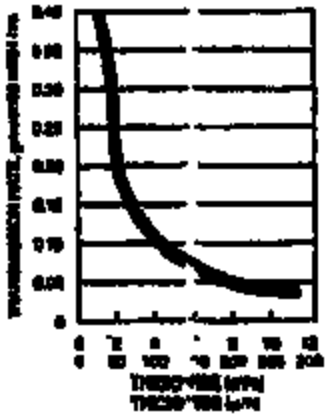
Many gases and vapors permeate FEP films at a much lower rate than for other thermoplastics (see Figure 13). In general, permeation increases with temperature, pressure, and surface contact area and decreases with increased film thickness. Table 6 lists rates at which various gases are transmitted through 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·s·atm)
Carbon Dioxide	26.9 × 10⁻⁹
Hydrogen	34.1 × 10⁻⁹
Nitrogen	5.0 × 10⁻⁹
Oxygen	11.6 × 10⁻⁹

*To convert to cm³/(100 in² · 24 h · atm), multiply by 6.4516.

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



Notes: Values are average 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	Temperature °F	Vapor Transmission Rate SI Units g/(m²·s)	Vapor Transmission Rate 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	10.3
Sodium Hydroxide, 50%	25	77	<0.2	<0.01
Sulfuric Acid, 98%	25	77	2 × 10⁻⁴	1 × 10⁻⁴
Water	39.5	103	7.0	0.45

TI-001468

Page 2

DD/NHTSA No. 4
00139

CHEMICAL PROPERTIES DATA ON KAPTON

CHEMICAL PROPERTIES DATA ON [illegible]

CHEMICAL		TIME	TEMP.	RESULTS	TIME, MINUTES	RESULTS
[illegible]		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	(4).	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]

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.

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 temperature and pressure.

In circumstances where end-use temperatures are close to the upper service limit 205°C (400°F), 30% 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 on-service use under actual end-use conditions.

The chemical substances listed in Table 6 are representative of those with which DuPont FEP film has been found to be nonreactive.

Table 6
Typical Chemicals with Which DuPont FEP Film is Nonreactive*

Abietic acid	Cyclopentanone	Hydrofluoric acid	Picric acid
Acetic acid	Dibutyl phthalate	Hydrogen peroxide	Pinene
Acetic anhydride	Dibutyl sebacate	Lard	Pip ridine
Acetone	Diethyl carbonate	Magnesium chloride	Potassium iodide
Acetophenone	Diethyl ether	Mercury	Potassium acetate
Acrylic anhydride	Dimethyl formamide	Methyl ethyl ketone	Potassium hydroxide
Allyl acetate	Di-isobutyl adipate	Methacrylic acid	Potassium Ferricyanide
Allyl methacrylate	Dimethylformamide	Methanol	Pyridine
Aluminum chloride	Dimethylhydrazine, unsymmetrical	Methyl methacrylate	Soap and detergents
Ammonia, liquid	Dioxane	Naphthalene	Sodium chloride
Ammonium chloride	Ethyl acetate	Naphthene	Sodium hypochlorite
Aniline	Ethyl alcohol	nitric acid	Sodium phenolate
Benzene	Ethyl ether	Nitrobenzene	Sodium sulfide, alkaline and polysulfide**
Benzoyl chloride	Ethyl hexane	2-Nitro-butanol	Stannous chloride
Benzyl alcohol	Ethylene bromide	Nitromethane	Sulfur
Borax	Ethylene glycol	Nitrogen tetroxide	Sulfuric acid
Boric acid	Ferric chloride	2-Nitro-2-methyl propanol	Tetrahydrofuran
Bromine	Ferric phosphate	n-Octadecyl stearate	Tetrachloroethylene
n-Butyl amine	Fluorocarbon gas	Oils, animal and vegetable	Trichloroacetic acid
Butyl acetate	Fluorochlorocarbon gas	Ozone	Trichloroethylene
Butyl methacrylate	Formaldehyde	Perchloroethylene	Triethanol amine
Calcium chloride	Formic acid	Perchloroethylene-carbonate	Triethyl phosphate
Carbon disulfide	Furfural	Perfluorocyclohexane	Triethanol amine
Catsup	Gasoline	Phenol	Vinyl methacrylate
Chlorine	Hexachlorobenzene	Phosphoric acid	Water
Chloroform	Hexane	Phosphorus pentachloride	Xylene
Chlorosulfonic acid	Hydrazine		Zinc chloride
Chromic acid	Hydrochloric acid		
Cyclohexane			

*Based on laboratory immersion tests at the boiling point of the liquid 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 hydrogenated sulfides may stress crack during flexing.

DD/NHTSA No. 4
00132

3713 1373

PRODUCED BY FORD

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 dimensional.

DuPont FEP fluorocarbon films have unusually low absorption compared with other thermoplastics. They absorb potentially no aqueous 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

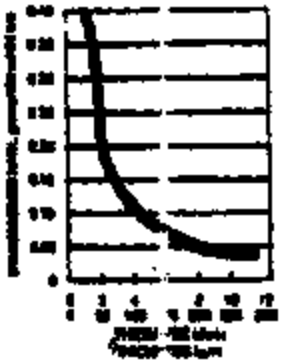
Many gases and vapors permeate FEP films at a much lower rate than for other thermoplastics (see Figure 13). In general, permeation increases with temperature, pressure, and surface contact area and decreases with increased film thickness. Table 6 lists rates at which various gases are transmitted through 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 40°C [77°F])

Gas	Permeability Rate* cm³/(m²·24 h·atm)
Carbon Dioxide	35.8 × 10⁻³
Hydrogen	34.1 × 10⁻³
Nitrogen	5.8 × 10⁻³
Oxygen	11.8 × 10⁻³

*To convert to cm³/(100 in² · 24 h·atm), multiply by 3.8646.

Figure 13. Water Vapor Transmission Rate of DuPont FEP Film at −9°C (16°F) w ASTM E-96 Procedure



Notes: Values are average 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)

Vapor	Temperature °C	Temperature °F	Vapor Transmission Rate SI Units g/(m²·24 h)	Vapor Transmission Rate English Units g/(100 in²·24 h)
Acetic Acid	25	77	0.3	0.01
Acetone	25	77	14.7	0.95
Benzene	25	77	9.8	0.64
Carbon Tetrachloride	25	77	4.8	0.31
Ethyl Acetate	25	77	11.7	0.76
Ethyl Alcohol	25	77	10.7	0.69
Freon® F-12	25	77	372.0	24.0
Hexane	25	77	9.7	0.63
Hydrofluoric Acid	25	77	<0.3	<0.01
Nitric Acid (Red Fuming)	25	77	160.0	10.3
Sodium Hydroxide, 50%	25	77	<0.3	<0.01
Sulfuric Acid, 98%	25	77	2 × 10⁻³	1 × 10⁻⁴
Water	38.5	102	7.9	0.49

Page 2

3713 1374

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DIMHTSA No. 4
00133

on KAPTON

Page 3

3713 1375

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DD/NHTSA No. 4
00134

OXALIC ACID TEST AVGS.

500FN131

		MODULUS	TENSIL	ELONG.												
CONTROL		317.8	26.2	112.9												
		ROOM TEMPERATURE								IN DRINKING O						
		0.9% SOLUTION				0.9% SOLUTION				0.9% SOLUTION				0.9% SOLUTION		
		MODULUS	TENSIL	ELONG.		MODULUS	TENSIL	ELONG.		MODULUS	TENSIL	ELONG.		MODULUS	TENSIL	ELONG.
100 HRS.		300.9	25.18	115		304.1	26.87	119.9		309.1	18.98	59.78		314.4	17.1	40.71
500 HRS.		327.4	26.78	111.7		350.1	25.3	107.5		341.2	14.88	16.5		345	13.83	13
2372 HRS.		321.7	23.48	95.36		323.5	21.76	82.07		345.8	9.841	4.398		355.1	10.07	4.134
3312 HRS.		314.9	22.17	89.41		314.8	21.51	81.90		285.3	9.577	4.049		341.9	9.075	3.274
5088 HRS.		221.3	16.51	100.1		228.9	18.36	83.49		282.9	0	6.7		284.8	8.539	4.386
6594HRS		317.5	22.49	69.57		302.8	16.72	64.05		376.5	9.389	2.598		Failed	Failed	Failed

OXALIC ACID TEST AVGS.

300FN929

	MODULUS	TENSIL	ELONG.
CONTROL	347.7	23.65	65.58

	ROOM TEMPERATURE						IN DEGREES C					
	0.5% SOLUTION			5.0% SOLUTION			5.0% SOLUTION			5.0% SOLUTION		
	MODULUS	TENSIL	ELONG.	MODULUS	TENSIL	ELONG.	MODULUS	TENSIL	ELONG.	MODULUS	TENSIL	ELONG.
100 HRS.	363.7	31.21	94.38	382.3	31.05	86.87	362	24.15	57.26	356	21.42	41.45
500 HRS.	382.8	30.06	86.69	388.2	31.31	81.79	421.1	19.14	21.89	408.1	16.76	13.66
2372 HRS.	382.8	27.77	76.82	382.2	26.79	74.85	421.1	12.89	9.311	422.8	12.96	6
3212 HRS.	409.4	26.69	76.53	374.4	25.36	64.21	409.4	13.36	6.555	416.9	10.30	3.103
5000 hrs	301.8	28.74	90.6	311.8	24.98	66.66	317.6	13.2	6.527	327	0	4.749
6694 HRS	356.7	28.84	70.41	379.0	22.57	44.47	481.9	12.98	3.996	0	0.209	0.0666

jaw

05/11/09

OXALIC ACID TEST AVGS.

300HN

	MODULUS	TENSIL	ELONG.
CONTROL	451.2	36.28	94.91

	ROOM TEMPERATURE						30 DEGREES C					
	5.0% SOLUTION			8.0% SOLUTION			5.0% SOLUTION			8.0% SOLUTION		
	MODULUS	TENSIL	ELONG.	MODULUS	TENSIL	ELONG.	MODULUS	TENSIL	ELONG.	MODULUS	TENSIL	ELONG.
100 HRS.	451.9	35.86	105.4	458.7	34.34	97.57	458.2	28.06	80.11	458.1	24.09	38.18
500 HRS.	494.6	32.21	86.07	476.7	31.28	80.65	515.8	21.28	17.63	518.3	17.91	9.504
2872 HRS.	470.8	31.4	85.86	471	28.85	75.82	509.9	15.33	5.148	516.3	14.18	3.636
3212 HRS.	409.04	29.08	76.83	471	28.84	69.61	466.6	14.3	4.18	472.7	8.839	2.645
5088 hrs	331	27.83	69.71	318.2	28.43	74.08	376.9	12.58	4.578	367.5	3.012	4.151
6524 HRS	483.6	28.62	86.26	494.1	25.5	46.37	605.3	14.8	4.176	488.2	7.462	1.709

DEMENTSA No. 4
06137

jaw

05/11/99

COMMUNICATIONS

Name / Project: MARK McAlees / Dennis Fairley

Company / Department: DuPont

Address: OHIO — FELD PORTER

Phones: 740-470-0725

DATE	TIME	NO.	REPORT/MEMO	RECEIVED/MEMO	INITIALS
			What is Delamination Temp?	Refluxed 268°C (514°F)	
			How can I induce brittleness (in KARTON) shortcut?	Time Temp Change Rate / Temperature 240°C 24 hrs 302 350°C 6 days 12 KAPTON 450° 2 hours 12 Kapton	
			Carona 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?	1988-9 inorganic pyrophosphate additive 1991 DDA & PMDA 1993 release no changes	
			500 HN ENBIL for Auto?	ADDITIONAL INSPECTION Yes 15/20 years	
			Is it suitable for use with DOT3 Brake Fluid?	ethylene glycol on FED STD 400°F no degradation	
			Is there test results for Brake Fluid compat?	"	
				MARK To call BACK With change history etc.	9/28

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3713 2051

DD/NHTSA No. 5
60801

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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 McAleer
Sr. Tech Service Rep. Kapton®
740-474-0725

mmm 2/23/99

DU PONT

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 DICG	T.E	508-236-3586

SENDER:	*BUSINESS SECTOR*	*LOCATION*
MARK MCALEES		

Total Number of Pages (Including Cover Sheet) 2

DuPont, Circleville HPF - SP Resin Fax No. - 614-474-8630, Verification No. 614-474-8445

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DDNHTSA No. 5
00003

DuPont Circleville
P.O. Box [illegible]
Circleville, OH 43113

DUPONT

DuPont Circleville

Porter
EXHIBIT NO. 49

Brian Digg
34 ForestStreet
AudeboroMA, 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 brake 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

Post-It® Fax Note 7671	Date	# of pages ▶
To Brian	From	
Co./Dept. Robinson	Co.	
Phone #	Phone #	
Fax # 313-390-4	Fax #	

Form 3/23/99

F. J. Gil Pen de Bernardo and Associates

DDWHTSA No. 5
00004

TI 0006372

COMMUNICATIONS

Name / Project: PAUL KANE ~~DUPONT~~

Company / Department: DUPONT

Address:

248-583-8107

Phones:

DATE TIME	NO.	MY PLAN / I LAID (NEED ENDORSED / FEEDBACK SOUGHT)	THEY SAID / FOLLOW UP (NEED ENDORSED / FEEDBACK GIVEN)	WHO DATE
10:15 4/1/90		Telecon: Greg Stevens	VØ PRODUCTS WILL CONTINUE TO BURN WHILE HEAT SOURCE IS PRESENT. SELF EXTINGUISHES.	
			- Zenite 6140L 40 Glass LCP FORD APPROVED ON WASHER SYSTEM IS VØ ~600+F Melt Point	
			- Zytel 117N 52G 35 FR Not FORD is VØ, ~540 F Melt Pt	
			PAUL Sending data sheets	
		I CALLED TI and asked them to look into Zenite 6140L		
		Zytel Sample tried at TI.		

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3713 2054

DD/NHTSA No. 5
00005

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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 Rytel HTN FR52G310BL 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

3713 6059

DD/NHTSA No. 5
00006

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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 (19.8)
Elongation at Break	ASTM D 638	%	3
Flexural Modulus	ASTM D 790	MPa (kpsi)	16000 (2400)
Flexural Strength	ASTM D 790	MPa (kpsi)	194 (28.1)
Izod Impact	ASTM D 256	J/m (ft lb/in)	108 (1.9)
Thermal			
Heat Deflection Temperature 1.82MPa (264psi)	ASTM D 648	°C (°F)	282 (540)
Melting Point	ASTM D 3418	°C (°F)	315 (600)
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 (630-680)
Mold Temperature Range		°C (°F)	30-95 (85-200)
Processing Moisture Content		%	<0.01

Measured properties measured at 23°C (73°F)
Contact DuPont for MSDS, general safety under normal [illegible] and ventilation, handling, storage, drying, etc.

During molding, use protective equipment and clothing. Skin contact with molten Zenite™ resins 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.

[illegible]
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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) 441-8378 • Automotive Inquiries (800) 320-1313

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
			DRY
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 Izod	ASTM D 4812	J/m (ft lb/in)	800 (15)
Thermal			
Heat Deflection Temperature	ASTM D 648	°C (°F)	
0.45MPa (66psi)			286 (545)
1.82MPa (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		1.63
Mold Shrinkage		%	
Flow, 1.6mm (0.063in)			0.1
Transverse, 1.6mm (0.063in)			0.9

Contact DuPont for MSDS, general safety and handling information, storage, handling, processing, drying, etc.
Mechanical properties measured at 23°C (73°F) unless otherwise noted.

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.

SD-130UD30
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Zytel® HTNFR52G30BL NC010

Property	Test Method	Units	Value
			DAM
Processing			
Melt Temperature Range		°C (°F)	325-340 (615-644)
Mold Temperature Range		°C (°F)	80-120 (140-248)
Drying Time, Dehumidified Dryer		h	4-6
Drying Temperature		°C (°F)	100 (210)
Air Dew Point		°C (°F)	<-20 (<-4)
Processing Moisture Content		%	<0.1

Contact DuPont for MSDS, general guides (safety additional information about warehouse, handling, pumping, drying, etc.
Mechanical properties measured at 23°C (73°F) unless otherwise stated.

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

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Dial DuPont Fiber (800) 441-8878 • Automotive Inquiries (800) 219-1313

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*************************************************************************
*          Note printed by GSTEVEN1 on 12 Apr 1999 at 07:27:04          *
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From: SREIMERS--DRBN007 Date and time 04/10/99 13:18:02
To: GSTEVEN1--DRBN005 FPORTER --DRBN007 Porter, F.J.

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

Steve Reimers building 3 3E008
EVT Chassis E/E System Applications mail drop 5011
39-03286 SREIMERS sreimers@ford.com fax 39-04145 ;>
*** Forwarding note from PAPCSHEU--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 FR52G30BL 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 160F 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

3713 6058

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DuPont Electronics
DuPont Company
Barley Mill Plaza
P.O. Box 80030
Wilmington, DE 19880-0030

.cc D. Reifschneider
C. Starr
KDL Report

To: Ed McKenzie

9/13/91

From: Mark McAlees

KAPTON DEVELOPMENT LAB REPORT

KDR NO. 91-14

Ed here is the information we talked about for the Texas Instruments job. As you know I have been trying to improve adhesion of 500FN131. To date here are the things we have done with their results.

The control laminate was tested to find out the peel strength. This was done on our in house Instron at 5 inches per minute peel rate. The control sample had an average peel strength of .6 pounds per inch strength.

The first test I ran was to heat the laminate to improve adhesion. The oven was heated to 200 degrees C, then samples were baked for 5 minutes. This increased the adhesion to 1.0 pounds per inch. Next the oven was heated to 300 degrees C and samples were baked for 5 minutes. There were blisters on all five test pieces. I then tried heating the film up slowly in the oven starting at 200 degrees C. With this method only two of the five samples had blisters on them. This tells me that CTS who is heating the laminate to improve adhesion, must be doing it very slowly or have some method that does not cause blistering. The few good samples that were obtained have been tested with an average peel of 2.0 pounds. 2.0 pounds peel strength is at the point of the Teflon beginning to stretch. There is a lot of chatter in chart from the Teflon breaking loose then catching again. Should adhesion be increased beyond this, we will not be able to give you any numbers do to the Teflon elongation.

The last thing that we tried was temperature and pressure. This was accomplished by putting a sample in the 100 ton press, heating it to 235 degree C and pressing at 500 pounds per square inch. Results are not what we had hoped, adhesion may have gotten a little worse down to .4-.5 pounds per inch.

This note is to keep you informed about our progress. Testing will continue to try to improve adhesion and improve the rate in which it can be done. If you have any questions please call.

DUPONT
CIRCLEVILLE

cc: W. Arnett
J Austin
R. Beliveau
P. Campbell
C. C. Chen
T. Clyde
G. Cook
D. Coverdell
W. Hsu
R. Hutton
J. Prinzler
R. O'Connor
A. Riggs
J. Smart
D. Welshimer (4)
C. Paulson - ExpSt 357207
O. Funahiki - TDC Tokai
M. Okabashi - TDC Tokai
File: K-14-t

August 29, 1996

To: E. McKenzie

From: J. Edman

J Edman

300HNH FLEX LIFE ANISOTROPY - MR 8125284

SUMMARY

Flex life anisotropy went from essentially 0 in the center of the mill roll to 35-40% at the edges. This is a significant improvement over standard 300HNH where flex anisotropy at the edges is estimated to be over 100%.

BACKGROUND

Small circles of Kapton®, from 0.5 to 1.0" in diameter, are used as diaphrams in pressure switches. Failures are rare because the average flex life and chemical resistance of Kapton® is outstanding, but flex life responds to chain axis alignment and, as a preventive safety measure, you requested that 300HNH for diaphram switches be isotropic so that circles would not have anisotropic flex behavior as a result of being from a chain edge rather than the center of the sheet.

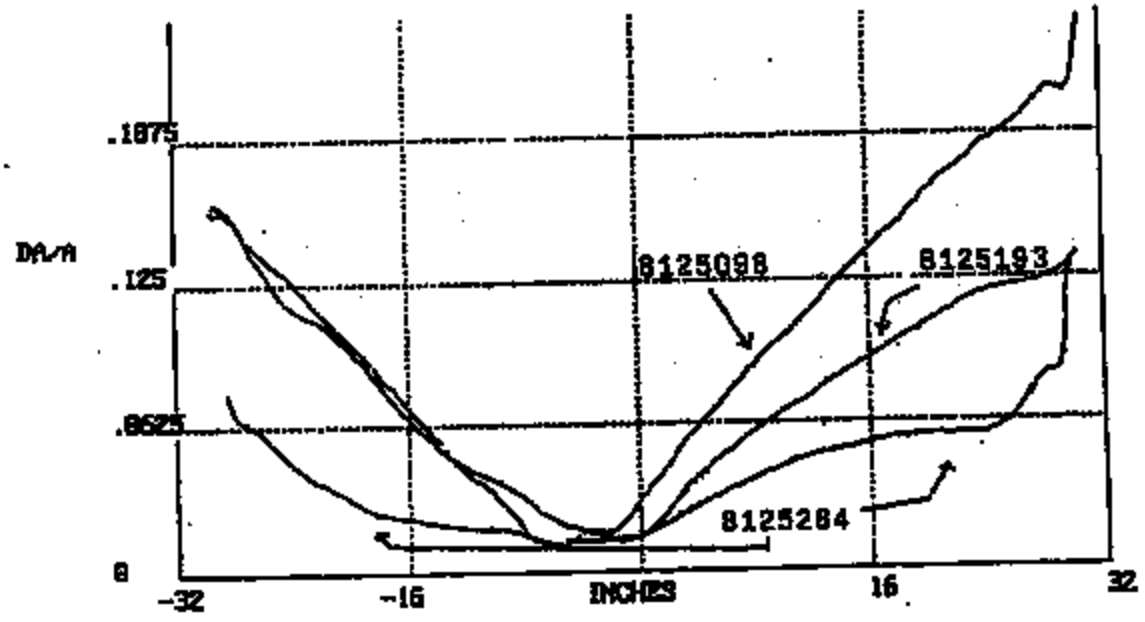
The reason for your concern is Jim Heacock's IPC flex testing of a few years ago in which Jim showed circuits could fail over a range of at least 2x as a function of chain axis alignment. Cycles to failure always were less in the direction of maximum chain axis alignment, the orientation angle in the dichroism measurement, and this explained why HA film performed differently in the MD than the TD. The other parameters that affect flex life are molecular weight (average chain length and chain length distribution), crosslinking, crystallinity and defects. Defects are a special category while molecular weight, crystallinity and crosslinking can be controlled from run-to-run, roll-to-roll and across a roll by specifications on polymer purity and SOC's covering percent solids, polymer viscosity and thermal history.

RESULTS

The reduction in anisotropy obtained by using the vacuum rolls and increasing MDX and TDX is shown in Figure I.

FIGURE I

ΔA/A COMPARISON OF K-1300HNH MILL ROLLS



The stretching conditions for these mill rolls are in Table I.

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(DRB.94752-bw

DUP 000269

TABLE I

K-1 300HNH STRETCHING CONDITIONS

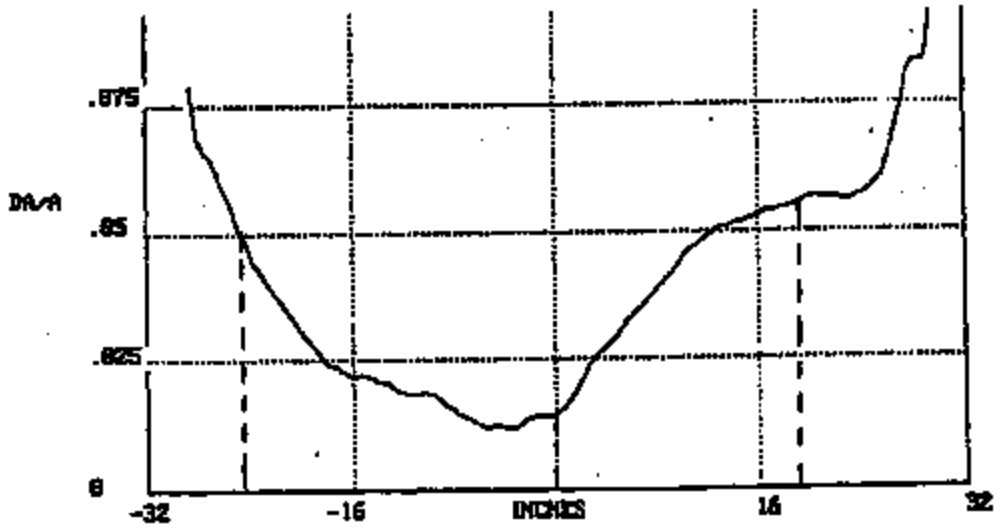
		STATIONS in.					DRAW[1]			
MILL ROLL	DIE WIDTH in.	1	2	3	4	ST4/ST1 TDX	D-SV	SV-FV	FV-TENT.	MDX[2]
8125284	57	48	56.6	59.3	62.64	1.305	1.074	1.12	1.01	1.21
8125098	62	55	60.0	62.8	63.4	1.15	-	-	-	1.15
8125193	62	54	61.6	62.8	63.6	1.18	-	-	-	1.15

1. SV = Slow Vacuum Roll, FV = Fast Vacuum Roll.
2. Tenter FPM/Drum FPM

Mill rolls 8215098 and 8125193 were cast without deckles while 2.5" deckles were in place for 8125284. The cast width is important in making isotropic film because there is a minimum TDX at which > 95% of the width will be below 0.05 ΔA/A and that minimum TDX will be slightly different for each gage and type on each line. TDX, by definition, is the widest tenter width (ST #4) ÷ the entrance width (ST #1) and the entrance width is a function of die width and MD draw (MDX) and how the MD draw is partitioned.

Bill Arnett cut three MD and three TD samples for flex testing at the locations shown in Figure II. Note the scale on the Y axis is different in Figure II than in Figure I.

FIGURE II
AA/A for 300HNH 8125284



(JRE.9573:lne

DUP 000270

In order to measure flex anisotropy, samples have to be cut along the optical axis, the direction of maximum chain axis alignment, and perpendicular to the optical axis. MD (0°) and TD (90°) are the angles of maximum and minimum alignment at 0", the center of the sheet, but at the TE location, -24.6", the max. and min. are at approximately +25" and -65" as determined by crossed polarizers and at the NTE location, + 20.8", max. and min. are approximately -30° and + 60°. Bill cut additional samples at these angles and the averages of the three samples in each direction are in Table 2.

TABLE 2

MIT FLEX CYCLES 300HNH MR #8125284

	TE (-24.6")	C (0")	NTE (+20.8")
MD	12,547	10,381	11,124
TD	12,506	10,172	11,499
∥[1]	9,340	10,381	9,059
⊥[2]	14,450	10,172	12,970
AVERAGE	12,210	10,276	11,163
Δ	5,110	209	3,911
Δ • 100/AV	42%	2%	35%

1. Parallel to the optical axis - i.e. maximum chain axis alignment.
2. Perpendicular to the optical axis - i.e. minimum chain axis alignment.

This is the first time we've measured MIT flex life anisotropies on 300HNH and considerable additional testing would have to be done to claim a quantitative correlation between ΔA/A and Δ flex life. Qualitatively, however, percent anisotropy increases, as expected, in going from 0.015 ΔA/A in the center to ≥ 0.05 ΔA/A at the TE and NTE. I would expect flex anisotropies, based on these measurements, to be well over 100% toward the edges of mill rolls 8125098 and 8125193. Although we have not measured flex anisotropy in the past, we did measure average flex lives, (MD + TD)/2, on 3 mill films in 1994 and I've attached a copy of that report for you. The average flex lives across MR 8125284 are typical based on previous testing. The differences between the averages in the center, NTE and TE, if they proved to be statistically valid with more testing, are most easily explained by small differences in crystallinity due to thermal history.

THE FUTURE

The reduction in anisotropy at approximately 1.30 TDX and only 1.21 MDX is impressive. I believe that by simply redistributing MDX to 1.08 SV-FV and 1.05, FV-tenter and increasing TDX to 1.35 (65"/48"), ΔA/A, over > 95% of the mill roll, would be well below 0.05 ΔA/A. I can't think of a single customer who would object to this improvement in uniformity and, as in the case of your diaphram application, it could prevent functionality problems in the future, or, at the least, simplify trouble shooting if problems arise. The barrier to making 3 mil, and for that matter, all H films "isotropic" is the productivity penalty if we rewrite the MDX and TDX SOC's today. It's one thing for me to say "simply redistribute MDX and increase TDX to 1.35" and it's another thing for the Line Engineers and Class 10's to do that without jeopardizing runnability, disrupting TD gage and maybe even being out on unit weight. However, each time we respond to a request such as yours we gain experience and ultimately we'll have a control system that allows the operator to dial in MDX and MD draw distribution and TDX and the adjustments will happen automatically, controlled by a program based on best practices.

To: Doug Wells
From: Mark McAlees

Background

In fourth quarter 1989 Bill Alzos started work on Kapton automotive fluids test program. On February 20, 1990 the first Engineering request form was signed. In mid April I took over responsibility for the program. Wednesday May, 16 we started the program at the Engineering Test Center. Chemical exposure went from mid May to mid September. Testing of samples started June, 1990 and went to mid October. I started working on spread sheet for the data in September and finished around mid November. All of the data that collected by me is in spread sheet now. The data that was gotten by Carl Killian is now being put onto my spread sheet. Carl is responsible for all the Pyralux samples that were tested. The estimated cost to the Kapton group is 17,500.

Conclusion

The automotive fluid test program was a success. Kapton did well in most fluids tested. With the exception of Methanol based fluids Kapton could be used in any fluid tested. Methanol fluids were not bad at room temperatures, but I believe more testing should be done.

Recommendation for additional fluid tests

This is a list of fluids that have already been requested by Du Ponters or customers. There are probable many more but these are the ones that have been brought to my attention.

* Methanol fuels (continue testing)
* Diesel fuel
* Gasoline
* Hydraulic fluid
* Kerosene
* OEM Brake fluid (silicon additive, Astroseal)

The automotive test program has come to a temporary conclusion. This is to summarize the results that have been gathered to date. When this test program was conceived it was much smaller, by the time testing began it had grown to this point. The test program include these items.7 polyimide films, 11 automotive fluids, 19 laminates, 6 exposure times, 4 tests and multiple test points on every sample. Here are some of the items in the program.

The films used in this program were.

1) 300HN
2) 300EP
3) 300HMK
4) 3 MIL UBE-S
5) 100EP LF-0111 (5457-0616)
6) 100HMK LF-0111 (5457-0677)
7) 1 MIL UBE-S

This is the list of fluids used in our testing and there specifications.

1) M-85 * 85% Methanol/7.5% Tolulene/7.5%Iso-octane at room temperature.
2) M-15 * 15% Methanol/42.5% Tolulene/42.5% Iso-octane at room temperature.
3) ATF * Dexron ATF Off shelf at 300 degree F.
4) GM SOUR GAS * Indolene HO3(amoco)/ .0028% T-BUTYL Hydroperoxide (90%) at room temperature.
5) BRAKE FLUID * "Berkebile 2+2" Dot-3 at room temp.
6) ANTIFREEZE * "Peak" Full concentration at room temp.
7) DETERGENT * "JOY" Dish liquid 50% concentration in water at room temperature.
8) SALT SOLUTION * Saturated 1511.7 grams NaCL / 13602.3 grams tap water at room temperature.
9) BATTERY ACID * H2SO4 off shelf - spec.grav. =1.265 at room temperature.
10) ISOPROPYL ALCOHOL * Full concentration at room temp.
11) 1,1,1 TRICHLOROETHANE * Full concentration at room temperature.
12) CAUSTIC CLEANER (PH>10) * Tap water/0.05% Trisodium Phosphate at room temperature.

The times that were used for chemical exposure are.

* 0 (control)
* 48 hours
* 100 hours
* 250 hours
* 500 hours
* 750 hours
* 1000 hours

The laminates used in this program, provided by Carl Killian. These were used for peel strength of .20 & .125 inch conductors.

* LF-9111 9788-7191 HMK
* RA-7 (AE) BAY-13-TN-9070952
* RA-7 SOMERS LOT# 23310 ROLL# 108902
* HMK LOT# 9787-7191
* ED-2 (PINK) JG2B HI DUCT# 9096793
* LF-9111 9788-7191 EP
* SHELDAHL
* EP
* SOMERS EXPERIMENTAL (SX)
* RA-8 (D) BHC-13-T LOT-3 A3
* STANDARD GOULD SG
* LR-8510 RA-7 FOIL 857-40
* LR-8510 RA-8 FOIL 858-40
* RA-8 (AE) BHY-12-TN-9070951
* LR-9111 ED FOIL
* LR-9111 RA-8 FOIL
* STANDARD SOMERS
* NIKAFLEX
* THERMOUNT

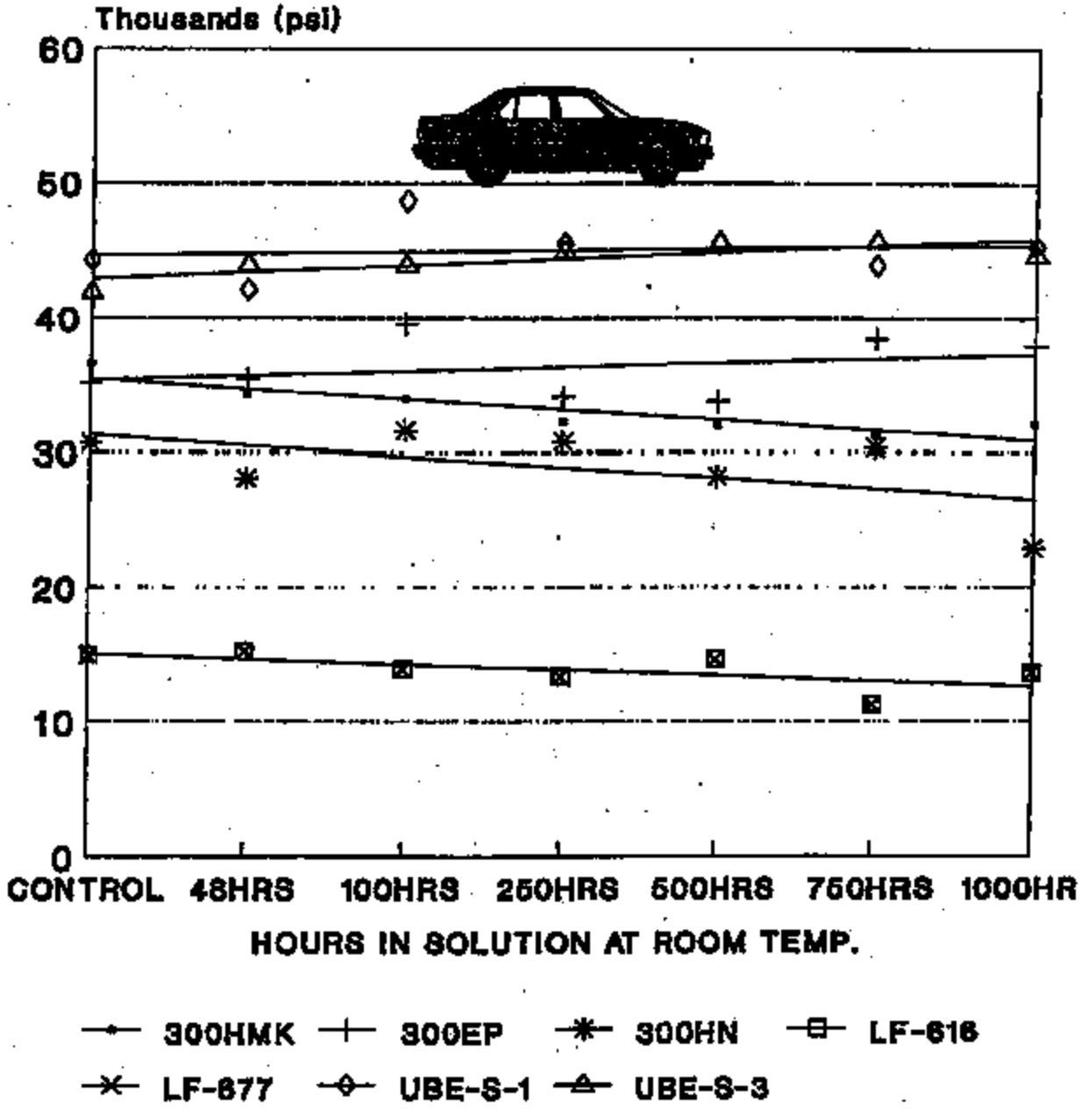
Tests that can be run and tests that have already been completed.

* TENSILE
* ELONGATION
* MODULES
* PEEL STRENGTH (.20 INCH)
* PEEL STRENGTH (.125 INCH)
* INITIATING TEAR
* SWELL
* FLEX ENDURANCE
* MOISTURE & INSULATION RESISTANCE

In conclusion I have attached all data gathered by myself to date. The samples that are at the experimental station should be added to this report. The volume of data is so great that I think charts and graphs should be done on an as need bases.

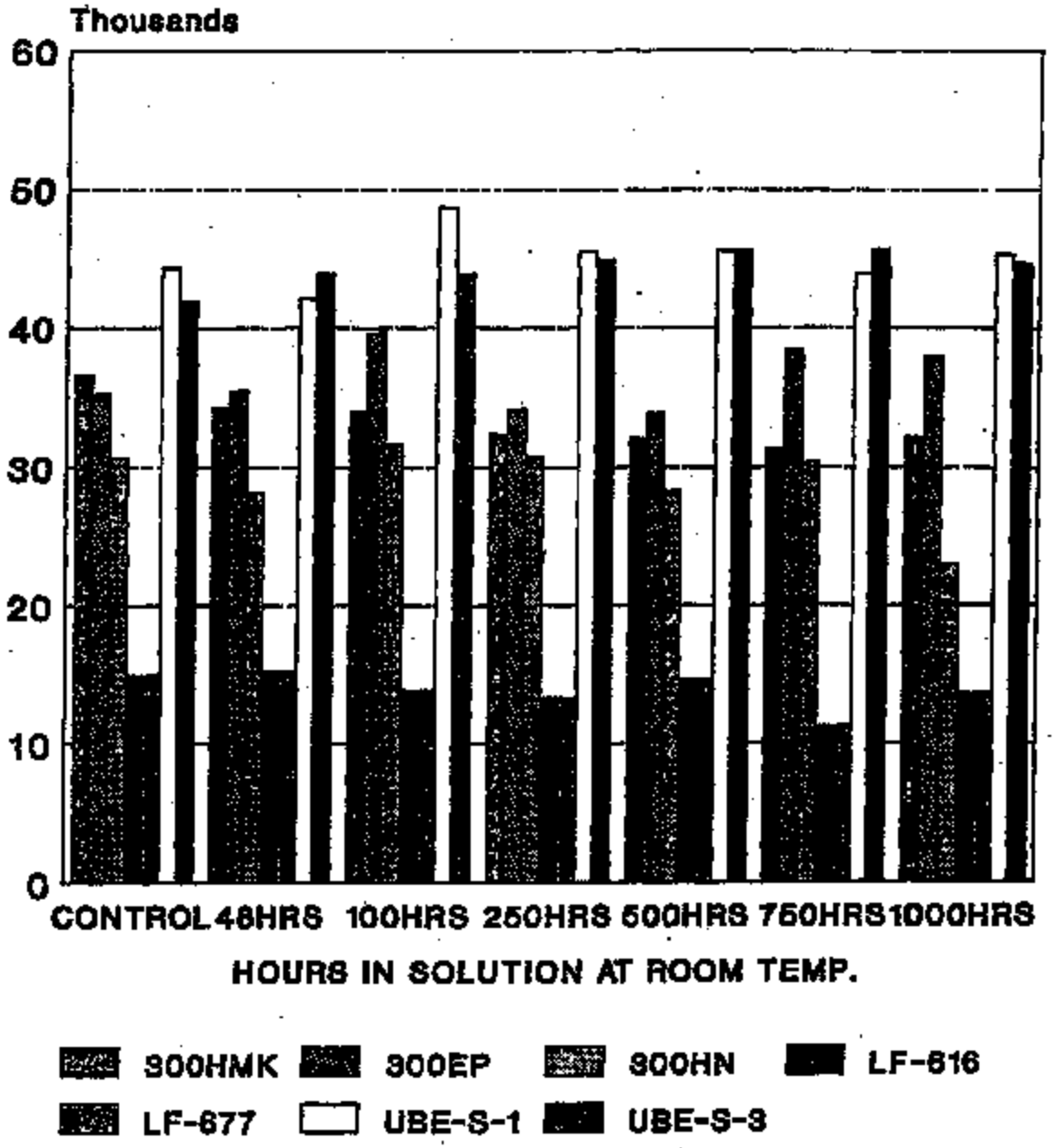
cc: Ralph Hutton
Dave Riefschider
Charlie Starr
Carl Killian

KAPTON IN BRAKE FLUID
KAPTON FILM TESILE STRENGHT



KAPTON FILM AUTO FLUIDS TEST PROGRAM

KAPTON IN BRAKE FLUID
KAPTON FILM TESILE STRENGHT



AUTO FLUIDS TEST PROGRAM

	AT	AU	AV	AW	AX	AY	AZ
1							
2	50CHRS	EXPOS.	INITIAL	MEASUR	1000HRS	EXPOS.	SWELL
3	LENGTH	WIDTH	LENGTH	WIDTH	LENGTH	WIDTH	MEAKE
4	8.024	0.502	8.053	0.502	8.084	0.503	300HHK
5	8.029	0.5	8.029	0.503	8.03	0.5	300HP-X
6	8.025	0.5	8.034	0.496	8.065	0.503	300HH906
7	8.13	0.499	8.038	0.5	8.042	0.5	LF0616
8	8.029	0.5	8.017	0.5	8.035	0.498	LF0677
9	8.039	0.501	8.04	0.3	8.037	0.309	UBE-8-2
10	8.033	0.501	8.036	0.499	8.026	0.501	UBE-8-3
11							200FW919
12							100EC
13							ATF
14	8.033	0.501	8.015	0.501	8.017	0.501	300HHK
15	8.042	0.501	8.032	0.479	8.036	0.478	300HP-X
16	8.02	0.496	8.029	0.502	8.017	0.502	300HH906
17	8.021	0.499	8.03	0.499	8.027	0.498	LF0616
18	8.036	0.499	8.013	0.477	8.017	0.476	LF0677
19	8.028	0.5	8.013	0.497	8.011	0.5	UBE-8-2
20	8.008	0.501	8.029	0.501	8.027	0.494	UBE-8-3
21	8.053	0.457	8.035	0.472	8.053	0.477	200FW919
22							100EC
23							ACID
24	8.033	0.5	8.028	0.499	8.031	0.5	300HHK
25	8.023	0.499	8.028	0.501	8.03	0.501	300HP-X
26	8.018	0.5	8.026	0.502	8.033	0.5	300HH906
27	8.026	0.5	8.037	0.502	8.034	0.5	LF0616
28	8.043	0.499	8.015	0.498	8.024	0.498	LF0677
29	8.015	0.5	8.028	0.499	8.027	0.5	UBE-8-2
30	8.027	0.502	8.019	0.499	8.019	0.5	UBE-8-3
31							200FW919
32							100EC
33							[illegible]
34	8.014	0.5	8.02	0.506	8.028	0.501	300HHK
35	8.022	0.501	8.034	0.501	8.039	0.501	300HP-X
36	8.023	0.501	8.035	0.503	8.028	0.499	300HH906
37	8.037	0.499	8.042	0.508	8.051	0.494	LF0616
38	8.027	0.498	8.01	0.499	8.014	0.5	LF0677
39	8.023	0.5	8.023	0.502	8.032	0.5	UBE-8-2
40	8.025	0.502	8.027	0.502	8.019	0.502	UBE-8-3
41	8.063	0.445	8.024	0.662	8.036	0.654	200FW919
42							100EC
43							H-85
44	8.019	0.501	FAIL	FAIL	FAIL	FAIL	300HHK
45	8.048	0.503	FAIL	FAIL	FAIL	FAIL	300HP-X
46	7.995	0.491	FAIL	FAIL	FAIL	FAIL	300HH906
47	8.024	0.499	FAIL	FAIL	FAIL	FAIL	LF0616

	AT	AU	AV	AW	AX	AY	AZ
48	0.004	0.495	FAIL	FAIL	FAIL	FAIL	LF0677
49	0.069	0.501	FAIL	FAIL	FAIL	FAIL	UBE-S-2
50	0.066	0.503	FAIL	FAIL	FAIL	FAIL	UBE-S-3
51	0.026	0.519	FAIL	FAIL	FAIL	FAIL	200FW919
52							100EC
53							SALT
54	0.02	0.502	0.025	0.503	0.033	0.502	300EHK
55	0.028	0.501	0.023	0.501	0.024	0.501	300EP-I
56	0.021	0.501	0.02	0.5	0.02	0.499	300EH806
57	0.007	0.5	0.015	0.499	0.019	0.499	LF0616
58	0.011	0.499	0.009	0.501	0.011	0.498	LF0677
59	0.022	0.5	0.014	0.502	0.015	0.501	UBE-S-2
60	0.03	0.501	0.03	0.502	0.037	0.501	UBE-S-3
61							200FW919
62							100EC
63							JOY
64	0.036	0.503	0.024	0.5	0.033	0.502	300EHK
65	0.022	0.502	0.02	0.501	0.029	0.501	300EP-I
66	0.024	0.5	0.044	0.499	0.047	0.499	300EH806
67	0.015	0.499	0.035	0.501	0.045	0.5	LF0616
68	0.025	0.5	0.024	0.506	0.04	0.5	LF0677
69	0.032	0.5	0.038	0.492	0.039	0.499	UBE-S-2
70	0.048	0.501	0.041	0.504	0.046	0.501	UBE-S-3
71							200FW919
72							100EC
73							ARFI-FR
74	0.029	0.5	0.025	0.499	0.03	0.501	300EHK
75	0.027	0.5	0.049	0.501	0.021	0.5	300EP-I
76	0.034	0.499	0.016	0.498	0.016	0.499	300EH806
77	0.058	0.499	0.012	0.498	0.016	0.499	LF0616
78	0.053	0.499	0.054	0.494	0.061	0.498	LF0677
79	0.032	0.414	0.037	0.459	0.031	4.58	UBE-S-2
80	0.013	0.5	0.023	0.501	0.022	0.5	UBE-S-3
81							200FW919
82							100EC
83							CLM-10
84	0.031	0.5	0.033	0.501	0.027	0.501	300EHK
85	0.027	0.5	0.027	0.5	0.034	0.501	300EP-I
86	0.002	0.492	0.022	0.5	0.024	0.501	300EH806
87	0.02	0.5	0.025	0.5	0.007	0.502	LF0616
88	0.04	0.501	0.029	0.5	0.018	0.5	LF0677
89	0.022	0.5	0.025	0.5	0.032	0.5	UBE-S-2
90	0.046	0.501	7.998	0.501	0.008	0.501	UBE-S-3
91							200FW919
92							100EC
93							IPA
94	0.019	0.501	0.034	0.501	0.045	0.501	300EHK

	AF	AG	AV	AW	AX	AY	AZ
95	8.015	0.499	8.028	0.499	8.027	0.499	300HP-I
96	8.029	0.499	8.024	0.499	8.036	0.5	300HN806
97	8.016	0.5	8.031	0.502	8.033	0.502	LF0616
98	8.035	0.501	8.024	0.501	8.032	0.5	LF0677
99	8.027	0.501	8.026	0.499	8.022	0.5	UHF-8-2
100	8.029	0.5	8.03	0.5	8.026	0.5	UHF-8-3
101							200FW919
102							100HC
103							1,1,1,TRI
104	8.023	0.5	8.005	0.5	8.016	0.501	300HK
105	8.019	0.499	8.017	0.5	8.017	0.502	300HP-I
106	8.025	0.5	8.027	0.5	8.038	0.5	300HN806
107	8.006	0.5	8.014	0.499	8.016	0.5	LF0616
108	8.044	4.97	8.024	0.493	8.038	0.494	LF0677
109	8.024	0.5	7.992	0.501	7.989	0.501	UHF-8-2
110	8.016	0.5	8.021	0.5	8.021	0.501	UHF-8-3

	AM	AN	AO	AP	AQ	AR	AS
1							
2	SHELL	INITIAL	MEASUR	48\HRS	EXPOS.	INITIAL	MEASUR
3	BRAKE	LENGTH	WIDTH	LENGTH	WIDTH	LENGTH	WIDTH
4	300HHK	8.017	0.501	8.019	0.499	8.016	0.504
5	300HP-X	8.032	0.431	8.029	0.439	8.031	0.501
6	300HH806	8.033	0.499	8.025	0.499	8.017	0.494
7	LF0616	8.018	0.501	8.019	0.5	8.01	..498
8	LF0677	8.015	0.498	8.015	0.499	8.023	0.501
9	UHE-S-2	8.018	0.501	8.02	0.5	8.041	0.504
10	UHE-S-3	8.045	0.501	8.041	0.499	8.036	0.503
11	200FW919						
12	100XC						
13	ATF						
14	300HHK	8.019	0.499	8.019	0.499	8.036	0.499
15	300HP-X	8.036	0.501	8.028	0.499	8.047	0.504
16	300HH806	8.035	0.497	8.037	0.494	8.028	0.495
17	LF0616	8.04	0.501	8.04	0.5	8.019	0.458
18	LF0677	8.035	0.494	8.036	0.502	8.034	0.5
19	UHE-S-2	8.047	0.5	8.047	0.5	8.019	0.503
20	UHE-S-3	8.036	0.499	8.027	0.5	8.005	0.496
21	200FW919	8.11	0.5	8.127	0.501	8.029	0.462
22	100XC						
23	ACID						
24	300HHK	8.044	0.5	8.047	0.5	8.027	0.5
25	300HP-X	8.023	0.5	8.025	0.5	8.025	0.5
26	300HH806	8.035	0.498	8.031	0.5	8.023	0.503
27	LF0616	8.035	0.5	8.041	0.5	8.022	0.501
28	LF0677	8.01	0.502	8.027	0.5	8.035	0.5
29	UHE-S-2	8.016	0.5	8.014	0.5	8.011	0.501
30	UHE-S-3	8.036	0.5	8.04	0.5	8.027	0.499
31	200FW919						
32	100XC						
33	SOR-GLS						
34	300HHK	8.017	0.5	8.016	0.499	8.016	0.5
35	300HP-X	8.031	0.5	8.028	0.501	8.022	0.5
36	300HH806	8.034	0.5	8.03	0.498	8.02	0.501
37	LF0616	8.027	0.501	8.03	0.498	8.036	0.502
38	LF0677	7.993	0.458	8.001	0.466	8.021	0.502
39	UHE-S-2	8.024	0.501	8.028	0.499	8.03	0.503
40	UHE-S-3	8.021	0.503	8.023	0.5	8.031	0.501
41	200FW919	8.028	0.498	8.032	0.504	8.046	0.439
42	100XC						
43	E-85						
44	300HHK	8.029	0.5	8.04	0.501	8.01	0.501
45	300HP-X	8.017	0.501	8.045	0.503	8.023	0.502
46	300HH806	8.02	0.502	8.018	0.498	8.013	0.488
47	LF0616	8.021	0.501	8.003	0.498	8.026	0.5

	AN	AM	AO	AP	AQ	AR	AS
48	LF0677	8.009	0.499	7.955	4.96	8.027	0.499
49	UBE-S-2	8.01	0.5	8.038	0.5	8.056	0.501
50	UBE-S-3	8.017	0.5	8.043	0.502	8.028	0.501
51	200FN919	8.007	0.5	8.022	0.5	8.025	0.517
52	100XC						
53	SALF						
54	300HHK	8.019	0.501	8.026	0.501	8.018	0.504
55	300EP-I	8.035	0.5	8.032	0.5	8.022	0.504
56	300HHB06	8.029	0.499	8.02	0.5	8.022	0.501
57	LF0616	8.016	0.502	8.009	0.5	8.005	0.5
58	LF0677	8.024	0.504	8.031	0.5	8.004	0.502
59	UBE-S-2	8.038	0.421	8.039	0.43	8.017	0.501
60	UBE-S-3	8.033	0.501	8.031	0.501	8.017	0.499
61	200FN919						
62	100XC						
63	JOY						
64	300HHK	8.015	0.501	8.009	0.501	8.021	0.502
65	300EP-I	8.027	0.466	8.027	0.473	8.016	0.499
66	300HHB06	8.029	0.502	8.029	0.502	8.027	0.502
67	LF0616	8.029	0.505	8.03	0.499	8.005	0.504
68	LF0677	8.042	0.501	8.048	0.497	8.014	0.5
69	UBE-S-2	8.023	0.5	8.02	0.499	8.026	0.5
70	UBE-S-3	8.048	0.501	8.054	0.5	8.032	0.502
71	200FN919						
72	100XC						
73	ANTI-FR						
74	300HHK	8.022	0.5	8.025	0.501	8.034	0.5
75	300EP-I	8.037	0.499	8.04	0.499	8.03	0.502
76	300HHB06	8.024	0.5	8.024	0.5	8.035	0.498
77	LF0616	8.034	0.5	8.031	0.502	8.047	0.501
78	LF0677	8.036	0.499	8.05	0.501	8.036	0.497
79	UBE-S-2	8.053	0.502	8.054	0.501	8.031	0.415
80	UBE-S-3	8.007	0.499	8.011	0.504	8.015	0.5
81	200FN919						
82	100XC						
83	CLM-10						
84	300HHK	8.031	0.5	8.037	0.501	8.039	0.501
85	300EP-I	8.014	0.498	8.016	0.5	8.023	0.501
86	300HHB06	8.023	0.499	8.025	0.5	8.008	0.491
87	LF0616	8.018	0.5	8.026	0.5	8.025	0.5
88	LF0677	8.034	0.498	8.046	0.499	8.029	0.5
89	UBE-S-2	8.026	0.501	8.023	0.501	8.025	0.5
90	UBE-S-3	8.043	0.501	8.052	0.501	8.038	0.504
91	200FN919						
92	100XC						
93	IPA						
94	300HHK	8.019	0.501	8.018	0.5	8.01	0.504

	AM	AN	AO	AP	AQ	AR	AS
95	300EP-X	0.017	0.499	0.018	0.5	0.016	0.499
96	300HH806	0.023	0.441	0.027	0.44	0.022	0.5
97	LF0616	0.032	0.5	0.033	0.5	0.014	0.503
98	LF0677	0.027	0.5	0.033	0.5	0.028	0.501
99	UHE-S-2	0.014	0.502	0.015	0.5	0.026	0.503
100	UHE-S-3	0.023	0.501	0.028	0.502	0.03	0.5
101	200TH919						
102	100XC						
103	1,1,1,TRI						
104	300HHK	0.019	0.499	0.025	0.5	0.016	0.5
105	300EP-X	0.01	0.5	0.011	0.501	0.02	0.499
106	300HH806	0.019	0.499	0.024	0.499	0.02	0.499
107	LF0616	0.025	0.502	0.023	0.502	0.008	0.5
108	LF0677	0.036	0.501	0.041	0.501	0.032	0.499
109	UHE-S-2	0.018	0.499	0.024	0.502	0.024	0.5
110	UHE-S-3	0.023	0.501	0.023	0.5	0.016	0.5

	AH	AI	AJ	AK	AL	AM	AN
1							
2							
3	BRAKE	500HRS	STD.DV	750HRS	STD.DV	1000HRS	STD.DV
4	300HHK	2528.7	7.7	2428.4	75.2	2345.3	91.4
5	300EP-X	2591.5	187	2735.2	162.2	2105.3	144.6
6	300HH806	2090.2	112.3	2084	72.9	1831.5	72.7
7	LF0616						
8	LF0677						
9	UBE-S-2	2730.1	79.1	2329.3	209.2	2493.3	72.3
10	UBE-S-3	2754.1	71.4	2793.4	64.5	2766	134.6
11	200FH919						
12	100XC						
13	ATF						
14	300HHK	2711.1	142.4	2750.1	144.8	2574.6	33.1
15	300EP-X	2687.5	168.9	2765	79.8	2776.4	210.7
16	300HH806	2368.2	119.8	2206.8	6.4	2208.2	116
17	LF0616						
18	LF0677						
19	UBE-S-2	3060	876.2	2430.7	219.2	2634.2	948.4
20	UBE-S-3	2866.2	65	2956.5	217.2	2888.5	93.2
21	200FH919						
22	100XC						
23	ACID						
24	300HHK	2577.9	75.2	2535.2	84.7	2464.7	57.2
25	300EP-X	2707.5	172.6	2598.3	69.1	2549.8	139.1
26	300HH806	2156.7	103.4	2297	385.6	2099	73
27	LF0616						
28	LF0677						
29	UBE-S-2	2504.2	94	2923.4	140	2503.7	496.9
30	UBE-S-3	2797.6	99.6	2666.4	74.9	2667.6	74.9
31	200FH919						
32	100XC						
33	SOR-GAS						
34	300HHK	2627.3	79.4	2621.7	114.2	2567.7	58.7
35	300EP-X	2944.8	457.1	2761.8	7.1	2810.1	391
36	300HH806	2233.5	99.2	2364.2	158.5	2171.4	13.8
37	LF0616						
38	LF0677						
39	UBE-S-2	3048	131	2800.8	223.7	2587.5	75
40	UBE-S-3	2879.2	46.1	2925.3	61.6	2825.6	35.9
41	200FH919						
42	100XC						
43	H-85						
44	300HHK	133.5	19				
45	300EP-X	553.5	54				
46	300HH806	FAIL	FAIL				
47	LF0616						

	AH	AI	AJ	AK	AL	AM	AN
48	LF0677						
49	UHH-S-2	1637.3	21				
50	UHH-S-3	1838.7	49				
51	200HH919						
52	100IC						
53	SALF						
54	300HHK	2617.4	173.4	2575	127.5	2447.7	34.8
55	300HP-I	2742	93.9	2700.8	195.1	2645.1	150.2
56	300HH806	2307.6	167	2186.5	155	2139.4	219.8
57	LF0616						
58	LF0677						
59	UHH-S-2	2592.8	309.8	2320.3	364.5	2979.6	158
60	UHH-S-3	2896.2	14.7	2776.1	37.8	2702	108.7
61	200HH919						
62	100IC						
63	JOY						
64	300HHK	2649.9	27.4	2629.4	49.6	2595.8	-106.6
65	300HP-I	2721.1	28.8	2732.8	108.1	2610.6	130.6
66	300HH806	2453.6	436.5	2413.3	219.6	2286	77
67	LF0616						
68	LF0677						
69	UHH-S-2	2537.4	124	2592.8	480.7	2714.5	571.5
70	UHH-S-3	2833.5	106.5	2860.4	64.9	2834.4	27.4
71	200HH919						
72	100IC						
73	ARTI-FR						
74	300HHK	1845.1	1007.6	2639	104	2035.8	27
75	300HP-I	2468.9	89.2	2556.4	156.3	1677.8	108
76	300HH806	2241.4	136.6	2092.1	59.4	1881.2	31
77	LF0616						
78	LF0677						
79	UHH-S-2	1842.8	234.4	2656.2	1119.8	1800	48
80	UHH-S-3	2705.8	93.3	2670.3	67.1	2797.2	126
81	200HH919						
82	100IC						
83	CLF-10						
84	300HHK	2514.4	124.6	2446.7	76.7	2224.7	15
85	300HP-I	2694.2	63.7	2663.9	270	1843	164
86	300HH806	2342.9	32.3	2230.5	61.5	1910.6	158
87	LF0616						
88	LF0677						
89	UHH-S-2	2059.3	528.7	2499.9	267.4	1747.6	4
90	UHH-S-3	2840.5	44.6	2734	29.4	2178.8	84
91	200HH919						
92	100IC						
93	IPA						
94	300HHK	2506.2	7.3	2685.6	197.5	2151.8	64

	AH	AI	AJ	AK	AL	AM	AN
95	300HP-X	2573.4	177.3	2771.4	278.5	1741.1	154
96	300HN806	2644	805.6	2238.2	148.3	2201.3	95
97	LP0616						
98	LP0677						
99	UHE-8-2	2380.9	238.6	2343.6	169	2065	116
100	UHE-8-3	2745.4	22.4	2800.8	44	2663.5	40
101	200PN919						
102	100HC						
103	1,1,1,TRI						
104	300HK	2697.1	322.6	2627.5	51.9	2473.5	29
105	300HP-X	2663.3	65.8	2737.7	184.7	2181.2	55
106	300HN806	2275.6	103	2195.7	6.2	1970.2	27
107	LP0616						
108	LP0677						
109	UHE-8-2	2634.4	87.6	2519.8	36.4	1752.6	26
110	UHE-8-3	2799.2	107	2727.9	187	2003.3	63
111	200PN919						
112	100HC						
113							

	Y	Z	AA	AB	AC	AD	AE	AF	AG
1									
2		IN-TEAR	LBS/INCH						
3	BRAKE	CONTROL	STD.DV	48HRS	STD.DV	100HRS	STD.DV	250HRS	STD.DV
4	300HHK	2384.1	79	2569.2	126.7	2644.9	95.8	2620.5	46.7
5	300EP-I	1820.9	89	2844.1	180.1	2738.9	99.3	2727.7	219.6
6	300HH806	1821.6	48	2317.1	64.5	2449.2	287.4	2302.9	231.5
7	LF0616								
8	LF0677								
9	UBE-S-2	1747.7	38	2711.9	171.6	2634.2	136.6	2507.7	139.2
10	UBE-S-3	2286.2	102	2438.7	47.5	2840.7	163.8	2821.5	78.2
11	200FM919								
12	100IC								
13	ATF								
14	300HHK	2384.1	79	2573.3	45.7	2520.9	58.8		
15	300EP-X	1820.9	89	2787.3	65.2	2811.4	84.6	2801.5	105.9
16	300HH806	1821.6	48	2130.1	98.4	2283.2	224.1	2417.1	146.3
17	LF0616								
18	LF0677								
19	UBE-S-2	1747.7	38	2325.3	418.5	2448.6	166.4	2249.4	1064.3
20	UBE-S-3	2286.2	102	2812.5	69	2901.8	71.9	2847.4	313.9
21	200FM919								
22	100IC								
23	ACID								
24	300HHK	2384.1	79	2649	219	2622.1	101.1	2642.9	133.9
25	300EP-X	1820.9	89	2726.9	72.6	2874.3	77.1	2771.1	131
26	300HH806	1821.6	48	2211.6	4.6	2119.4	51.6	2581.9	324
27	LF0616								
28	LF0677								
29	UBE-S-2	1747.7	38	2721.8	750.5	2726.2	122	2773.3	426.2
30	UBE-S-3	2286.2	102	2903.5	72.9	2996.3	72.3	2944.8	62.8
31	200FM919								
32	100IC								
33	SOR-GAS								
34	300HHK	2384.1	79	2604.5	31.6	2831.4	94.2	2714.9	109
35	300EP-I	1820.9	89	2803.7	200.8	2665.6	21.5	2643.9	148.5
36	300HH806	1821.6	48	2465.5	114.3	2207.6	77	2234.6	23.8
37	LF0616								
38	LF0677								
39	UBE-S-2	1747.7	38	3182.9	989	2612.4	239.5	2530.8	211.6
40	UBE-S-3	2286.2	102	2822	27.3	2851.3	74.3	2874.8	103.9
41	200FM919								
42	100IC								
43	H-85								
44	300HHK	2384.1	79	2437.8	59.9			1476.3	20
45	300EP-I	1820.9	89	2556.6	141.8			1096	45
46	300HH806	1821.6	48	2113.5	50			1142.8	76
47	LF0616								

	Y	Z	AA	AB	AC	AD	AE	AF	AG
48	LF0677								
49	UBE-S-2	1747.7	38	2540.1	172.5			1540	26
50	UBE-S-3	2286.2	102	2858.9	191.4			1763.9	43
51	200FH919								
52	100XC								
53	SALT								
54	300HNK	2384.1	79	2641.5	46	2261.1	52.6	2597.8	80.3
55	300EP-X	1820.9	89	2830.9	4.4	2705.4	176.5	2720	99.6
56	300HH806	1821.6	48	2184.1	131.5	2215.6	138.5		
57	LF0616								
58	LF0677								
59	UBE-S-2	1747.7	38	2622.1	338.5	2410.2	487.9	971.5	1319.4
60	UBE-S-3	2286.2	102	2910.7	38.5	2974.3	224.2	2889	110.5
61	200FH919								
62	100XC								
63	JOY								
64	300HNK	2384.1	79	2684.4	42.1	2690	148.2	2600.7	35.2
65	300EP-X	1820.9	89	3043	409.9	2685.8	108.5	2702.4	88.5
66	300HH806	1821.6	48	2191.5	71.9	2457.8	207	2332.3	156.4
67	LF0616								
68	LF0677								
69	UBE-S-2	1747.7	38	2611.6	189.9	2231.2	302.4	2194.3	168.8
70	UBE-S-3	2286.2	102	2840.5	112.3	2745.6	63.1	2749.4	60.8
71	200FH919								
72	100XC								
73	ANTI-FR								
74	300HNK	2384.1	79	2335.6	71.1	2215.5	186.9	2614.6	16.5
75	300EP-X	1820.9	89	2296	203.3	2680.5	209.5	2645.9	56.7
76	300HH806	1821.6	48	2050.7	53.7	2015.2	26.8	2158	16.9
77	LF0616								
78	LF0677								
79	UBE-S-2	1747.7	38	2382.1	260.4	2464.4	768.5	2542.7	196.2
80	UBE-S-3	2286.2	102	2779.7	60.3	2521.2	67.9	2844.8	81.5
81	200FH919								
82	100XC								
83	CLE-10								
84	300HNK	2384.1	79	2366	59.3	2422.8	329.6	2653.2	228.3
85	300EP-X	1820.9	89	2116	381.4	2268.6	130.2	2517.7	142.7
86	300HH806	1821.6	48	1949	44	2125.5	170.4	2345.6	488.9
87	LF0616								
88	LF0677								
89	UBE-S-2	1747.7	38	2407.9	771.9	2619.1	706.7	2566.6	148.2
90	UBE-S-3	2286.2	102	2458	139.9	2538.9	45	2849.3	60.2
91	200FH919								
92	100XC								
93	IPA								
94	300HNK	2384.1	79	2698.3	39.6			2636.3	176.4

	Y	Z	AA	AB	AC	AD	AE	AF	AG
95	300EP-I	1820.9	89	2769.1	59.2	2901.3	94.1	2648.9	86.9
96	300HH06	1821.6	48	2301.4	175.3	2194.3	14.2	2255	43.6
97	LF0616								
98	LF0677								
99	UBE-S-2	1747.7	38	2393.6	244.6	2712.5	50.7	2670.9	252.6
100	UBE-S-3	2286.2	102	2924.8	54	2802	157	2812.5	46.5
101	200FW919								
102	100EC								
103	1,1,1,TRI								
104	300HHK	2344.1	79	2315.5	36.1	2572.3	34.6	2544.4	46.5
105	300EP-I	1820.9	89	2297.8	142.4	2596.9	140.6	2687.8	121.4
106	300HH06	1821.6	48	2084.8	224	2202.4	92.4	2215	43.3
107	LF0616								
108	LF0677								
109	UBE-S-2	1747.7	38	2217.3	373.1	2721.3	108.9	2959.5	149.4
110	UBE-S-3	2286.2	102	2604.1	175.9	2843.9	21.4	2892.6	140.1
111	200FW919								
112	100EC								
113									
114									
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	Q	R	S	T	U	V	W	X
1								
2		MODULUS						
3	BRAKE	CONTROL	48HRS	100HRS	250HRS	500HRS	750HRS	1000HRS
4	300HK	492985	520456	518223	523363	515276	515107	526089
5	300HP-X	751127	767462	742241	746182	768670	776755	774775
6	300HH806	373724	410615	395551	396987	400145	419675	404709
7	LF0616	374356	402824	388270	373895	347221	309833	349164
8	LF0677	301037	330417	279197	280448	292330	237067	249408
9	UHH-S-2	1130955	1175853	1160033	1170125	1142409	1198455	1214670
10	UHH-S-3	861171	881713	881422	879530	871746	912001	921077
11	200FH919	298726						
12	100IC	473690						
13	ATF							
14	300HK	492985	504949	520328		545258	556074	580441
15	300HP-X	751127	747912	795813		765072	752015	824441
16	300HH806	373724	391411	415416		408480	NO DATA	431554
17	LF0616	374356	402068	420918		440105	431898	488203
18	LF0677	301037	334726	348619		368199	371796	400329
19	UHH-S-2	1130955	1182294	1181695		1170461	1133725	1198644
20	UHH-S-3	861171	885273	852195		865619	840861	920207
21	200FH919	298726	215690	253278		259901	13307	258470
22	100IC	473690						547132
23	ACID							
24	300HK	492985	462751	516392	524169	506176	535601	540342
25	300HP-X	751127	726016	765611	786310	762730	793010	802134
26	300HH806	373724		417664	437641	400962	396032	408276
27	LF0616	374356	366731	426059	359651	394427	373712	408351
28	LF0677	301037	311414	316480	328372	321059	335675	341214
29	UHH-S-2	1130955	1196148	1215751	1147378	1123884	1204710	1217721
30	UHH-S-3	861171		896101	890205	897466	934684	929747
31	200FH919	298726			263664			
32	100IC	473690						
33	SOR-GAS							
34	300HK	492985			494847	495147	NO DATA	536115
35	300HP-X	751127			753216	758133	771077	808277
36	300HH806	373724				393613	408373	425904
37	LF0616	374356			353204	347577	376702	364733
38	LF0677	301037			266342	315459	314894	290012
39	UHH-S-2	1130955			1164229	1106789	1197003	1190346
40	UHH-S-3	861171			914228	869460	886282	924910
41	200FH919	298726			245955	244864	252270	254048
42	100IC	473690						
43	H-85							
44	300HK	492985	571533		566361	608047		
45	300HP-X	751127	766762		784662	821427	810528	
46	300HH806	373724	432373		449430	498000		
47	LF0616	374356	644945		565345	490581	346405	

	Q	R	S	T	U	V	W	X
48	LF0677	301037	529646		451291	410129		
49	UHE-S-2	1130955	1194670		1231120	1179454	1254029	
50	UHE-S-3	861171	879423		885080	887035	906839	
51	200FW919	298726	275850		266099	293362		
52	100XC	473690						
53	SALT							
54	300HHK	492985				497400	532299	531555
55	300HP-I	751127				732621	776245	783683
56	300HH806	373724				389025	397487	427384
57	LF0616	374356				398254	394020	396829
58	LF0677	301037				314435	316152	327891
59	UHE-S-2	1130955				1024376	1157096	1195265
60	UHE-S-3	861171				842559	919717	917777
61	200FW919	298726						
62	100XC	473690						
63	JOY							
64	300HHK	492985	534590	544913		537409	579099	610600
65	300HP-I	751127	770217	775650		774918	760333	843893
66	300HH806	373724	403543	417563		429204	433306	441131
67	LF0616	374356	428539	411126		406543	421524	431484
68	LF0677	301037	334159	342596		333161	332348	346485
69	UHE-S-2	1130955	1083514	1194323		1126362	1206079	1217266
70	UHE-S-3	861171	894445	905016		853975	936130	949668
71	200FW919	298726						
72	100XC	473690						
73	ANTI-FR							
74	300HHK	492985	514224	443048	474993	523671	544687	522585
75	300HP-I	751127	706951	791104	754523		784415	788928
76	300HH806	373724	389434	378574	399273	403421	410088	424374
77	LF0616	374356	368531	441789	362187	322482	360791	344148
78	LF0677	301037	311932	390968		279392	247665	257199
79	UHE-S-2	1130955	1039550	1210284	1249026	1200730	1253332	1169993
80	UHE-S-3	861171	823961	889034	904349	881259	903106	907634
81	200FW919	298726						
82	100XC	473690						
83	CLR-10							
84	300HHK	492985	522618	508045	518973	523453	525780	524025
85	300HP-X	751127	738530	734543	787431	786924	779397	777534
86	300HH806	373724	343933	389379	398085	403976	404548	391050
87	LF0616	374356	395113	393560	422527	398894	397254	384262
88	LF0677	301037	316790	321342	331950	314092	323405	307811
89	UHE-S-2	1130955	1147685	1134139	1111669	1188496	1224260	1110149
90	UHE-S-3	861171	863773	865937	918187	900520	929493	913347
91	200FW919	298726						
92	100XC	473690						
93	IPA							
94	300HHK	492985	512824	513091	485590	505283	537272	525339

	Q	R	S	T	U	V	W	X
95	300EP-X	751127	766070	745830	763376	753861	784151	763320
96	300HN806	373724	397908	418750	399656	399364	422643	401449
97	LF0616	374356	408890	414302	369791	406884	391163	395758
98	LF0677	301037	330234	338588	312311	329234	319195	303539
99	UBE-S-2	1130955	1144252	1219029	1087906	1166948	1203507	1143712
100	UBE-S-3	861171	895379	901171	863415	899767	922542	891967
101	200EN919	298726			273575			
102	100IC	473690						
103	1,1,1,TRI							
104	300EHK	492985	519118	482219	518166	530080	536668	526752
105	300EP-X	751127	759936	798856	757143	791943	793966	780421
106	300HN806	373724	394524	401366	384010	423147	412927	402592
107	LF0616	374356	390508	416187	375663	392853	418258	389718
108	LF0677	301037	319283	326914	304764	341106	342542	312967
109	UBE-S-2	1130955	1161300	1140162	1117340	1201860	1203806	1118543
110	UBE-S-3	861171	881568	902246	894276	919862	916200	909080
111	200EN919	298726						
112	100IC	473690						
113	N-85							
114	300EHK	492985	544454			725629		613764
115	300EP-X	751127	763352			850031		959622
116	300HN806	373724	416949			585491		485283
117	LF0616	374356						
118	LF0677	301037						
119	UBE-S-2	1130955						
120	UBE-S-3	861171						
121	200EN919	298726						
122	100IC	473690						
123	N-15							
124	300EHK	492985	754123			699948		585359
125	300EP-X	751127				868649		979311
126	300HN806	373724	402890			574505		506061
127	LF0616	374356						
128	LF0677	301037						
129	UBE-S-2	1130955						
130	UBE-S-3	861171						
131	200EN919	298726						
132	100IC	473690						

	A	B	C	D	E	F	G	H
1								
2		TENSIL	AVR. 3					
3	BRAKE	CONTROL	48HRS	100HRS	250HRS	500HRS	750HRS	1000HRS
4	300HHK	36572	34221	33969	32270	31974	31176	32070
5	300EP-I	35139	35399	39561	34097	33784	38433	37926
6	300HH806	30647	28125	31557	30716	28246	30345	32925
7	LF0616	15912	16501	16082	16456	15301	14682	15940
8	LF0677	14994	15256	13911	13371	14659	11246	13639
9	UHR-S-2	44308	42120	48720	45503	45497	43914	45314
10	UHR-S-3	41923	43979	43949	44952	48657	45683	44697
11	200FH919	24714						
12	100EC	14763						
13	ATF							
14	300HHK	36572	33646	35176		34792	34352	33220
15	300EP-I	35139	35645	34625		36894	30221	34522
16	300HH806	30647	33304	33733		32761	1471	29196
17	LF0616	15912	16763	16874		15647	17203	19465
18	LF0677	14994	14989	16106		15968	16097	16750
19	UHR-S-2	44308	45412	41510		36554	46187	45230
20	UHR-S-3	41923	41369	44946		42848	41757	42692
21	200FH919	24714	14581	14525		14042	944	19401
22	100EC	14763						16137
23	ACID							
24	300HHK	36572	33475	35335	35242	34606	33627	36310
25	300EP-I	35139	38522	40178	36389	36010	36370	40587
26	300HH806	30647		32105	31926	31414	30895	31801
27	LF0616	15912	16093	17244	15679	15750	15676	16270
28	LF0677	14994	15794	14852	15877	15219	15146	16077
29	UHR-S-2	44308	50544	49317	43958	42074	50400	46362
30	UHR-S-3	41923		44310	41851	44447	43706	44330
31	200FH919	24714			20375			
32	100EC	14763						
33	SOR-GAS							
34	300HHK	36572			33397	33413	1710	34816
35	300EP-I	35139			35902	38006	41466	35715
36	300HH806	30647				29384	31363	33011
37	LF0616	15912			15204	16006	18942	15535
38	LF0677	14994			14185	15200	15260	14603
39	UHR-S-2	44308			43004	45503	45175	46447
40	UHR-S-3	41923			43984	45135	44896	45141
41	200FH919	24714			19161	14699	18094	17621
42	100EC	14763						
43	H-85							
44	300HHK	36572	29944		20980	18729		
45	300EP-I	35139	31017		24191	21496	18528	
46	300HH806	30647	25846		18080	12793		
47	LF0616	15912	9223		11477	12058	9199	

	A	B	C	D	E	F	G	H
48	LP0677	14994	12396		8837	7352		
49	UBE-S-2	44308	40608		36998	36374	35647	
50	UBE-S-3	41923	37213		33568	33006	31553	
51	200FW919	24714	13637		11124	10150		
52	100EC	14763						
53	SALT							
54	300HEK	36572				32010	33768	32273
55	300EP-I	35139				31531	35670	37600
56	300HEB06	30647				30115	28758	31917
57	LP0616	15912				16560	15846	15819
58	LP0677	14994				14804	13154	13453
59	UBE-S-2	44308				40536	44368	47546
60	UBE-S-3	41923				42118	43985	43385
61	200FW919	24714						
62	100EC	14763						
63	JOY							
64	300HEK	36572	32070	34833		31453	31559	30704
65	300EP-I	35139	36823	41281		39413	35713	35957
66	300HEB06	30647	29355	31724		30013	30478	27204
67	LP0616	15912	15949	15019		15750	15946	16068
68	LP0677	14994	14781	14989		13020	14098	12859
69	UBE-S-2	44308	41770	47612		43065	48117	51531
70	UBE-S-3	41923	45442	46436		42194	42498	44684
71	200FW919	24714						
72	100EC	14763						
73	ANTI-FR							
74	300HEK	36572	33720	31713	32005	32134	32630	32086
75	300EP-I	35139	39835	40644	35926		35169	39099
76	300HEB06	30647	32003	28043	30867	29679	30241	30335
77	LP0616	15912	15693	17112	16070	14805	16158	15004
78	LP0677	14994	15396	13517		14480	13572	13895
79	UBE-S-2	44308	46902	46836	51510	45896	42805	44478
80	UBE-S-3	41923	43252	44546	44189	43902	42428	41611
81	200FW919	24714						
82	100EC	14763						
83	CLN-10							
84	300HEK	36572	35528	33900	33107	33876	34391	31666
85	300EP-I	35139	34489	34869	36357	35216	36803	37821
86	300HEB06	30647	33119	28517	31064	29182	30883	27246
87	LP0616	15912	16431	15849	17045	16029	15933	15003
88	LP0677	14994	15060	15786	15662	14339	13833	13701
89	UBE-S-2	44308	44626	46764	44995	48220	44764	42796
90	UBE-S-3	41923	43550	44138	41439	45082	45833	41935
91	200FW919	24714						
92	100EC	14763						
93	IPA							
94	300HEK	36572	35930	34404	34679	35186	32185	32961

	A	B	C	D	E	F	G	H
95	300EP-X	35139	38797	42593	35587	35638	38133	39189
96	300EH406	30647	31250	32858	31827	30790	31045	33536
97	LF0616	15912	16855	17039	15839	16874	15652	16716
98	LF0677	14994	16175	15066	14741	14465	15121	14221
99	UBE-S-2	44308	41874	41007	42619	47810	48423	45909
100	UBE-S-3	41923	44192	46205	43748	43906	43706	45491
101	200FH919	24714			20175			
102	100EC	14763						
103	1,1,1,TRI							
104	300EHK	36572	34983	33340	34701	33117	36183	34041
105	300EP-X	35139	38816	35250	33665	35346	36484	34249
106	300EH406	30647	31161	31548	30212	32919	35144	28948
107	LF0616	15912	16556	16446	16003	15662	17018	16448
108	LF0677	14994	16222	15394	15410	15951	15697	15365
109	UBE-S-2	44308	46430	46467	42268	44948	48905	46448
110	UBE-S-3	41923	44623	44774	45136	43692	44445	42639
111	200FH919	24714						
112	100EC	14763						
113	K-85	EH\THP						
114	300EHK	36572	34632			33130		32391
115	300EP-I	35139	33026			35455		32589
116	300EH406	30647	31123			30569		30273
117	LF0616	15912						
118	LF0677	14994						
119	UBE-S-2	44308						
120	UBE-S-3	41923						
121	200FH919	24714						
122	100EC	14763						
123	K-15	EH\THP						
124	300EHK	36572	33618			30179		30954
125	300EP-I	35139				36006		34433
126	300EH406	30647	27597			28902		29059
127	LF0616	15912						
128	LF0677	14994						
129	UBE-S-2	44308						
130	UBE-S-3	41923						
131	200FH919	24714						
132	100EC	14763						

	I	J	K	L	M	N	O	P
1								
2		FLUID						
3	BRAKE	CONTROL	48HRS	100HRS	250HRS	500HRS	750HRS	1000HRS
4	300HBK	54.9	55.8	54.6	44	47.7	47.6	50
5	300HP-X	22.7	24.1	39.1	27	20.1	32.6	29.8
6	300HB806	67.4	45.2	71.8	66.4	54.2	61.4	39.3
7	LF0616	42.2	44.6	42.3	43.2	41.9	43.7	42.8
8	LF0677	50.2	50.8	63.3	56.3	50.4	40.7	64.8
9	UBE-S-2	16.6	12.3	21.5	19.4	18.1	14.5	16.3
10	UBE-S-3	26.8	31.3	31.2	31.4	33.3	31.4	29.8
11	200FH919	71.1						
12	100EC	13.8						
13	ATF							
14	300HBK	54.9	57.2	61.8		59.9	54.5	46.2
15	300HP-X	22.7	28	18.4		27.8	13	17.1
16	300HB806	67.4	75	73.7		73.1	61.8	50.3
17	LF0616	42.2	45.1	40.3		31.1	44.8	39.6
18	LF0677	50.2	44.5	57.9		53.5	53	45.8
19	UBE-S-2	16.6	17.1	14		10.9	18.5	15.6
20	UBE-S-3	26.8	26.2	31		29.2	26.2	26.8
21	200FH919	71.1	51.1	62.8		57.1	66	66.1
22	100EC	13.8						11.3
23	ACID							
24	300HBK	54.9	65.1	63.5	58.8	63.5	50.4	64
25	300HP-X	22.7	27	37.9	25.6	25	25.4	37.2
26	300HB806	67.4	68.1	63.9	63	68	65.2	66.5
27	LF0616	42.2	43.1	44.7	41.2	42.3	42.8	40.3
28	LF0677	50.2	53.8	66.6	55.3	56.7	48.9	52.9
29	UBE-S-2	16.6	21.6	18.6	16.4	16.5	22.1	16.8
30	UBE-S-3	26.8	29.9	30.3	27.3	30.5	28.4	29.4
31	200FH919	71.1			65.5			
32	100EC	13.8						
33	SUR-GAS							
34	300HBK	54.9			57.2	58.4	63.5	57.6
35	300HP-X	22.7			26.4	33.4	42.8	23.1
36	300HB806	67.4				57.2	61.3	58
37	LF0616	42.2			41.8	43	41.8	43.7
38	LF0677	50.2			49.2	55.8	55.5	47.3
39	UBE-S-2	16.6			21.5	20.9	16.7	17.8
40	UBE-S-3	26.8			28.7	33.4	32.2	31.2
41	200FH919	71.1			68.6	69.3	63	58.9
42	100EC	13.8						
43	M-85							
44	300HBK	54.9	27.6		9	5.2		
45	300HP-X	22.7	16.7		4.7	3.3	2.7	
46	300HB806	67.4	34.4		10.3	3.3		
47	LF0616	42.2	2		5.9	6.7	4.8	

DOT/NHTSA No. 6
00163

	I	J	K	L	M	N	O	P
48	LF0677	50.2	11.9		5.9	3.6		
49	UBE-S-2	16.6	11.5		7.2	7.8	5.5	
50	UBE-S-3	26.8	21.9		13	13.2	8.4	
51	200FN919	71.1	27.2		14.1	8.3		
52	100EC	13.8						
53	SALT							
54	300EHK	54.9				55.9	56.7	50.8
55	300EP-I	22.7				19.4	27.1	30.1
56	300EH806	67.4				67.7	59.4	64.6
57	LF0616	42.2				46.1	41.6	42
58	LF0677	50.2				51.8	34.4	36.5
59	UBE-S-2	16.6				13.8	17.5	20.3
60	UBE-S-3	26.8				28.8	29.5	28.9
61	200FN919	71.1						
62	100EC	13.8						
63	JOY							
64	300EHK	54.9	61.6	54.3		41.3	37.9	29.7
65	300EP-I	22.7	27.3	41		39	26.2	20.7
66	300EH806	67.4	54.7	63		53.9	54.7	42.9
67	LF0616	42.2	32.1	30.8		34.8	34.1	32.1
68	LF0677	50.2	64.7	43.1		26	37.7	24
69	UBE-S-2	16.6	13.2	18.6		16	20.4	23
70	UBE-S-3	26.8	30.6	32.1		29.6	27	31
71	200FN919	71.1						
72	100EC	13.8						
73	ARFI-FR							
74	300EHK	54.9	52.3	50.1	50.6	49.1	46	45.5
75	300EP-I	22.7	38.9	34.2	24.3		22.5	35.6
76	300EH806	67.4	64.5	51.1	60.8	58.6	61.8	48.8
77	LF0616	42.2	36.2	40.2	41.7	42.1	42.1	39.9
78	LF0677	50.2	58.8	52.7		52.2	49.5	45.9
79	UBE-S-2	16.6	23.9	15.8	21	17.1	12.7	14.6
80	UBE-S-3	26.8	32.4	29.6	29.8	31.3	29.1	26.2
81	200FN919	71.1						
82	100EC	13.8						
83	CLM-10							
84	300EHK	54.9	66.8	54.4	48.2	57.8	58.3	48.9
85	300EP-I	22.7	25.8	26.8	23.3	24	29.6	33.2
86	300EH806	67.4	63.9	56.1	63	60.1	65.4	50.1
87	LF0616	42.2	44.9	41.6	41.1	40.4	40.5	40
88	LF0677	50.2	54	60.3	56	48.7	42.6	49.4
89	UBE-S-2	16.6	17.4	20.2	18.2	21	16.2	18.4
90	UBE-S-3	26.8	31	31.3	22.8	31.5	31.9	27.4
91	200FN919	71.1						
92	100EC	13.8						
93	IPA							
94	300EHK	54.9	61.1	55.3	62	61.2	43.9	47.3

	I	J	K	L	M	N	O	P
95	300EP-X	22.7	34.1	49	25.2	27.7	31.7	34.6
96	300HH806	67.4	62.6	62.3	67.7	62.2	61.2	75.5
97	LF0616	42.2	41.6	41.4	44	44.2	41.4	42.8
98	LF0677	50.2	60.1	45.4	47.8	46.2	53.7	50.4
99	UBE-S-2	16.6	13.5	12.5	14.5	20.9	20.3	18.3
100	UBE-S-3	26.8	28.4	31.7	30.5	29.7	27.4	32.5
101	200FH919	71.1			66.9			
102	100XC	13.8						
103	1,1,1,TXI							
104	300HHK	54.9	55.2	49.7	51	47.6	62.9	51.4
105	300EP-I	22.7	31.9	21.1	19.9	21.9	24.7	20.1
106	300HH806	67.4	62.5	61.4	61.9	67.2	82.3	52
107	LF0616	42.2	45.3	37.9	42.5	36.5	39.1	43.3
108	LF0677	50.2	59.1	51.4	52.8	52.7	49.5	53.4
109	UBE-S-2	16.6	17.9	18.2	15.6	15.7	21.4	20
110	UBE-S-3	26.8	28.4	28.3	29.6	28.6	30.2	26.4
111	200FH919	71.1						
112	100XC	13.8						
113	H-85							
114	300HHK	54.9	54.8			42.3		41
115	300EP-I	22.7	17.6			22.1		19.5
116	300HH806	67.4	63.6			50.8		48.1
117	LF0616	42.2						
118	LF0677	50.2						
119	UBE-S-2	16.6						
120	UBE-S-3	26.8						
121	200FH919	71.1						
122	100XC	13.8						
123	H-15							
124	300HHK	54.9	20.1			36.9		40.2
125	300EP-X	22.7				24.4		17.1
126	300HH806	67.4	52			46.7		44.2
127	LF0616	42.2						
128	LF0677	50.2						
129	UBE-S-2	16.6						
130	UBE-S-3	26.8						
131	200FH919	71.1						
132	100XC	13.8						

DD/NHTSA No. 6
00165

AUTOMOTIVE FLUID TESTING
KAPTON® FILM AND LAMINATE TEST

- ATF • DEXRON ATF OFF SHELF • 300 DEGREE F
- GM SOUR GAS • INDOLENE H 03(AMOCO)/.0028% T-BUTYL HYDROPEROXIDE (90% PURE) • ROOM TEMP.
- BRAKE FLUID • BERKEBILE 2 + 2" DOT-3 • ROOM REMP.
- ANTIFREEZE • "PEAK" FULL CONCENTRATION • ROOM TEMP.
- DETERGENT • "JOY" DISH DETERGENT LIQUID 50% CONCENTRATION IN WATER • ROOM TEMP.
- SALT SOLUTION • SATURATED 1511.7 GRAMS NaCL/ 13602.3 GRAMS TAP WATER • ROOM TEMP.
- BATTERY ACID • OFF SHELF H2S04 - SP GRAV. = 1.265 • ROOM TEMP.
- ISOPROPYL ALCOHOL • FULL CONCENTRATION • ROOM TEMP.
- 1,1,1 TRICHLOROETHANE • FULL CONCENTRATION • ROOM TEMP.
- CAUSTIC CLEANER (PH > 10) • TAP WATER/ TRISODIUM PHOSPHATE 0.05% • ROOM TEMP.

PRODUCT AND TEST INFORMATION

- FILMS IN TEST
  1) 300HN
  2) 300EP
  3) 300HMK
  4) 100EP LF-0111 (5457-0616)
  5) 100HMK LF-0111 (5457-0677)
- LAMINATES IN TEST SEE CARL KILLIAN
- TESTS TO BE COMPLETED
  1) TENSILE
  2) ELONGATION
  3) MODULUS
  4) SWELL
  5) INITATION TEAR

GENERAL INFORMATION

- ALL CONTROL SAMPLES EXCEPT SWELL ARE THE AVERAGE OF FIVE DATA POINTS

- ALL TEST POINTS EXCEPT SWELL ARE THE AVERAGE OF THREE TEST POINTS

- SWELL DATA IS ONLY ONE TEST POINT, TWO POINTS WHERE RECORDED BUT DATA WAS SO REPRODUCABLE ONLY ONE WAS USED

TESTING RUN AT E.T.C.

[illegible] IV Adhesive Fluids

[illegible]	[illegible] Control	[illegible] No. 2 [illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
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ZPA							
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[illegible]	[illegible]						

[illegible]	FLUID CONTROL	40MPH	100MPH	200MILE	500MIN	750MIN	1000MIN
20WDEX	34.9	39.9	34.9	49	47.7	47.6	50
30WEP-X	32.7	24.1	35.1	37	30.1	33.8	29.0
30WDM4	67.4	48.2	71.9	66.4	34.8	41.4	36.3
LF0414	42.2	44.5	42.2	41.2	41.9	43.7	42.0
LF0477	56.2	50.8	63.5	56.3	50.4	49.7	54.8
20WPW10	71.1						
10W30	13.8						
ATF							
20WDEX	34.9	37.2	41.0		50.0	54.8	46.2
30WEP-X	32.7	28	18.4		37.8	15	37.1
30WDM4	67.4	78	72.7		72.1	63.8	36.3
LF0414	42.2	48.1	48.2		32.1	44.9	39.4
LF0477	56.2	44.9	37.9		53.5	30	46.8
20WPW10	71.1	51.1	63.0		57.1	65	54.1
10W30	13.8						11.5
ACID							
20WDEX	34.9	48.1	63.8	54.8	43.6	50.4	54
30WEP-X	32.7	27	37.8	35.8	28	38.4	37.3
30WDM4	67.4	69.1	63.9	63	68	63.2	66.0
LF0414	42.2	45.1	44.7	43.2	43.1	41.8	40.3
LF0477	56.2	55.8	66.6	65.3	56.7	46.9	59.8
20WPW10	71.1			58.5			
10W30	13.8						
BOR-GAS							
20WDEX	34.9			37.2	38.4	65.5	37.8
30WEP-X	32.7			36.4	33.4	41.8	33.1
30WDM4	67.4				57.1	61.3	38
LF0414	42.2			41.9	40	41.6	43.7
LF0477	56.2			49.2	50.8	58.8	47.3
20WPW10	71.1			56.8	50.5	45	54.8
10W30	13.8						
GAIN							
20WDEX	34.9				55.3	36.7	39.8
30WEP-X	32.7				19.4	27.1	30.1
30WDM4	67.4				67.7	38.4	64.6
LF0414	42.2				46.1	41.4	43
LF0477	56.2				51.8	34.4	36.8
20WPW10	71.1						
10W30	13.8						
ICE							
20WDEX	34.9	41.6	54.3		41.9	37.9	39.7
30WEP-X	32.7	37.3	41		30	38.2	30.7
30WDM4	67.4	64.7	63		53.9	38.7	43.9
LF0414	42.2	33.1	39.8		34.8	34.1	33.1
LF0477	56.2	64.7	43.1		36	37.7	34
20WPW10	71.1						
10W30	13.8						

[illegible]	[illegible] CONTROL	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
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[illegible]	[illegible]						

[illegible]	MOPELON CONTROL	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

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[illegible]	[illegible]						
[illegible]	[illegible]						

BRAKE	IN-TEAR CONTROL	LBS/IPOK STD.DV	[illegible]	STD.DV	[illegible]	STD.DV	[illegible]	STD.DV
[illegible]	2164.1	.79	2869.3	136.7	2844.9	81.6	2828.5	46.7
[illegible]	1830.9	89	2864.1	180.1	2738.9	98.3	2727.7	213.6
[illegible]	1831.6	48	2217.1	84.5	2449.2	307.4	2302.9	231.3
LF0616								
LF0677								
[illegible]								
160HC								
ACF								
[illegible]	2164.1	79	2872.3	48.7	2828.9	89.8		
[illegible]	1830.9	89	2767.9	66.3	2831.4	84.6	2801.6	108.9
[illegible]	1831.6	48	2138.1	98.4	2293.3	184.1	2417.3	146.3
LF0616								
LF0677								
[illegible]								
160HC								
ACID								
[illegible]	2164.1	79	2869	219	2622.1	161.1	2642.9	133.9
[illegible]	1829.9	89	2738.9	78.4	2874.3	77.1	2771.1	131
[illegible]	1831.6	48	2311.6	4.6	2119.4	51.8	2381.9	134
LF0616								
LF0677								
[illegible]								
160HC								
[illegible]								
[illegible]	2164.1	79	2894.6	51.8	2831.4	94.3	2714.9	109
[illegible]	1830.9	89	2873.7	108.6	2888.6	21.8	2849.3	148.6
[illegible]	1831.6	48	2468.6	114.3	2387.6	77	2234.6	23.8
LF0616								
LF0677								
[illegible]								
160HC								
[illegible]								
[illegible]	2164.1	79	2841.5	46	2281.1	62.6	2887.6	86.3
[illegible]	1830.9	89	2830.9	4.4	2788.4	278.3	2720	86.4
[illegible]	1831.6	48	2184.1	171.5	2319.6	138.5		
LF0616								
LF0677								
[illegible]								
160HC								
JOY								
[illegible]	2164.1	79	2684.4	42.1	2888	188.2	2880.7	38.2
[illegible]	1830.9	89	3041	489.9	2888.5	158.5	2703.4	88.3
[illegible]	1831.6	48	2181.8	71.2	2457.8	387	2333.3	184.4
LF0616								
LF0677								
[illegible]								
160HC								

[illegible] IN AUTOMOTIVE FLUIDS

[illegible]	[illegible] CONTROL	[illegible] STD.DV	[illegible]	STD.DV	[illegible]	STD.DV	[illegible]	STD.DV
[illegible]	2384.1	79	2338.6	71.1	2316.3	38.9	2314.4	26.3
[illegible]	1828.9	89	2301	273.3	2418.5	309.3	2468.9	86.7
[illegible]	1821.4	46	2180.7	83.7	2015.2	30.0	2186	36.9
[illegible]								
[illegible]								
[illegible]								
[illegible]								
[illegible]								
[illegible]-10								
[illegible]	2384.1	79	2364	89.1	2423.8	139.6	2493.3	208.3
[illegible]	1880.9	89	2116	303.4	2469.8	156.3	2317.7	163.7
[illegible]	1821.6	46	1948	44	2135.3	179.4	2349.6	488.9
[illegible]								
[illegible]								
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[illegible]								
[illegible]								
[illegible]	2384.1	79	2448.3	89.6			2430.3	178.4
[illegible]	1838.9	89	3700.1	97.1	2001.3	94.1	2019.9	46.8
[illegible]	1821.4	48	2301.6	175.3	2184.3	18.3	2288	43.4
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[illegible]								
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[illegible]	2384.1	79	2315.8	36.1	2372.3	34.6	2364.4	48.6
[illegible]	1838.9	89	2397.6	141.4	2404.9	140.8	2397.8	121.4
[illegible]	1821.4	48	2084.8	324	2362.4	92.4	2013	43.3
[illegible]								
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DD/NHTSA No. 6
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[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	2518.7	7.7	2438.4	73.1	2148.1	91.4
[illegible]	2801.8	187	2739.2	162.5	2108.3	144.6
[illegible]	2004.2	119.3	2084	72.9	1831.5	72.7
[illegible]						
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[illegible]						
[illegible]	2711.1	142.4	2780.1	144.8	2874.8	32.1
[illegible]	2487.6	108.9	2945	79.6	2778.4	210.7
[illegible]	2300.2	119.6	2308.8	8.4	2908.8	118
[illegible]						
[illegible]						
[illegible]						
[illegible]						
[illegible]						
[illegible]						
[illegible]	2877.8	71.3	2938.8	64.7	2464.7	87.2
[illegible]	2787.5	172.6	2988.2	49.1	2849.9	139.1
[illegible]	2184.7	103.4	2287	102.6	2000	73
[illegible]						
[illegible]						
[illegible]						
[illegible]						
[illegible]						
[illegible]						
[illegible]	2487.3	79.4	2821.7	114.8	2967.7	98.7
[illegible]	2944.6	487.1	2983.8	7.1	2818.1	301
[illegible]	2222.8	80.2	2246.2	188.8	2171.4	13.8
[illegible]						
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[illegible]						
[illegible]						
[illegible]	2617.4	172.4	2875	117.8	2447.7	34.8
[illegible]	2763	93.8	2783.8	186.1	2048.1	130.2
[illegible]	2287.8	167	2188.5	159	2139.4	218.8
[illegible]						
[illegible]						
[illegible]						
[illegible]						
[illegible]						
[illegible]						
[illegible]	2600.9	27.4	2639.4	49.4	2888.5	108.4
[illegible]	2721.1	38.8	2721.0	188.1	2810.4	138.8
[illegible]	2481.4	438.8	2413.3	219.4	2238	77
[illegible]						
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[illegible] IN AUTOMOTIVE [illegible]

	10-YEAR	LBS/INCH				
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	1849.1	1097.6	3010	104	[illegible]	37
[illegible]	2461.0	89.2	[illegible]	150.3	1477.8	150
[illegible]	2842.4	156.6	3092.1	89.4	1881.8	31
LP0416						
LP0677						
[illegible]						
10000						
OLD-10						
[illegible]	2814.4	158.6	3445.7	76.7	2824.7	18
[illegible]	3094.8	68.7	3003.9	370	1843	164
[illegible]	2942.9	22.2	3230.5	61.0	1858.6	154
LP0416						
LP0677						
[illegible]						
10LBP						
3M						
[illegible]	[illegible]	7.3	[illegible]	197.5	[illegible]	64
[illegible]	2873.4	177.3	3771.4	279.8	1791.1	184
[illegible]	2844	[illegible]	[illegible]	185.3	1801.3	95
LP0416						
LP0677						
[illegible]						
10000						
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[illegible]	3637.1	333.6	3637.8	81.8	3675.5	39
[illegible]	3868.3	48.8	3737.7	186.7	3181.2	88
[illegible]	3278.6	105	3183.7	8.2	1970.2	27
LP0416						
LP0677						
[illegible]						
10000						

[illegible] IN AUTOMOTIVE PLASTICS

SHELL BRAND	INITIAL LENGTH	INITIAL WIDTH	48 HRS LENGTH	EXPOS. WIDTH	INITIAL LENGTH	INITIAL WIDTH	30DAYS LENGTH	EXPOS. WIDTH	INITIAL LENGTH	INITIAL WIDTH	180DAYS LENGTH	EXPOS. WIDTH
30GEN	0.417	0.501	0.419	0.499	0.014	0.504	0.034	0.508	0.050	0.501	0.064	0.503
30GEP-X	0.032	0.431	0.029	0.430	0.031	0.501	0.028	0.5	0.029	0.503	0.03	0.5
30GEN304	0.035	0.499	0.019	0.499	0.017	0.498	0.018	0.5	0.034	0.496	0.066	0.501
LP0616	0.018	0.501	0.036	0.5	0.01	0.496	0.13	0.499	0.039	0.5	0.043	0.5
LP0677	0.019	0.498	0.018	0.499	0.021	0.501	0.028	0.5	0.017	0.5	0.036	0.499
30GEN919 100W												
30												
30GEN	0.010	0.499	0.020	0.499	0.036	0.499	0.033	0.501	0.019	0.501	0.017	0.501
30GEP-X	0.036	0.501	0.028	0.499	0.047	0.504	0.042	0.501	0.021	0.479	0.036	0.478
30GEN304	0.035	0.497	0.027	0.498	0.030	0.499	0.03	0.494	0.029	0.503	0.017	0.502
LP0616	0.04	0.501	0.04	0.5	0.019	0.498	0.021	0.499	0.03	0.499	0.027	0.499
LP0677	0.035	0.498	0.036	0.502	0.036	0.5	0.036	0.499	0.015	0.477	0.017	0.478
30GEN919 100W	0.11	0.5	0.120	0.501	0.038	0.462	0.025	0.457	0.015	0.472	0.023	0.477
ACE												
30GEN	0.044	0.5	0.047	0.5	0.047	0.5	0.033	0.5	0.029	0.499	0.031	0.5
30GEP-X	0.023	0.5	0.028	0.5	0.025	0.5	0.030	0.498	0.028	0.501	0.03	0.501
30GEN304	0.029	0.498	0.031	0.5	0.033	0.503	0.018	0.5	0.020	0.503	0.035	0.5
LP0616	0.018	0.5	0.041	0.5	0.032	0.501	0.026	0.5	0.037	0.502	0.031	0.5
LP0677	0.01	0.502	0.027	0.5	0.029	0.5	0.043	0.498	0.011	0.499	0.034	0.496
30GEN919 100W												
[illegible]												
30GEN	0.017	0.5	0.016	0.499	0.016	0.5	0.014	0.5	0.01	0.504	0.030	0.501
30GEP-X	0.031	0.5	0.020	0.501	0.020	0.5	0.018	0.501	0.030	0.502	0.029	0.501
30GEN304	0.034	0.5	0.03	0.498	0.03	0.502	0.028	0.501	0.015	0.503	0.024	0.499
LP0616	0.027	0.501	0.03	0.496	0.036	0.503	0.037	0.499	0.043	0.496	0.021	0.498
LP0677	0.013	0.498	0.031	0.496	0.021	0.503	0.027	0.498	0.01	0.499	0.014	0.5
30GEN919 100W	0.015	0.499	0.032	0.504	0.046	0.479	0.023	0.445	0.034	0.462	0.036	0.434
[illegible]												
30GEN	0.019	0.501	0.020	0.501	0.018	0.504	0.02	0.502	0.026	0.501	0.035	0.502
30GEP-X	0.028	0.5	0.032	0.5	0.020	0.504	0.030	0.501	0.024	0.501	0.034	0.501
30GEN304	0.029	0.499	0.02	0.5	0.020	0.501	0.021	0.501	0.02	0.5	0.03	0.499
LP0616	0.018	0.502	0.009	0.5	0.008	0.5	0.007	0.5	0.018	0.479	0.019	0.498
LP0677	0.024	0.504	0.021	0.5	0.024	0.502	0.014	0.499	0.000	0.501	0.031	0.498
30GEN919 100W												
JOE												
30GEN	0.018	0.501	0.009	0.501	0.021	0.502	0.026	0.503	0.024	0.5	0.033	0.502
30GEP-X	0.027	0.498	0.027	0.473	0.016	0.499	0.021	0.501	0.02	0.501	0.038	0.501
30GEN304	0.029	0.503	0.029	0.502	0.027	0.502	0.024	0.5	0.044	0.499	0.047	0.499
LP0616	0.030	0.498	0.03	0.499	0.022	0.504	0.019	0.499	0.028	0.501	0.041	0.5
LP0677	0.041	0.501	0.040	0.497	0.024	0.5	0.020	0.5	0.024	0.505	0.04	0.5
30GEN919 100W												

EXPOSE IN AUTOMOTIVE FLUIDS

SHELL	INITIAL	[illegible]	[illegible]	EXPOS.	INITIAL	[illegible]	[illegible]	EXPOS.	INITIAL	[illegible]	[illegible]	EXPOS.
ANTI-FR	LENGTH	WIDTH	LENGTH	WIDTH	LENGTH	WIDTH	LENGTH	WIDTH	LENGTH	WIDTH	LENGTH	WIDTH
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]