EA02025

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

REQUEST 10

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PART A – G
PART B

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REQUESTER HOTHER OF CHARGE. YES	-	Ripo	UNITER AWARD OF PORMA	n Y88
DP 92 -017 PETITION				
1/21/04 - Boros will be ordered			•	
				•

OFFICE OF DEFECTS INVESTIGATION

SECTION I

PETITION FILE INDEX DP92-017

DISS DATE	SEQUENCE NUMBER	DATE/SUBJECT	EXHIBIT NUMBER	CLASS
09-11-92	DP92-017-1	Petition: To Administrator, National Righway Traffic Safety Administration (MHTSA) from Benjamin Kelley, Institute for Injury Reduction seeking to initiate a defect investigation of the design of some seatbelt buckle latch. Connections can open unintended during accident.	• /	P
	DP92-017-2	Letter: To Distribution from ODI/MHTEA Advising of petition and a request for information.	•	Þ
5	-2a	Distribution Lists (2)		P
_9-23-92	DP92-017-3	Letter: 'To Distribution from ODI/NHTSA. Advising of Patition and a request for information.	•	P
		Distribution List		Þ
09-23-92	DP92-017-4	Letter: To Mr. Benjamin Kelley, Institute for Injury Reduction. Acknowledging receipt of petition dated September 11, 1992.		P
09-30-92	DP92-017-5	Letter To Gateway Safety Systems, Takata Inc. from ODI/MHTSA. Request for information with attachments.		P
	-5a	Attachment: Letter to Administrator, NHTSA from Relph Hoar dated 9-17-92 with Patents 4,875,907 and 4,733,444		P
	-5h	Attachment: Letter to Administrator, NHTSA from Ralph Hoar dated 9-24-92.	•	. P

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Sep'ermer 11, 1992

Ys. 'Arion Blakey

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'i' onel Righway Traffic Safety Administration

CC 7th Street, N.W.

stor 5220

''.shipeton, DC 20590

Jour Administrator Blakeys

AL SUPATION FOR DEPECT, RULEMAKING ACTION

The Institute for Injury Reduction patitions

La ational Highway Traffic Safety Administration

- 1. Initiation of a defect investigation of the distance, leading to appropriate recall and corrective of the parameterists whose seat belt systems have published it:
- Initiation of rulewaking leading to amendment of Fodoral Motor Vehicle Safety Standard
 Out to preclude such designs in future;

920914002

DuPont High Performance Films

DuPont High Performance Films U.S. Rous 23 & DuPont Road P.O. Box 50 Circleville, CH 43113 Tel. (614) 474-0724 Fac (814) 474-0722

September 17, 1993

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

Dear Deve,

Enclosed is the following information per your request:

Attachment 1 Pinhole detection in Kapton® film

Attachment 2 YTD Hele Performance

Attachment 3 Process desciption

Attachment 4 Summary of contact with TDC (IV partner in Japan)

Attachment 5 300EN Tensiles and Elengations - YTD Attachment 6 500FN131 Tensiles and Elengations - YTD

I am still working on an opinion statement on the use of Kapton® film in the power steering fluid you described, and will forward to you by fax.

Good back with your upcoming meeting, and please let me know if you have any questions.

Sincerely.

Edward C. McKenzie

TI-NHTSA 017497

Tricked = Particular Paper

ATTACHMENT 1

PINHOLE DETECTION IN KAPTON® FILM TYPES 300HN, 500EN131

Texas Instruments will only be supplied film which has been 100% impected. Any pinhole detected will be flagged and removed in the subsequent slitting operation.

Currently, Kapton® film is inspected on an off-line inspection rewinder, using a proprietary laser inspection system development by DuPont. This system takes advantage of the fact Kapton® film blocks certain wavelengths of light. Thus if Kapton® is passed between a light source of this wavelength and a detector, a highly effective method of detecting the presence of pinholes can be constructed. The inspection system has located a 1 mil diameter pinhole which was purposely introduced in the film.

Once detected, the system identifies the area of film where the hole is detected, and stops the film in front of a lighted inspection area. The operator marks the location with tape, flags the end of the mill roll, and logs the location into the defect map which accompanies the roll.

Calibration: The laser system undergoes routine preventative maintenance based on ISO schedules. The operator sets sensitivity per standard operating procedures.

Occurrence of Holes in 300HN:

Recent studies by Circleville personnel have concluded that the formation of holes less than 10 mils in diameter do not occur in the manufacture of 3 mil film at Circleville. This conclusion is based on over 6 years of research into the cause of such film defects, and the culmination of efforts to develop an on-line high resolution camera inspection system. This system, which will become fully operational by early next year, has permitted the opportunity to look at literally millions of square feet of film, and have detailed pictorial information stored for observed defects.

Further detail is not available due to the proprietary nature of the manufacture of Kapton® film. However, this new information has led to better understanding of the dynamics of our process, and the nature of the polymerization reaction.

Attached is a year to date summary of the pinhole performance on 300EN and 500FN 131 film. The data is obtained from the defect map generated by the inspection rewinders.

To summarize the pinhole performance:

	No. of Holes Detected	No. of Rolls Inspected	Total Sq. Footage	Average Sq. Ft.
500FN131	4	13	260000	1 per 65000
300HN	43	20	650000	1 per 15000

If you remove from consideration the 2 rolls which accounted for 38 of the detected holes in the inspected 3 mil, we experienced an average of 1 hole per 4 mill rolls, or 130000 square feet of film.

While we feel it is not possible to "guarantee" hole free film, we do feel that if the film is inspected, we can locate and remove the infrequent holes which do occur. DuPont is also committed to continuous improvement, as demonstrated by the advent of the on incommerce system, which will greatly enhance our ability to locate and to respond to problems as they occur.

Hole Performance: 500FN131 YTD 9/93

Gage/Type	Mill Roll	Date	Holes/Bubbles
500FN131	4118040	02/22/93	Ò
500FN131		02/23/93	0
500FN131	4118042	02/23/93	n
500FN131	4118043	02/23/93	0
500FN131	4118044	02/23/93	į.
500FN131	4118194	05/23/93	0
600FN131	4118223	06/11/93	ı
500FN131	4118224	06/17/93	0
500 F N131	4118247	07/07/93	0
500FN131	4118248	07/08/93	1
500FN131	4118300	08/05/93	0
500FN131	4118301	08/05/93	Ó
500FN131	4118306	08/25/93	1

Hole Performance: 300HN YTD 9/93

Gage/Type	Mill Roll	Date Holes	& Bubbles
300HNH	B121804	04/13/93	O.
BOOHNH	8121809	04/15/93	O
300HNH	8121811	04/15/93	0
300HNH	8121612	04/18/93	0
300HNH	8121926	05/31/93	0
SOOHNH	8121927	05/31/93	ī
300HNH	8121928	05/31/93	Ĭ.
SOOHNH		06/01/93	2
300HNH	8121930	06/01/93	ō
300HNH		06/02/93	ò
300HNH	8121942	06/05/93	0
300HNH		08/08/93	Ö
300HNH		06/09/93	20
300HNH	8121951		18
300HNH		06/09/93	0
SOOHNH		06/13/93	ĩ
SOOHNH		06/18/93	ō
HIMHOOE	6121962		ŏ
BOOHNH		06/14/93	ŏ
SOOHNH	8121969		ō

ATTACHMENT 3

September 10, 1993

PROCESS DESCRIPTION KAPTON® 300HN, 500FN131

Kapton® polyimide film is synthesized from a polycondensation reaction between an aromatic disnbydryde and an aromatic dismine. The resulting base film, type HN, is a tough aromatic polyimide film with an excellent combination of mechanical, electrical, and chemical properties. The product is made in thicknesses from 30 gage (3 mil) up to 500 gage (5 mil). Kapton®300HN is also used as the substate for the 500FN131 laminate.

Process Flow

Chemical Area:

Raw materials are mixed with a solvent and passed through a series of filters and holding tanks, to bring the solution to proper viscosity. The final step before casting is to add catalysts in a final mixing operation.

II. Castine:

The polymer solution, held at low temperature is cast through a die onto drum, which is at a higher temperature. This abrupt temperature change begins the imidization process. After the film travels part way aroung the drum, it has sufficient strength to support its weight, and is transferred to a series of air heated zones which remove additional solvent. The film then enters a series of heat zones which finish the polymerization reaction and lower the solvent content to proper levels. The film exits the oven and is wound in roll form on a two turrent winder, with sutconsted transfer capability. Each run of poduct is considered to be one lot, broken up into several "mill rolls" of about 750 to 800 lbs, to permit subsequent handling and processing of the film.

Film samples are sent to the Physical Testing Lab, at each roll break, where film properties are measured, compared to specifications, and recorded. The frequency of testing is statistically determined, based upon the likelihood of change from roll to roll, and the usefulness of the information in helping manufacturing control the process. For example, certain properties such as thickness, are measured every roll break, others such as tensiles and elongation are measured every other roll. If a problem occurs word is sent immediately to the Casting area, to initiate corrective actions. That roll and any subsequent roll is restricted and not permitted to be used to fill orders.

At this point, if specifications are met, the film is sent to storage, awaiting off line inspection, slitting to fill customer orders, or further processing (laminating or coating).

III. __Teffon@00 same film

Teflor® fluoropolymer films used in 500FN131 laminates are produced from FEP (fluoronated ethelyne-propylene) copolymer. Teflor® FEP exhibits flow characteristics similar to commonly used thermoplastic resins, allowing melt extusion into films which have good surfaces and homogeneous structures, avoiding problems such as sintering, void content and crystallinity associated with TFE resins. Teflor® FEP film is chemically inert and slovent resistent to virtually all chemicals except molten alkali metals, fluorine at elevated temperatures, and certain complex halogenated compounds at elevated temperatures and pressures.

Teflon® FEP resin is processed through a melt extruder, and forced through a die onto a heated quench drum. The film is conveyed through over a series of rolls through a Measurex to measure thickness and is wound into rolls. The Measurex feeds back information to an automatic gage control computer (similar to Kapton®) to close the loop and provide adjustment to the die lip opening.

The 100 gage film is then corona treated in a proprietary process to enhance the surface tension, in preparation for lamination.

IV. Lamination

The 500FN 131 laminate is produced in one pase on a 3 web laminator. A combination of heat and pressure is used to join Kapton® 300HN with 1 mil Tefloo® FEP film on each side.

The production unit is again the mill roll, which contains up to 4000 feet of product. A sample of each mill roll is sent to the lab for testing and comparison to specifications. If within spec, the mill roll is released to the semifinished warehouse to await customer orders.

V. Process/Quality Control

Du Pont's Kapton®-Teflon® manufacturing facilities are ISO 9002 certified, with periodic inspections to assure complience. The site processes are run under a state of controlled conditions with include:

- production schedules, based on orders and forecasts.
- Documented work instructions, Area Procedures and Operating Procedures, explain how tasks are to be performed where lack of such procedures could reduce the product's level of quality.
- Standard Operating Conditions which describe where process parameters should be set.
- Control of process parameters within specific ranges.

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

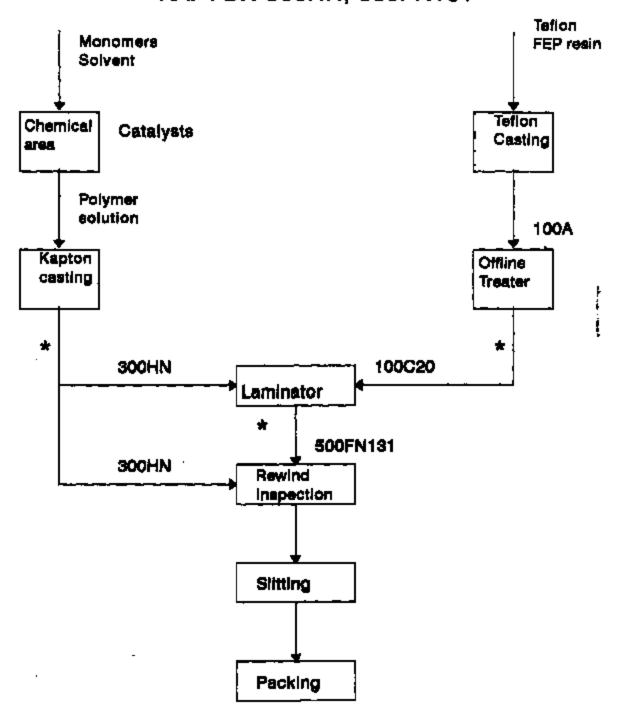
- automatic control loops
- manual controls
- computerized control systems
- statistical control charts

Gage Control

Primary thickness control, a major concern in production of film, is accomplished by measuring the film using radiation source based Measurex equipment, which traverses the web. The thickness signal is continuously fed back to a proprietary computer program. This program analyzes the thickness information and sends corrective control signals to adjust the die lip openings.

Physical properties are tested in the Quality control lab, using sample retains that are taken from each mill roll produced. The frequency of testing is determined statically, based on historical data on shift of properties due to changes in process conditions.

PROCESS FLOW KAPTON 300HN, 500FN131



* At this point, samples of each mill roll are sent to the QC lab for testing and verification of conformance to specifications.

"KAPTON" 300HN YTD

9/9/93

PROCESS CAPABILITY

FILM TYPE 300HN TI PART NO: 27225-4

substrate for 27225-1, -2 DHTR PERIOD: 1993 YTD

		SPEC.	LAB RELEASE DATA				. .
PROPERTY	COUNT	Min	fl√g	STOV Avg	-3×STDV Av	g-4×STDV	CPK
MD Tensile	49	24.00 kp s i	35 . 8 7	1.69	30.81	29. 12	2.34
TD Tensile	49	24.00 kpsi	33. 49	1.66	29.50	26.83	1.90
MD % Elong	48	50.00	79.19	6.47	59.77	53.29	1.50
TD X Elong	49	50.00	83.84	9.11	59.51	51.40	1.39
Modulus	11	370.00 kpsi (typ) 438.27	18.33	363.26	364.95	

Sace/Type	Mill Rol Date	KD Hodulus	MD Tessile	70 Tempile	WD Blossation	TO Elementica
300 m T	8121806 04/14/93		35.100	34.190	77.00	84.00
36094	8121808 04/14/93		35.290	35.100	60.00	91.90
301 1111	8121810 04/15/93		39.100	35,00	98.00	10.40
300 1111	8121611 04/15/93		36.580	34.800	E1.00	94.46
30 0 ENT	8121613 04/16/93		36.500	34.400	77.00	88.60
30 498 1	8121815 44/15/93		38.704	32.440	84.00	58.00
301 25	8121816 04/17/88		37.606	35.2 8 0	85.00	60 .60
30 00	B121924 65/30/93	461.00	31.01	34.880	64.04	89 .00
300 100	8121936 45/31/98		36.00	32.880	74.00	58.00
30 478 TK	8121928 48/41/48	440.00	85.600	31.880	79.04	80.06
30 4200	8191990 00/61/98	458.80	34.800	39.100	73.00	92.00
30 1001	8111982 66/41/48	446,00	35.60 0	51.360	75.00	T\$.06
300200	8121939 66/62/63		37.306	32.704	\$1.40	18.40
304000	8121935 48/48/48	454.00	84.200	\$1.409	TP.66	46.66
30000	B121987 00/63/94	446.00	35.440	30.400	78.60	77.60
300000	8121838 04/08/83		35.280	81.706	78.00	14,60
300 000	8121942 06/66/98		34.180	81.100	68.00	\$0.40
300EM	8121943 06/06/93		34.680	29.700		75.00
300min	8121846 06/07/98		35.300	32.760	75.00	64.00
300EE	8121MT 04/08/93		38.500	33.00	84.00	\$7.60
300 000	5121949 06/06/93		34.100	32.300	72.00	65.60
300EE	8121950 04/09/93		35.100	31.100	71.00	78.00
300 501	8121861 08/09/98		38.104	34.760	79.0¢ 63.0¢	85.00 90.00
SOMME	3121853 06/10/93		83.200	33, 440		85.00
\$00 99	8121969 96/12/89		30.100	24.900	81.09	85.06
30 0003	8121860 46/13/93		88,904	34.900	\$1.90 66.00	82.00
500EE	6121001 06/13/93		34.300	32.360		\$6.66
300 18 1	8121902 06/18/98		88 . LO4	34.100	76.67 70.60	10,40
201	8121964 66/14/89		34.01	22,700 22,100	83.60	84.90
\$00 000	8121D66 96/14/93		87.501	84.408	84.00	13.60
30 0991	6121968 46/14/83		32.504 35.501	38.401	81.60	40.00
300 7811 30 0781 1	8222116 46/20/93 8222118 86/20/93		35.384	35.204	84.00	88.60
360000	R222121 06/21/83		34.300	34,004	TT.00	80.00
30087	6222123 66/21/63		34.700	88,700	80.00	81.80
300876	M222125 M6/22/\$3		35.600	33.49	87.00	85.00
100EE	8222127 06/23/93		35.100	34,660	52.00	90.00
3000	8222129 04/23/33		23.300	34.300	76.00	87.04
300 53 F	8222131 04/23/93		85.304	58,560	86.00	H.10
30000	8222185 04/24/93		87.600	18,490	16.40	82.00
1000	8222135 06/25/98		82,804	81,200	74.00	17.00
300	8222137 46/25/48		36.64	32,809	86.00	74.00
1001	8222130 06/25/90		34.200	52.600	79.00	79. 00
300	8212141 46/26/93		15.560	34.800	85.00	81.00
300 1111	5212143 46/16/93		33.000	53.606	76.00	84.00
30 000	8222145 88/27/95		35.300	35.105	88.00	84.00
340ENR	8222147 06/27/83		35.800	29.60	45.40	75.60
300000	8212171 97/44/83		34.600	34.980	TB.90	69.00
300EM	8222172 07/04/92		84.400	\$4.460	79.40	\$5.99

"KRPTON" 500FN131

9/9/93

FILM TYPE 500FN191 TI PART NO: 27225-1, -2 DATA PERIOO: 1993

	!	SPEC.	LAB RELEASE	DATA			
PROPERTY	COUNT	Min	AVG	STOV	AVG-9×STDV	AVG-4×STDV	CPK
MD Tensile	10	15.00	22.30	1.73	17.12	15.39	1.41
MD 2 Elong	10	35.00	71.50	17.20	19.90	2.70	0.71
Hodulus	9		282, 23	17.08	230.99	213.91	

Gage/7790	H11 1 61]	Date H	D Tensile MD	I] onest!
500 F f131	41 18040	02/22/95	21.27	70.08
500 FN 131	4118041	02/23/95	29.04	80.00
500PW131	41 18042	02/23/83	21.08	58.00
500FN131	4118043	02/23/83	22.02	58.00
500 F1 131	4118044	02/23/93	20.68	50,00
550 W 131	4118184	05/23/93	18.80	43.00
50 0][131	4118223	08/11/93	24.70	67.00
506期181	4118224	08/17/83		
5007 1 18t	4118247	07/07/98	23.50	61.00
500 FN 18t	4118248	07/08/98		
60 070 131	4118800	08/65/98	23.46	99.00
5047 1 181	4118301	08/05/98		
504FN131	4118306	08/25/93	24.38	65.60

DuPont High Performance Films

DuPont High Performance Flims
U.S. Roets 23 & DuPont Roed
P.O. Box 89
Circlaville, OH 43113
Tel. (614) 474-0724
Fac (614) 474-0722

September 20, 1993

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

Dear Dave,

In response to your inquiry, I have reviewed the composition of the automotive power steering fluid, with D. J. Parish, Research Chemist. Dr. Parish is involved with research and development of Kapton® polyimide films. The composition, provided by John Brennan of Texas Instruments is as follows:

89-90% mineral oil
3-10% additives:
friction modifiers, (fatty acid esters) anti-oxidents (hindered phenols) proprietary (metal deactivators to protect non-farrous parts)
slightly alkaline: pH 7.5-9

Taken individually, each component, with the obvious exception of any unknown proprietary compounds which may be included, should pose no adverse effects on the strength or physical proporties of Kaptoo® type HN or type FN film. However, 100% assurance cannot be predicted without testing.

While DuPont has not run tests specifically with OEM power steering fluids to determine the effect on ultimate tensile strength and elongation, we have conducted these tests involving off the shelf automatic transmission fluid (similar in construction to power steering fluid). Our findings, included in the packet you received during your visit to Circleville; Kapton® type 300HN and 200FN919 films retain a high percentage of tensile strength and elongation after hundreds of hours of exposure. This data would appear to support Texas Instruments testing of 300HN and 500FN131 with power steering fluid.

This information and any available test data, offered without charge as part of our service to customers, is based on our testing and experience and is believed to be reliable. The DuPont Company makes no guarantee as to results obtained by others, and assumes no liability in connection with the use of this information. Determination of product suitability for any specific application is the responsibility of the user.

TI-NHTSA 017509



Thank you for your interest in DuPont High Performance Films. Please call if you have any questions or I can be of further service.

Sincerely

Edward C. McKenzie

Sr. Technical Service Representative



To: Edward McKenzie

DuPont High Performance Films

(614) 474-0680

Tal (614) 474-0730

From: Chris Wagner

Texas Instruments

Fax (508) 699-3153

Tel (508) 599-3170

Ed.

Yesterday we overnighted to you 3 bags, each containing 2 pieces of Kapton squares, labeled 3, 5, and 11. Each piece of Kapton has a circular area in the middle which has a plastic deformation and is sketched below. The fluid side of the Kaptons is indicated in this sketch, in case that information is pertinent to your analysis. As you've discussed with Dave Czarn, we would like you to compare this center section on all the kapton samples to unused 500FN131 film to see if any chemical degradation has taken place.

On the corner of each Kapton in sample 11 is inscribed, in small letters, "Top" or "Bot" for top and bottom kapton layer. In your results for sample 11, please indicate which set of results are from the top layer of Kapton and which is from the bottom layer.

Should you have any questions, please don't hesitate to call me.

Thank you,

Chris D. Wagner

Fuxed 9/28/93

side View of Deformed Area

View A.A



DuPont High Performance Films

Du Pant High Performance Films U.S. Route 23 & CuPant Road P.O. Box 89 Circleville, OH 431 I3 Tel. (814) 474-0724 Fac: (614) 474-0722

October 1, 1993

John Brennan Texas Instruments MS 10-13 34 Forest St. Attleboro, MA 02703

Dear John,

I have reviewed the attached document concerning films made from DuPont Teflon® fluoropolymer regins, with Frank Schmidt, Senior Chemist, associated with the Teflon ®film manufacturing area at the Circleville site. We found the information to be essentially correct. However, a point of clarification should be made regarding the next to last paragraph on page 1. Aqueous dispersions of Teflon® are produced as a result of the polymerization process. Teflon® fine powders and granulars are created by further processing, and cannot be re-dispersed into a liquid.

The following references should prove helpful in understanding the fabrication of Teflon® regime:

Polytetrafluoroethylene - by S. V. Gongal

Kirk-Othmer: Encyclopedia of Chemical Technology Volume 11, Third Edition Pages 1-24

Polymer Science and Engineering Encyclopedia
 Tetrafluoroethylene Polymers - Wiley

Volume 16, page 577

I hope this information is helpful. Please call me if you have further questions.

Sincerely.

Edward C. McKenzie

Sr. Technical Service Representative

TI-NHTSA 017512

(EML019)

Mittel as Recycled Paper

Tailon Pilme

Teflon is Du Ponk's trademark for their fluoropolymer materials. Teflon refers to both polytetrafluorosthylene (PSFE) and fluorisated ethylene propylene (FSF), and other fluoropolymers.

FEF is a copolymer of tenderfluoroethylene and hazafluoroetopylene. It has the chemical repeat etwasture of "CF2CF2CF(CF3)CF3". The parentheses indicate that the CF3 unit is a side group pendant from the third C in the repeat unit.

for is mit producedle. It was developed to achieve the properties of PYTH with the edded boxus of being menufecturable on conventional polymer processing equipment. The film is produced by mail entrusion. All is equily removed from the thin polymer layer, so microvoids or perceity is not an issue with FEF film.

PTFE has the chamical repeat unit of -CF2CF2". PTFE is so viscous when maltan that it cannot be precessed by conventional injection molding or mait embrusion. FUFE can easy be manufactured by cintering or by casting. Both sintering and casting can be used to produce PTFE films.

Fintering is eccomplished in a manner similar to powder metallurgical techniques. Fine PTFR powders are compressed and bested. This sintening causes the powders to contains into a solid billet. Films can be made from this billet by outting thin suctions from it. This is called skiwing.

deposited as a thin layer. The liquid is driven off, and the pewders conlegue under heat.

A FTFE film results.

Skived film and sest film are easily distinguishable. Cast film is clear, whereas skived film is white. The PTFS film semoved from Make switches are abived films.

Both processing techniques create microveid passetty in the final PTFE product. This is a bigger problem in shived film than in east film. In sintering, it is difficult to remove air from the thick billet. Small air bubbles are trapped in the billet. When the billet is out during shiving, the bubbles are cross-sectioned, creating microvoid passetty in the film. Shived film is more passetble than cast film as a result. The parametricity of cast PTFE film is approximately equivalent to that of FEF.

This information is based on posversation with Maurice Raumann of Du Funt, and from material is Resinanting Polymer Asuroshoph by Raymond B. Segmour.

PEPLON FEP FILM

Helt processable
Microveide and possesty not a problem
Very low permeability
Film is along

TEFICH PUTE PILK

Not noit processible

Cost film-clear

Shived film-chits

Microveid parasity in skived film

Higher personbility in shived film



DuPont High Performance Films

DuPort High Parlormance Films U.S. Route 23 & DuPont Road PO. Box 65 Circleville, CH 43113 Tel. (614) 474-0724 Fax: (814) 474-0721

October 1, 1993

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

Dear Dave,

In response to your inquiry, I have reviewed the composition of the automotive power steering fluid, with D. J. Parish, Research Chemist. Dr. Parish is involved with research and development of Kapton® polyimide films. The composition, provided by John Brennan of Texas Instruments is as follows:

89-90% mineral oil 3-10% additives:

friction modifiers, (fatty acid enters) anti-oxidents (hindered phenols) proprietary (metal deactivators to protect non-ferrous parts)

stightly alkaline: pH 7.5-9

Taken individually, each component, with the obvious exception of any unknown proprietary compounds which may be included, should pose no adverse effects on the strength or physical properties of Kapton® type HN or type FN film.

While DuPont has not run tests specifically with OEM power steering fluids to determine the effect on ultimate tensile strength and elongation, we have conducted these tests involving off the shelf automatic transmission fluid (similar in construction to power steering fluid). Our findings, included in the packet you received during your visit to Circleville: Kapton® type 300HN and 200FN919 films retain a high percentage of tensile strength and elongation after hundreds of hours of exposure. This data would appear to support Texas Instruments testing of 300HN and 500FN131 with power steering fluid.

This information and any available test data, offered without charge as part of our service to customers, is based on our testing and experience and is believed to be reliable. The DuPont Company makes no guarantee as to results obtained by others, and assumes no liability in connection with the use of this information. Determination of product suitability for any specific application is the responsibility of the user.

(EMOL7)

E.L. du Porti de Mamours and Company

Printed on Recycled Paper

Thank you for your interest in DuPont High Performance Films. Please call if you have any questions or I can be of further service.

Sincerely

Edward C. McKenzie

Sr. Technical Service Representative

cc: R. Hutton
W. Y. Hsu
W. E. Marsh
D. P. Reifschneider
T. E. Clyde
I. R. Edman
R. Webb
File: K-6, K-10
K-24-k

October 27, 1993

To: E.C. McKenzie

From: J.A. Kreuz 3497

INVESTIGATIONS OF KAPTON TYPE F (1-3-1) IN AUTOMOTIVE PRESSURE SWITCH APPLICATIONS

SUMMARY

The Kapton® type F disphragms from the dismantled pressure switches that were in automobiles have shown no evidence of hydrolysis, even after the maximum use of 121,700 miles. This conclusion is based primarily on inherent viscosity measurements in suifaric acid, after stripping the 1.00 mil Teflon® FEP from either side of the 3.00 mil Kapton®. No significant differences were observed between the inner area of the Kapton® films that were directly opposite the working fluid that might contain water, and the outer areas of the Kapton® films that were protected by metal and/or gaskets during the entire times of operation.

BACKGROUND

About one month ago you requested that we examine the Kapton® type F (1-3-1) disphragms that had been in Texas Instruments' (TI) pressure switches, which were installed on GM automobiles. These pressure switches had operated satisfactorily for mileages ranging from 30,177 to 121,700. You asked that we look for evidence of hydrolysis, and if hydrolysis was not observed, then DuPont and TI might be able to convince Nissan to adopt these switches and thereby grow the market for Kapton® in this application.

You supplied three samples, each sample containing two disphragms from the dismantled pressure switch. One disphragm faced the working fluid and the other disphragm faced the mechanical/electrical contacts of the switch. Unfortunately, only one set of disphragms indicated which disphragm faced the working fluid. Other pertinent identifiers were:

- (A) #3 1989 Pontiac Gran Prix, Date 8-1-93, Engine 2.8L V-6, Mileage 30177.
 No identification of which disphragm faced working fluid.
- (B) #5 1990 Pomiac Gran Prix SLE, Date 12-22-92,
 Engine 3.1L, Mileage 33619.
 No identification of which disphragm faced working fluid.
- #11 1988 Oldsmobile Cutlass Calaise, Date 4-12-88,
 Engine ?, Mileage 121700.
 Disphragms identified as to position relative to working fluid. "Top" disphragm faced fluid. "bottom" disphragm faced metal/electrical contacts.

RESULTS AND DISCUSSION

The square samples, approximating 3/4" on a side, were first stripped of the Teflon® FEP by time consuming effort under the microscope. Following this, the "Top" sample of (C) was submitted to Ron Webb, who ran FTIR's of the inner circular area, 0.06"2, and the outer area. The inner circular area faced the working fluid. The objective of this test was to look for the possible presence of hydrolysis through possible differences in the spectra in the regions around 3500cm⁻¹-3000cm⁻¹, and 1800cm⁻¹.

The (C) disphragm was the most likely one to provide evidence of hydrolysis (121,700 miles), even though we felt that FTIR was not a sensitive enough tool to detect hydrolysis of perhaps 1%-2%, which would be sufficient to embrittle the disphragm. And it was evident that the film was very tough. The spectra were virtually superimposable as can be seen by the attached copies, and it was concluded that if hydrolysis were occurring, it had to be less than 1%-2%.

The next approach was to run inherent viscosity measurements in concentrated sulfuric acid of the inner and outer areas of all the stripped disphragms. The paucity of sample sizes, especially the inner circular areas, necessitated that we run the inherents at 0.25%, rather than 0.50% (cf. Method at end of this report). The data were not only very convincing, but also very consistent in showing that hydrolysis did not occur. We were looking for depressions in inherents from outer to inner areas amounting to more that 0.2-0.3 units, but these were not observed. The Table summarizes the results.

The consistency of the inherent viscosity data was mispicious to us and we double checked our method and calculations. The only rationale that we can offer for what appears to be "padded" data is the probability that all these pressure switches were made from the same Mill Roll of Kapton® type F or different lanes of the same Mill Roll. One inner sample area of (C) that faced away from the working fluid had a lower inherent by 0.15 units relative to the outer portion. This is the type of experimental variation that would be expected, especially working with such small sample size; I would not say that it is evidence of hydrolysis.

INHERENT VISCOSITY METHOD - The sample was cleaned with methanol and dried at 100C for 30 minutes. It was then weighed and to it was added enough concentrated sulfurio acid in milliliters to give a solution of 0.25gm/ml. The total quantities of solutions from the inner areas amounted to about 2ml., since the weights of the samples were of the order of 4mg. The flow time of the sulfuric acid was first measured in an Ubbelohde semimicro viscometer at 30C. The flow time of the sample was then measured. Inherent viscosities were calculated by:

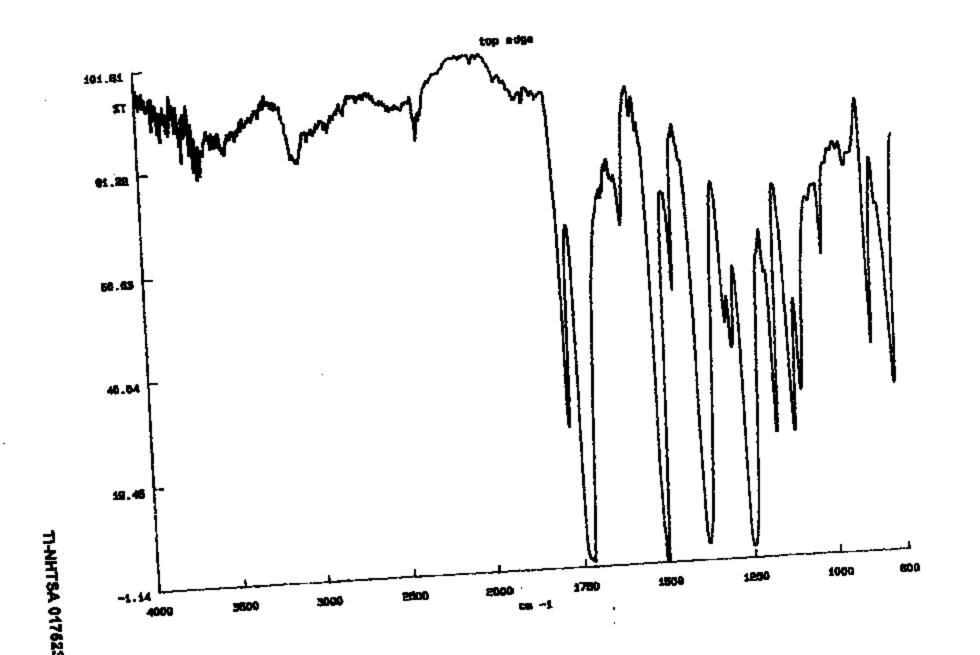
In(flow time of sample/flow time of solvent)/.25

INHERENT VISCOSITIES OF KAPTON® DIAPHRAGMS FROM PRESSURE SENSITIVE SWITCHES

SAMPLE IDENTITY		TOP/ BOTTOM*	INHERENT INNER AREA	VISCOSITIES (0,25%, 30C) OUTER AREA
(A)	#3 1989 Pontiac	· ·		· · · · · · · · · · · · · · · · · · ·
	30,177 Miles	?	1.54	1.54
		?	1.54	1.54
(B)	#5 1 990 Pon tiac			
	33,619 Miles	7	1.54	1.54
	·	?	1.65	1.65
(C)	#11 1988 Olds.			, .
	121,700 Miles	Top	1.65	1.62
	-	Bottom	1.50	1,65

Top = Diaphragm facing working fluid.
 Bottom = Diaphragm facing metal/electrical parts.

TI-NHTSA 017522



DuPont High Performance Films

Duffors High Performance Films U.S. Rouse 23 & Cuffert Ross PO. Box E7 Circlywille, DH 43113 Tel. (814) 474-0724 Fac: 1814) 474-0712

November 11, 1993

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

Dear Dave.

Enclosed you will find the following information regarding Kapton® polyimide film :

- Test report, disphragms removed from service: Detailed findings from J. A.
 Kreuz, Research Fellow with the Circleville Research and Development
 Laboratory, in which no evidence of degradation or hydrolysis was observed in
 the disphragm samples.
- 2. Film physical properties versus color: Tensile strength and elongation is plotted against L color (measure of "light to dark" for 300HN Kapton®). Data from 200 rolls produced in 1992 and 1993 are shown. Slightly lower elongations are observed in lower L color (darker) film. While other factors (such as raw material consistency) can affect color, film which has seen higher heat cross links to a greater extent, becomes darker and less elastic.

Physical properties across the sheet: Kapton® film is manufactured 50-60 inches wide. Film properties of tensile strength and elongation to break are measured across the sheet in roughly 10-12 inch intervals. Enclosed is the raw test data taken from 15 mill rolls of 300HN produced in 1993, representing 4 different production runs. Also included is the historical standard sheet performance. Although performed on 1 mil film, this is an indication of the variability of the test methods involved in measurement of film tensiles and elongations. Variation in measured values across the web greater than those expected due to test variability, in many cases coincide with thickness variations across the sheet.

TI-NHTSA 017524

(EM.020)

LL de Past de Humany and Company

(A) Printed as Recorded Paper

You will notice differences in machine direction (MD) and transverse direction (TD) values. These result from the manner in which Kapton® film is manufactured, and the necessity to restrain the film and carry it through the oven. We continue to learn more about our process and development is ongoing to improve the balance of properties.

Please call if you have any question or I can be of further assistance.

Sincerely,

Edward C. McKenzie

Sr. Technical Service Representative



CIRCLEVILLE PLANT

№ 3 Box 89 Chicleville, OH 43113 Date: Time: Fax No: 508

FACSIMILE TRANSMISSION COVER SHEET

Addressee(s);		
Name	Company or Department	Location
DAVID CHARN	THE INSET	ATTLEBORD 189
eç:		
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·	DUPONT	Coccernet
<u></u>	PAGE(S) TO FOLLOW THIS CO	VER SHEET
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Just Est " WE	76 13 774E METHOD (
THI	E FAX NUMBER FOR AGV IS (614) TION NUMBER IS (614) 474-0799 (1	474-0794.
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	& & & CONFIDENTIALITY NOTE.	医胶胶

The documents accompanying the streety: resumnization contain information from DaPont VMED which is confidential and/or legally provileged. The information is not - ed only for the use of the institutional or entity named on sing transmission week. If you are not the intended exception, you are vereby antified that any disc. o are, copying, distribution or the taking of any action in reliance on the continue of the telecopied information is strictly prolabited, and that the documents abould be returned to DuPont IACD immediately. In this regard, if you have received this telecopy in error, please notify we by selephone at (614/474-11739) immediately so that we can arrange for the return of the original documents to us at no cost to you.

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durting a Control of a conference

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KIM Deelgnetion: O £176 - 49

Standard Test Method for Folding Endurance of Paper by the M.I.T. Tester

This complete is troops upder the fixed designation to 2176; the parallest insteadistrip following the designation includes the year of original adoption on in the case of revision, the year of instruction, A superior is placed by included an address the respectively. A superior opposite the first configuration of includes an address the respectively of respectively.

1. Scope

1.1 This last method describes the use of the M.L.T.-type folding apparatus for determining folding endurance of paper. The M.I.T. tester can be adjusted for papers of any thickness; bowever, if the outer Abrous layers of paper thicker than about 0.25 som (0.01 in.) cupture during the first few folds, the test loses its significance. The procedure for the Schopper-type apparatus is given in Test Mathod D 643. This test method is the technical convenient of TAPFI T 511.

1.2 This standard does not purport to address all of the rafesy problems, if any, associated with its use. It is the responsibility of the user of this standard to establish appears priote safety and health practices and determine the applicability of regulatory limitations prior to use.

2. Referenced Decrements

2.1 ASTM Standards:

To \$85 Methods for Surspling and Accepting a Single Lot of Paper, Paperhourd, Piberboard, or Release Product?

D 643 Test Method for Folding Endurance of Paper by the Schooper Tetter^a

D 689 Method of Conditioning Paper and Paper Products for Testing

3. Terminology

3.1 Definitions:

3.1.1 fold number—the number of double folds.

3.1.1 folding endurance—the logic of the folding number.

d. Apparette

١

4.1 Folding Tener, consisting of:

4.1.1 A spring-leading clamping jaw countrained to unove without greation in a direction perpendicular to the axis of rotation of the folding head specified below and having its claraping serfaces in the plane of this axis. The load thall be applied through a spring attached to the jew assumbly, which is easily adjustable to provide any desired tention on the specimen from 0.5 to 1.5 kg. The deflection of the spring when loaded shall be at least 17 mm. (0.67 in.)/kg.

4.1.2 As oscillating folding hand supporting two smooth.

cylindrical folding surfaces parallel to, and symmetrically placed with respect to, the sais of rotation. The portion of the axis of rotation shall be midway between the common tangent planes of the two lividing surfaces. The folding beed shall be provided with a cleanping law with its nesters ed-9.5 mm (0.375 m.) beyond the sais of rotation. The rutary oscillating movement of the hand shall be such as to fold the permit through an earlie of $135 \pm 2^{\circ}$ both to the right and to the left of the position of the unfolded specimen. Each of the two folding surfaces shall have a radius of curvature of 0.18 ± 0.015 mm (0.015 ± 0.001 in.) and a width of oot lets the 19 mm (0.75 in.). The distance separating the folding surfaces shall be greater than the uncompressed thickness of the paper being thated but by no more than 0.25 mm (0.0) in.). Various size folding heads are required for testing different thicknesses of paper. Heads available will seconmodete thicknesses from 0 to 0.01, 0.01 to 0.02, 0.02 to 0.03, 0.03 to 0.04, and 0.04 to 0.03 in.

4.1.3 Maron-A power-drives device for importing a rotary oscillating motion of 175 ± 25 periods/min to the folding damp.

4.1.A Counter, for registering the number of double folds: required to brook the specimen.

4.2 Strip Chater, to cut 15-mm wide parallel strips to

within 0.02 mes with close other.

4.3 Exhaust Fan, combridged, mounted to that its intel, at least 5 cm in diameter, is next to the conflicting beed and the arrectures being towed, thus diswing the conditioning more sir rapidly over both specimen head it capacity shall be great enough to prevent the temperature of the head from rising more than 0.3 C.

B. Test Specimen

5.1 The mample to he rested shall be obtained in accordance with Methods D 565. From each sample shall be obtained, so as to be representative of the test unli, at least sen specimens in each principal direction of the paper cut accurately to a width of 15 ± 0.02 mm and a length of 13, profesably 15 cm. Strips shall be selected that are free of wrinkles or blemister not inherent in the paper, and that shall be taken that the arm where the flexing takes place doct not contain any portion of a wantemark. The long edges of the specimen shall be clean cut and parelly.

6. Adjustment med Calibration

6.1 Make sure that the folding edges are free from rust or

dirt and that the counter operates properly.

6.2 Measure the physics disting by determining the additional land required to move the prunter perceptibly when displaced under a load of 1.0 kg or the load sension used in testing. The friedon should not by greater than 25 \$.

^{*} This was question in maker the particular of ASTM Committee D-4 on Paper and Paper Products and in the direct responsibility of Bobsessmittee 206.92 on

Current edition superoved June 34, 1999, Published Assess 1989, Originally published in D 2176 - 63 T. Last province adules D 2176 - 69 (1982)²³, Promotly part of Methods D 643, 2 Assessi Seek, of ARTH Standards, Vol. 19.09.

* Chappelinearity on 1980 Assessi Seek of ARTH Standards, Part 20.

|h ||:

6 3 Measure the change in tension due to eccentricity of pation of folding adjet at follows: Place a test strip of strong agar of the proper thickness, cut in the machine direction, the tester at for making a folding test, and apply a tension of the or that to be used for the testing. Rotate the folding end slowly throughput the antire folding cycle and measure he maximum change in displacement of the planger to an ecuracy of 0.1 mm (0.004 in.). This should not be greater has that produced by a weight of 35 g. The curvature of the iding edges can be measured by making casts, magnifying hem in profile and comparing thum to true circles. A folding star in steady tite should be adjusted and calibrates at narration of not more than 1 month. If not in steady the, then musclinistly before a standard test.

1. Confitioning

7.1 Condition and test the paper in an atmosphere in accordance with Method D 685. Handle a specimen by the ends and do not touch is with the hands in the region in which it is to be folded.

Note 1—As faiting endurance is very sentitive to the recipions operate of the specimen, it is important to clearly string the requirements for presentitioning from the dry side, for conditioning, and for conditions during testing.

I. Procedute

\$.1 Turn the estillating feiding hand so that the opening is vertical. Place a weight on the top of the plunger equivalent to the tension desired on the specimen, necessity i kg, top the plunger eldoways to eliminate friction, check and set the load indicator, and remove the weight. Depress and look the plunger in position corresponding to the load. Without touching the part of the strip to be folded, clamp the

specimen firmly and aquapty in the jaws, with the surface of the specimen lying wholly within one plans, that is, flat, and with the sides not touching the oscillating jaw mountingplats.

8.2 Unarrow the plungar lock to apply the specified tension to the sest strip. If the reading of the load ludicator then changes, reclamp the specimen under the proper tension. Whenever possible use a tension of I kg, but if this close not give good results (that is, however 10 and 1000 double folds), use a greater or lesser tension.

Norm 2.—The autober of the folds will vary by about the cube of the section product.

8.3 Set the counter to seep and fold the ettip at a uniform rate of 175 ± 25 double folds/min until it breaks.

3.4 Record the number of double folds made before

9. Report

9.1 Folding Endomnics—Convert raw data to logic Caloultie mean of logs and caport as "logic M.I.T. Folding Endomnious."

9.2 Fold Number-Report the number of double folds.

9.3 State clearly if a tension other thus, 1 kg is used.

10. Province and Blos

10.1 Represibility:

Folding Endurance 0.12 log₁₀ Fold Number 5.8 %

10.2 Reproducibility:

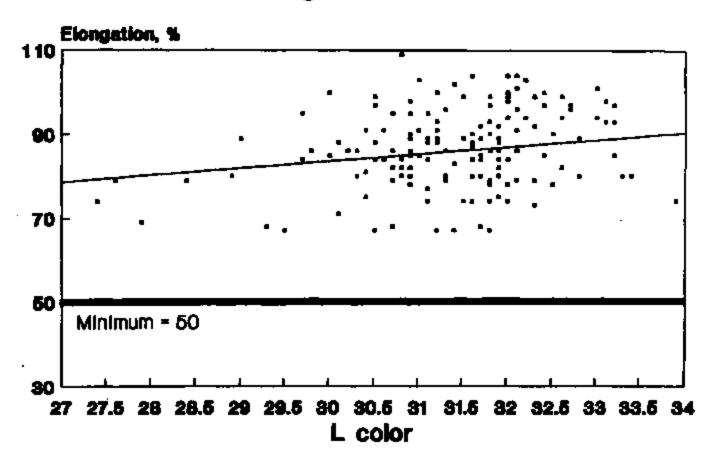
Folding Endurance 0.39 Tog.o Fold Number 15.7 %

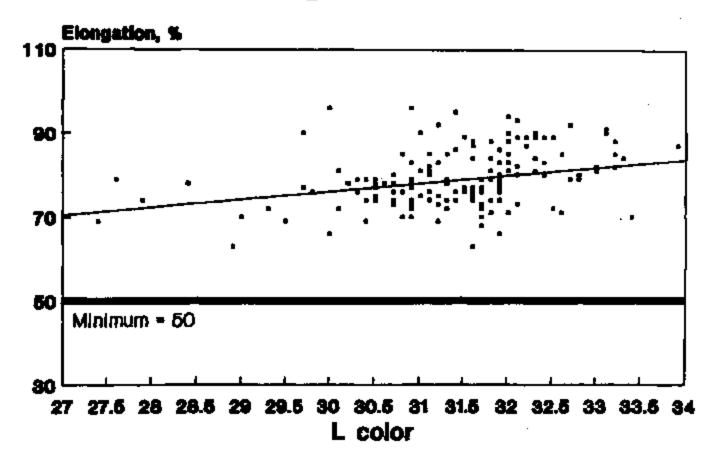
10.3 Bies-The bies for this test method is unknown.

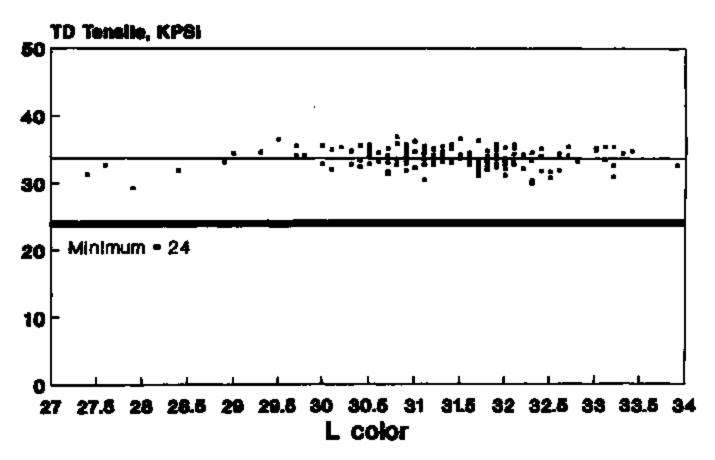
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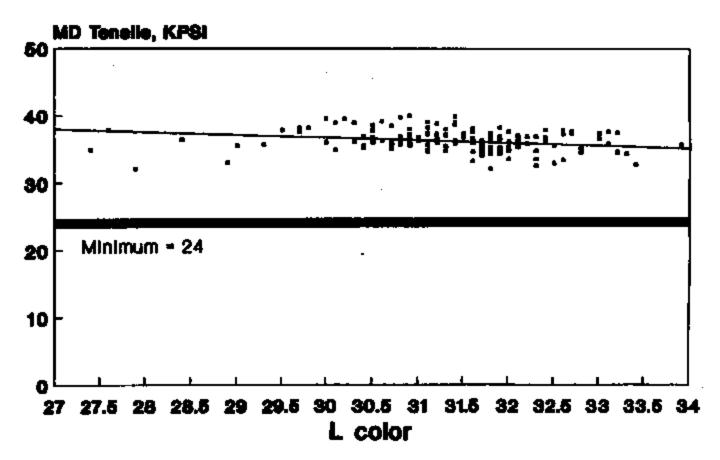
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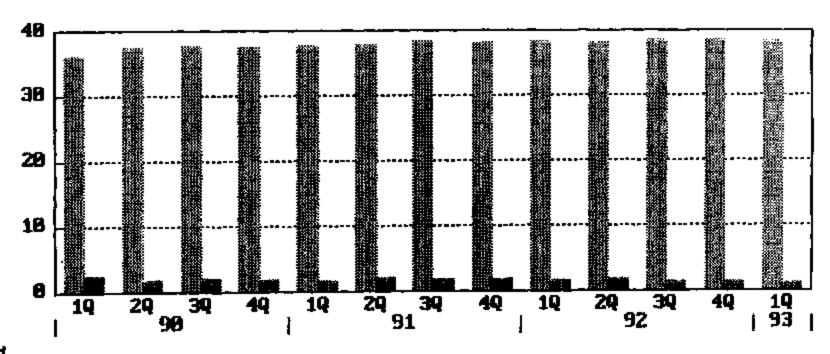
300HN MD Tensile Strength vs L color



FAPTONE STANDARD SHEET

AD Tennile strongth (KPSI)				AD ELDAY	ation [1]				
1990	19	29	36	44	1990	ι φ .	20	30	44
RVE	34,200	37.500	37,733	37.652	AVE.	84.300	87,100	87.4B1	87.656
GTD	2.150	1,840	1.893	L-824	578	7,200	3.690	5.340	5.398
COV	0.076	0.549	0.050	840.B	COV	0.083	0.063	0.061	0.062
1991	10	29	370	49	1991	10	20	320	44
445	37.700	38,100	38,404	38.300	AVS	84.900	96.300	89.200	89.000
ETD	1,500	1.960	1.800	09B. J	STD	5.008	6,200	1.300	3.800
COV	0.040	0.450	0.046	0.045	COV	0,058	0.072	1.060	9.965
1772	LD	20	30	40	1992	10	20	70	44
AVB .	38.401	39,297	38.778	38.438	AVE	10,487	87.841	87.671	89.913
STD	1.636	1.741	1.215	1,242	STB	4.530	5,748	4.317	4.233
CON	0,043	0.045	0.031	0.032	CON	0,072	0.046	0.948	0.047
1993	16	24	30	44	1993	16	29	30	49
AVE	38.433				AYO	84,064			
510	1.131				670	3,927			
COV	0.029				COV	4.044			

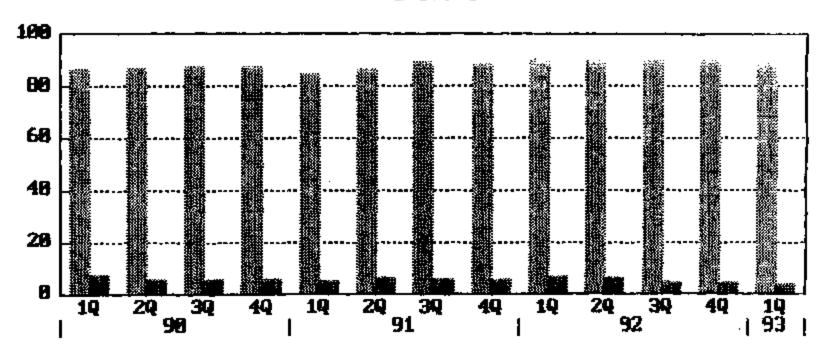
MD TENSILE STRENGTH SM



Series 1 Series 2

AVERAGE STD DEV

MD ELONGATION ELM



Series 1 Series 2

AVERAGE STD DEV

Post-It* brand fex wansmittel n	námo 7671 d of pages > 3
Ed mcking	Dave Cedica
Durat	© <i>T</i> <u>∫</u>
Dept.	Set 697-153%
G14 474-6680	

12/1/93

Ed,

(1) I've made some small changes to the proposed effec. (sin to following pages) Can you please review to see if you agree?

Also, please let me know the ASTM spec # for tenante texting a and your recommendation for motorion size.

[I've agent to give Nies are update to their many open questions only 2 wich starting this Friday, 148. If one of the experience it was in TI/DuPont's Kapton seec. It you generally agen with the spec, I'll wiched is it as a publication good in may up date of Note Spec was not presented to Nissam. AJM 7/12/94

(3) Nivan has Ct'd a midflat Jammong visit date, but, I still don't have their asynda. If you could let me know some good days for you (pulable a I day trip is Oh), I can start to from up the plans

Elean call when you have a chance.

Franks, Van

NISSAN RESEARCH & DEVELOPMENT INC.

39001 Brianne Drive Fermington Mills, MT 48281

P.O. Box \$200 Farmington (Ettle, M) 46305-9900 Telephone: (513) 486-4122 Farmington (515) 488-8607

488: 3905°

October 25, 1993

Mr. Norm Freda Texas Instruments 33737 West 12 Kile Road Farmington Hills, MI 48331

T.I. Power Steering Pressure Switch Open Issues for Nissan North American Vehille Applications.

Hr. frada:

Attached is a list of open technical issues regarding Kapton as it is used in T.I. pressure switches. The list describes specific issues as it relates to the pump sounted T.I. switch (MMMC applications) and line mounted T.I. switch (Quest/Villager) applications.

The questions were generated by Nissan in Japan (Nissan Technica) Conter) and Nissan Research and Development (USA) based on T.I.'s technical presentations concerning Kapton. Based on the open issues and the time required to resolve them, it is not possible to implement the T.I. switch for MF start of production.

Please respond to these open issues to the Nissan Technical Center (Japan) and Missan Research and Development (MRD. After making these issues clear, NRD and NRMC will decide on implementation timing for the T.I. pressure switch.

If you have any questions, please call.

Thank you,

Ohio Meuro

Chris Gleason

Engineer

Chassis Design Engineering

NRD

Mr. Cikawa - NRD

Mr. Miller - MRD

NMMC - Mr. Maggart

MMMC - Mr. Swenson

Group Project Engineer Chassis Design Engineering

NRO

TI Japan - Mr. Sayema

ZUA Autoparts - Mr. Draney

ZUA Autoparts - Mr. Kumasaki

Questions	Application [Switch Type]		
	Line Noust	Pump Howark	
1. Nigean (RCS) questions about the Kapton material as quarenteed by Duposts		1	
*Please provide the details of DuFont's quarastes on 100% isspection of Eapton material. Provide detailed information wand to guarantee the Eapton material, in addition to tensils strength, for items such as slongation, thickness and pinhole detection.			
eplease provide data that can back up this guarantee of Rapton material. For example, does Supont guarantee tensile strongth based on test regults taking variation factors into account? Sampling is required if there are variation factors in manufacturing conditions such as the baginning and ending of roll, temperature and pressure at the edge. When there are tiny pisholas that cannot be detected during inspection, we must have data on correlation of strength change and elongation of the test nample.			
We received the numeral data on pinholes and noticed the number of pinholes increased buddenty to 38 in the manufacturing roll or 6/9/93. Missen assumed II has checked Dupont's capability to guarantee the size and number of pinholes if II has the values quaranteed by Dupont. In other words, Hisean wants to know if II determines DuPont's capability based on test results that has taken variation factors into account.			
-Nissen was told the Items are guaranteed, for Kapton in general, per drawing specification; however, does Depont have any special guarantee on the material (Kapton 100 BMB)?	•	•	
Thora hupont guarantee the characteristics of Kapton after it has been wolded?			
2. Bissas (KCS) questions shout the Rapton esterial us quaranteed by the molding supplices			
«Please provide the details of supplier's guarantee on 2004 inspection of Repton. For example: thickness reduction, scratches, and cuts.		1.	
For material deterioration, provide information that shows the molding temperature, pressure and process timing that guarantees no deterioration.			
"Please provide the data to quarantee the items listed above. Hiesen wants to know if II understands the process capability based on test data that has taken variation factors into account. We want II to study and determine the worst case accounts. For example, if some Rapton material has no pinholes (as detected by testing), is it possible that Rapton containing smaller cracks will be molded?		•	

	Duestions		Application (Switch Type)	
	•	tine Rount	Pemp Housel	
	3. K(gens (KCS) questions concernies now materials and procuss.		'	
e v	what molded Expton been used beform? If so, provide examples and applications.		•	
by	files Kapton been used without telion conting?		•	
c	-What type of plastic is used to insulate the switch? In there any added material that has an adverse effect on the contact points?		• .	
d ·	• As the dispraw (Kapton) is being used as a switch contact point, is there special processes that insure this function.		•	
	For example, how is non-contamination of the contact point insured for both switch monufactoring and switch operation? (Note: [It is unlikely that the switch contact point more ment of the Kapton can be regarded as a mechanism to "clean" the Kapton surface).			
,	on market results for the above items.	•	•	
t	•In the absence of market results, how does II handle the above items? What studies/tosts are done (ie. monitor vehiclos). Please provide FMEA results for the above.		• .	
			<u> </u>	

Owestions	Mpoli (Swite	cation h Type)
Q2441201	Line Houst	Pump Hourt
4. Hitses (RC5) questions required tout results (se siready provided).		
The life of Kapton is determined by decability test (1 to 2 Hz) and static strength test. Please enswer the following questions.		١.
offer TJ keard Dupont's opinion on high compression? [As related to Mapton strength.]	1	1
Based on DuPont's opinion, are the durability test and static strength test the only tests required? Do we have to increase the duration of durability test?		
elles TI confirmed there are we problems with densbility and pressure resistance at worst case condition (at minimum levels as quaranteed by Dupont and the molding supplier). • $R_{ij} = R_{ij}$		
Please provide Depont's study results on chemical deterioration (molecular bonding level) after they examined the parts returned from market. If chemical deterioration does occur, what are the major tauses in Dupont's opinion? Has chemical deterioration been improved in the current switch?	•	
offer TI checked the final damage mode of defective switch. If oll leaks, what is the extent of leakage?		
•Are both sides of the Repton sheet used in the molding operation? Is there a difference between one nide to another of the Rapton sheet?	•	-
off there is a fatigue limit of Eapton or if the S-F curve can be plotted, does fatigue limit change at different durability frequencies? P		•
-7 Die S. N curve for Menda	1	•
what is the clearance between pressure sensor pln and housing?		
Does the sensor pin stick if there is contaminant in that area? Can the relief value of ill function under that condition?		•
	1	-

1 11 11

. 14

1	Overtions	Appli (Sulte	estion b Type)
		Line Boost	Pump Hount
	5. Rivers (Ner) constions concerning Replan		
. 4	"For Eapton material: Please describe the material behavior during loading (is. provide there of stress/strain behavior) Does the material have permanent deformation up the yield stress?]	
· · ·	When the material is used in design, to what limit is it expected to perform (only to the yield streng with some safety factor, or to the withmate tensile atrength of the material?) (EA	•	
ь	*Patigue endurance test: We want RUA/TI to test the switches to failure.		•
C	errom thin data, provide an S-M chart that shows endurance behavior (ie. provide enderance limit stress. We want to kebu if we can expect an infinite swoant of endurance cycles if the applied stresh is kept below the endurance limit).	•	•
d.I	•Kapton meterial cafety mergin.	1	
	1. Calculate min. strose bused on malarial data:]	Į.
:	Min. = Material stress min Application Factors x <u>Endurance Limit = Tield Stress</u> Stress Dupont) Stress Maximum Stress Ultimate Stress Dupont) Oil influence)		
dI	1). Calculate actual stream of mwitch operation itself by:		•
	 Uning design date, calculate the actual stress of the Empton switch with PEN study. 	, D	1
	 Using actual switch test results, provide actual stress (measured value). Describe correlation of actual test results to FEN study. 	ľ	1
do	1(1) Develop safety margins on comparing 1. (Repton stress min. based on material) vs. 11. (actual acress based on the switch limit). 7		
ni.		1]
:]		ŀ	j
		ţ	<u> </u>



DuPont

Engineering Polymers Elastomers Pluoroproducts Packaging & Industrial Products

Dear Customer:

Enclosed are DuPont's Material Safety Data Sheets for the products you have purchased or inquired about.

Our Material Safety Data Sheets (MSDS) communicate important information about the safe handling of DuPont products, recommended protective measures, and health hazard information in compliance with the Occupational Safety & Health Administration (OSHA) Hazard Communication Standard (29 CFR 1910.1200), and status under certain Federal, State, and foreign regulations.

Our MSDS also includes the TSCA inventory status of product ingredients and lists ingredients that are on the Toxic Chemical List, and the concentrations at which they are present in compliance with the Superfund Amendments & Reauthorization Act of 1986, Title III (SARA), Section 313.

As part of DuPont's longstanding commitment to product safety, we provide MSDSs for all products, both hazardous and nonhazardous. An MSDS is sent to all customers with their initial order of a product, and with their next order after a MSDS is revised with significant new information. If you do not purchase directly from DuPont, your supplier should provide the MSDS to you.

You should provide the information contained in the enclosed MSDS to your employees, agents, contractors, distributors, and customers who handle, use, purchase, or otherwise may be exposed to the DuPont products described.

If you have questions regarding this Material Safety Data Sheet, please contact the person named on the last page of the MSDS. If you need a MSDS for other DuPont polymer products, please contact our MSDS Coordinator.

Sincerely,

DuPont Polymers MSDS Coordinator 302-999-4586 P. O. BOX 80713 Wilmington, DE 19880-0713

Enclosure 12/93 -MSG MP= 799049 FR=1LC TO=SR2 **※歴史を34/32/9**4 の3 (2) **22** RE-010 ST=C DIV=0050 CC=00101 SY=1LC AT=04/22/94 03:29 PM

APRIL 22, 1994

TOI STEVE BUILER 80B1 DENNIS NATALE DJM1 AL AMORE AA1 STAN HOMOL sH2

TIM SPOONER TR91

WB4 CC 1 BILL SWEET TOM CHARBONNAU TC:

JOHN PECHONIS JSP1

FRt DAVE CEARN ZARN

第三章 FORMING KAPTON

DUPONT'S MARK MOALLEES (MACK-A-LHESE) - (614) 474-0725 - CALLED ME AT TON CLYDE'S REQUEST TO DISCUSS MAPTON FORMING. TOM - DUPONT'S HIGH PERFORMANCE FILM B.U.M. - GOT WORD TEAT WE WERE HAVING ISBUES WITH THE FORMED KAPTON FROM INSULFAB. MARK IS THE ENGINEER MOST FAMILIAR WITH PORMING, ALTHOUGH DUPORT IS NOT (AND DOESN'T INTERD TO CRY INTO) THE PORMING BUSINESS. MARK'S EXPERIENCE STREET FACH TRYING TO UNDERSTAND BOW TO MAKE KAPTON BASIER TO FORM AND MORE REPEATABLE.

IN AMY CASE, MARK HAD SOME INTERESTING IMPUTS, WHICH ARE SIMILAR TO WHAT DENNIS RECENTLY LEARNED FROM ASTRO SEALS. HE ALSO SAID THAT HE CONSIDERS ASTRO SEALS AS "THE SEST IN THE KAPTON PORKING BUSINESS". WE'VE YOUND THAT THEY'RE ALSO VERY EXPENSIVE.

NOTES:

- TO ENGURE THAT KAPTON RETAINS ITS FORM, IT'S TYPICALLY FORMED AT 725-750 DECREES F., WITH 10-15 SECONDS PER CYCLE. COOLING THE FORMED PART WHILE HOLDING IT IN SHAPE IS ALSO SEMETIMES DONE, TO DEPROVE DIMENSIONAL STABILITY .. FORMING IS DONE WITH SITHER PRESSURE OR MATCHED PUNCH/DIE. FORMING AT 725-750 DEGREES F REMOVES THE MATSHIAL.
- WHEN ASKED ABOUT POTESTIAL EFFECTS OF THE 725-750 DEGREES F TEMPERATURE ON MECHANICAL PROPERTIES, MARK CONCEDED THAT ATTEMPTOR MESSEDS TO ME PAID TO THE TIME/TEMPERATURE CYCLE TO BESURE IT'S HININIZED, OR THE MATERIAL MAY AGE AND POSSIBLY LOSS BOME DUCTILITY.

MARK DID OFFER, HOWEVER, TO ASSIST IN TESTING MATERIAL SEFORE AND AFTER THE TIME/TEMPERATURE CYCLE IF WE DECIDED TO EVALUATE TRIS TYPE OF PROCESS FOR MNY APPLICATIONS DOWN THE ROAD.

MY THOUGHTS:

- AS YOU KNOW; WE COLD FORM KAPYON IN ALL OUR PRESEURE SWITCHES. IN THE 8998, INSULTAB FORMS IT TO A GIVEN SHAPE. IN THE OTHER SWITCHES, HE FORM IT BY OVERPRESSURE AT ROOM TEMPERATURE.
- O IN THE 89PS, HE MIST LONG SOME OF THE POINT AFTER IT SHIPS HIGH TEMPERATURE IN THE DEVICE. PRESUMBELY, WE DON'T SEE A PERFORMANCE ISSUE AS A RESULT OF THE DIMENSIONAL CHARGE. IN ANY CASE, IT'S WORTH TAKING A CLOSER LOCK AT NOW TEMPERATURE/PRESSURE CYCLING APPECTS THE SOPS IN TERMS OF THE KAPTON DIMERSIONS, AS MELL AS CALIERATION VS. TEMPERATURE REFORE AND AFTER HEAT AGING. THIS EFFORT MAY SUPPORT A MOVE TOWARDS FLAT KAPPON FOR THE SSPS (?) -STEVE D.
- IN A/C ENTYCHES, WE'VE TALKED ABOUT USING KITH TEMPERATURE AS A MEANS OF IMPROVING WESTING AND REDUCING DRIFT. I DON'T THINK, BONEVER, WE'VE BEEN IN THE RIGHT HALLDARK FOR THE TEMPERATURE WE USB.

WHILE IT'S MIT POSSIBLE TO HEAT THE DEVICE TO THIS TEMPERATURE, I KNOW ME'VE CONCEPTUALIZED FRE-PORMING THE KAPTON DEING PRESEURE AGAINST A DIE SKAPED LIKE THE CONVERTER/WASHER.

TIM/AL, PERHAPS WE SHOULD CONSIDER TRYING THIS OUT, NUT FORM AT MUCH HIGHER TEMPERATURE THAN WE'VE DONE IN THE PAST.



OutPont H. Jaronnes Filos U.S. Route Duffont fique P.O. Box 95 Circlevale, Cit 43113 Tel. (814) 474-0724

Fax: (614) 474-0722



June 3, 1994

Mr. John Forsyth Commodity Manager Texas Instruments 34 Forest Street Attleboro, MA 02703

Dear John,

Enclosed is the completed supply agreement we've been working on. As you recall, we marked some changes when we met on April 29, and I needed to have it signed for DuPont. That has been done, and the agreement and pricing are now in effect.

I will have our invoicing group review invoices for shipments since April 1, and correct those that do not have the current pricing per our agreement. Please let me know if you do not receive adjustments to those within the next few weeks.

I know you had some concerns about the agreement when we first met, but I think you will find it to be very beneficial to Texas Instruments over the next few years.

Thank you for your continued business.

Sincerely,

Dave Reifschneider Account Manager

SUPPLY AGREEMENT BETWEEN

DUPONT HIGH PERFORMANCE FILMS CIRCLEVILLE.OH

AND

TEXAS INSTRUMENTS, INC. ATTLEBORO, MA

DuPont hereby tenders the following offer to provide polyimide film, and Texas Instruments, by its' acceptance of this document, agrees to accept DuPont as sole source for its' needs, as follows:

| DuPont hereby tenders the following offer to provide polyimide film, and Texas Instruments, by its' acceptance of this document, agrees to accept DuPont as sole source for its' needs, as follows:

gar opr

I. Products

Kapton® Polyimide Film, Types 500FN131, 200HN, and 300HN, for the fabrication of diaphragms for pressure sensors.

IL Quantity

Current estimate of need is:

1994 1995 1996 7000 lbs. 7600 lbs. 8000 lbs

III. Duration

This agreement covers product ordered for delivery from the date of acceptance of this document, for approximately a two and one half year period, ending December 31, 1996.

IV. Standard Rolls

Material will be provided in the form of standard rolls conforming to DuPont's normal roll sizes shown on the published price list.

April 29, 1994

-1-

TI-NHTSA 017545

V. Pricing

It is the intention of this agreement to maintain a 5% discount from list price in effect on January 1 of each year for all purchases during that calendar year, for the life of this agreement, subject to the maximum price limitation in the tables below. Prenotification of any upcoming pricing change will be provided to TI by approximately October of the preceding year.

The pricing shown below is firm beginning on the date of acceptance of this agreement, for the balance of calendar year 1994. It is based on a 5% discount off the current General Price List, which is dated June 4, 1990.

TI Part no.	Kapton Type	<u>Width</u>	TI Price	Current List Price
27225-1	500FN131	3/4"	\$85.98/lb.	\$90.50/lb.
27225-2	500FN131	31/32"	\$85.98/lb.	\$90.50/lb.
74224-1	200HN	15/16"	\$57.71/lb.	\$60.75/Ib.
27225-4	300HN	3/4"	\$57.71 /lb.	\$60.75/1b.

(Note for reference: prior to the effective date of this agreement, pricing for the above items has been based on a 4.6% discount, or \$86.50 for the first two items, and \$58.00 for the third. The fourth item has not previously been discounted.)

For calendar years 1995 and 1996, the 5% discount will apply to the list price in effect on January 1, 1995 and January 1, 1996, respectively. If that list price should be greater than 5% above the current list price dated June 4, 1990, TTs price will be capped at a 5% increase. Thus, the maximum possible price to Texas Instruments for 1995 and 1996 will be:

TI Part no.	Kapton Type	Wldth	TI Price
27225-1	500FN131	3/4"	\$90.28/lb.
27225-2	500FN131	31/32"	\$90.28/lb.
74224-1	200HN	15/16"	\$60.60/lb.
27225-4	300HN	3/4"	\$60.60/lb.

VI. Addition of New Products

The addition of new Kapton products or put-ups to this pricing agreement will be assumed automatic if they are of film types HN or FN, and in reasonably similar gauges, widths and rolls to those currently listed.

The addition of any other new film types, different put-ups, etc., will be negotiated based on availability and market conditions.

VII. Quality

DuPont agrees to ship product that conforms to DuPont's published General Specification Bulletin GS-92-6, and agreed upon specifications set forth in Texas Instruments Engineering Standard E9898 and drawing numbers 27225 and 74224.

VIII. On-time Delivery

DuPont is committed to on-time delivery performance. Initially, DuPont agrees to maintain a minimum inventory of approximately one month's consumption of purchased products to ensure a high level of quality, service, and on-time delivery. Such supply will be based on Texas Instruments' historical usage.

We agree to work together to find ways to meet on-time delivery while reducing or eliminating the need for inventory.

IX. Conditions of Sale

Except as otherwise provided herein, the standard Conditions of Sale set forth in the Kapton Ordering Guide and General Price List will apply.

OFFERED:

DUPONT

L. F. Campbell

Marketing & Sales Manager

High Performance Films

ACCEPTED:

TEXAS INSTRUMENTS

Commodity Manager

Texas Instruments

Kapton-Teflon Quality Manual

UNCONTROLLED COPY

Section: 1 Revision: 3

Page: 2 of 36

QUALITY MAKUAL

This manual is the property of:

E.I. du Pont de Memours, Circleville, OH

It may be freely consulted by our customers and by agreed product quality and quality systems certifying organizations.

Reproduction as a whole or in parts is prohibited, nor can it be given to third parties Without the specific parmission of the Worldwide High Performance Film (HPF) Business Manager.

Quality Systems Administrator

Kapton-Teflon Quality Manual

Section: 1 Revision: 3 Page: 3 of 36

Distribution:

Copy No.	Holder
Original	ISO Clerk
1	BSI, U/L, or QSA
2.	K-T Stenographer
3	Quality Systems Administrator(QSA)
4	HPF Fin & QC Area Supt.
5	Removed
6	Production Control Supervisor
7	Q.C. Laboratory Supervisor
8	HPF Mfg Area Supt.
9	Removed
10	HPF Integrated Op. Area Supt.
11	Worldwide HPF Business Mgr
12	Teflon Operations Supervisor

Section: 2 Revision: 3 Page: 4 of 36

Revisions to Quality Manual

Date	Revision	Section	Page	Modification
8/26/91	1	All	All	General; Pressessment
10/15/92	2	1	3	Remove copies 5,9
10/15/92	2	3	6	Rev product thicknesses
10/15/92	2	3	7	Added Prod Contr. Ref
10/15/92	2	4.1	9	Removed Tech. Mgr, BS Sup Added Oper. to Day Supv Added Distribution Mgr
10/15/92	2	4.1	10	Removed Tech Mgr
10/15/92	2	4.1	11	Added Maint Supv
10/15/92	2	4.1	12	Added Int Audits to QSA
10/15/92	2	4.1.4	14	Added ref to QSP0018
10/15/92	2	4.2	16	Added QSP 0017, 0018
10/15/92	2	4.13	29	Added Tech Rep, 2nd Para.
10/15/92	2	4.13	30	Rem. repeated sentence
10/15/92	2	4.14	31	Added Mylar Prod Contr
10/15/92	2	4.15	32	Added new locations
05/06/93	3	1	2	Revised Names, Titles
05/06/93	3	1	3	Changed Titles
05/06/93	3	2	5	Added new page for Rev.
05/06/93	3	2	6	Revised page numbers
05/06/93	3	4.1	9	Drop SP-ST, Chg Name
05/06/93	3	4.1	10	Chg Title Oper Mgr
05/06/93	3	4.1	11	Chg Titles, Rev Resp.
05/06/93	3	4.1	12	Chg Titles, Rev Resp.
05/06/93	3	4.1	13	Chg Titles, Rev Resp.

Section: 2 Revision: 2 Page: 5 of 36

Revisions to Quality Manual

Date	Revision	Section	Page	Modification
05/06/93	3	4.1	14	Chg Titles, Rev Resp.
05/06/93	3	4.1	1.5	Added Resp to Doc. Contr.
05/06/93	3	4.12	30	Chg'd Sr Qual Engr to Lab
•				Supv., Auth for Disp.
05/06/93	3	4.13	31	Dropped "plant", last Para
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3.1 INTRODUCTION

The Kapton-Teflon plant at Circleville manufactures Kapton polyimide films and Teflon films. Chemically, Kapton is a polyimide polymer makeup that is the result of a polycondensation reaction. The resulting base film, type KM, is a tough aromatic polyimide film that is an exceptionally strong, heat resistant film with an excellent combination of mechanical and electrical properties. The plant makes two other general types of Kapton, type FN, which is a heat sealable grade. This product is achieved by combining type KN Kapton with Teflon FEF fluorocarbon resin, through a laminating or coating process. Type VN films exhibit the same tough polyimide properties as HN, with superior dimensional stability at elevated temperatures. Kapton films are sold in thicknesses of 0.3 mils to 11.0 mils.

Teflon films are produced from various fluorocarbon resins including FEP, PFA and Tefzel, some of which are pigmented. The pellets are melted and extruded into a Teflon film for subsequent processing in treating, laminating and slitting. In addition to the different resin types, the plant offers Teflon films in thicknesses ranging from 0.5 mils to 225.0 mils. It is sold into several markets where it is unique among plastics. It is the most chemically inert of all plastics, withstands both high and low temperature extremes, has superior electrical properties, has superior anti-stick/ low friction properties plus many more unique characteristics.

Some of the applications or markets for Kapton from the electrical and electrical industry field are: field coil insulation, substrates for flexible printed circuits, motor and generator armsture slot liners, magnet wire insulation, transformer and capacitor insulation, magnetic recording and pressure-sensitive tapes, and wire and cable insulation.

A few of the applications for Taflon include a general purpose items such as Cell culture bags, plain and metallized microphone electrots and a variety of release applications; cementable films for laminated belting, high-performance pressure-sensitive tapes and protective clothing; chemical process films for tank linings, thermoformed rupture disc seals, and thick gaskets and drop-in mold liners; and aerospace composite molding release films.

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3.2 Purpose

The Quality Management System as defined by this Quality Manual is applicable to all Kapton* and Teflon* production and support facilities located at the DuPont site in Circleville, OH.

This manual is intended as a general overview of the Kapton*-Teflon* Quality Management System and does not include specific information related to the actual execution of many of the Quality System features. This manual is the responsibility of the Quality Systems Administrator and is reviewed/updated at least every two years.

3.3 General References

- * ISO 9002: 1987, "Quality Systems -- Model for Quality Assurance in Production and Installation"
- * Circleville Safety How
- * Circleville General Procedures How
- * Circleville Site Manufacturing Plan
- * PON Manual
- * Kapton General Specification Bulletins
- * Teflon General Specification Bulletins

3.4 Controlled Documents Referenced

- * Kapton-Teflon Quality Manual
- * Kapton-Teflon Quality System Procedures (QSP's)
- * Kapton-Teflon Area Procedures (AP's)
- * Kapton-Teflon Operating Procedures (OP's)
- * Kapton-Teflon Standard Operating Conditions (SOC's)
- * Kapton-Teflon Area Forms, Reference Charts, Decision Trees and similar forms used and described in area procedures.
- * Business Services Purchasing Manual
- * Business Services Quality Manual
- * Mylar Production Control Manual/Procedures

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4.1 MANAGEMENT RESPONSIBILITY

4.1.1 Quality Policy

The quality policy of the Kapton*-Teflon* plant is the following:

"The Kapton*-Teflon* plant will be recognized as providing the best value to customers through quality leadership and continuous improvement in all our products and services."

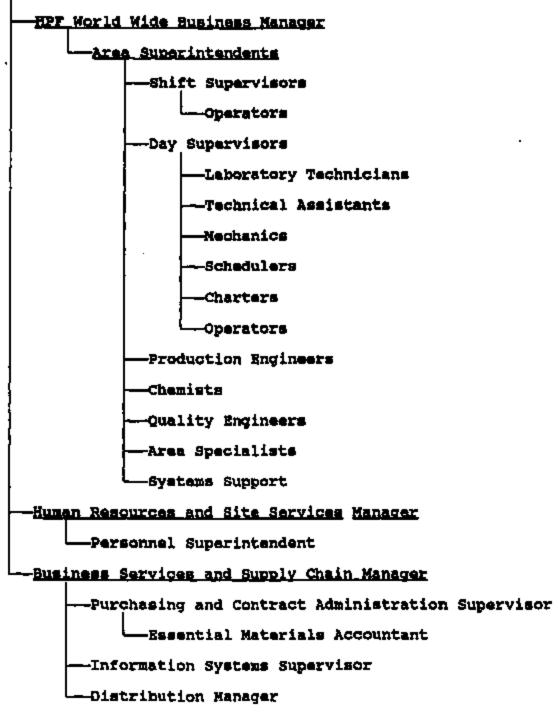
R. Hutton Worldwide HPF Business Ngr 10 May 1993

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4.1.2 Organisation

The basic Organization Chart of the Kapton*-Teflon* plant is as follows:





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4.1.3 Responsibilities and Authorities

An outline of the responsibilities and authorities of the different functions on the Organization chart is as follows:

o Plant Manager

Has the responsibility of providing overall leadership for the plant site in order to accomplish the strategic objectives of the business served.

o HPF Worldwide Business Mgr.

Overall managerial responsibility for the Kapton* and Teflon* products.

Authorization of top level documents and the Quality Policy of the referenced product lines.

o KPF Manufacturing Area Superintendent

Overall responsibility for the manufacturing operations

Authorization of the procedures and documents relating to activity in his areas.

Responsibility for and participation in periodic Quality System reviews for their areas:

- * internal reviews
- * external reviews

Defines assignments of the Production Engineers, Chemist, and specialists.

Overall responsibility for area process development efforts.

Authority to accept material by concession in concert with the Process Engineer.

Overall responsibility for the Kapton-Teflon maintenance operation, including calibration of process equipment.

o HPF Integrated Operations Area Superintendent

Overall responsibility for Production Control.

Authorization of the procedures and documents relating to Production Control. Defines assignments of Production Control Supv. CFM Engineers and Specialists.

Responsibility for and participation in periodic Quality System reviews for Kapton-Teflon: * internal reviews * external reviews

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- 4.1.3 Responsibilities and Authorities (cont'd)
- o Area Superintendent-Production and Technical-Finishing & QC

Designated Kapton - Teflon Management Representative who, irrespective of other responsibilities, has full authority and responsibility for ensuring that the requirements of ISO 9002 are implemented and maintained.

Overall responsibility for the Kapton - Teflon Finishing operation.

Overall responsibility for the Quality Control laboratory.

Authorization of the procedures and documents relating to Finishing and Quality Control.

Responsibility for and participation in periodic Quality System reviews for specified areas:

- * internal reviews
- * external reviews

Defines assignments of the Production Engineers, his Supervisors, and Project Engineers

o Production (Area) Supervisors

Safety and Environmental in the process areas.

Provide scheduling of equipment maintenance.

Monitor and support for the plant operation, including coordinating process outage.

Oversee the supplies for the process including raw materials

Coordination of housekeeping.

o Maintenance Supervisors

Safety and Environmental in the maintenance areas.

Review scheduling of equipment maintenance, schedule people

Monitor and support for the plant operation

Responsible to provide resources as required to see that calibration of process equipment is completed according to procedures.

Coordination of housekeeping.

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4.1.3 Responsibilities and Authorities (cont'd)

o QC Lab Supervisor

Administrative responsibility of the laboratory.

Maintenance of lab equipment and supplies.

Manages all raw material specifications and testing
'Initiates action to dispose of non conforming product
Maintain product release system; product reviews
Customer inquiries and concerns; customer certification

o Production Engineers/Chemist

Routine support for the processes.

Design and revision of equipment and operating systems.

Corrective action on process upsets.

Design and follow up of Test Authorizations.

Develop and maintain standard operating conditions and procedures.

Monitoring process operation and review of process documentation.

o Process Development Chemists/Engineers

Design and implementation of manufacturing experiments.

Process development and support the Kapton-Teilon processes

Assist in design and revising equipment for the Kapton-Teflon processes

Develop laboratory basic data for Kapton-Teflon processes.

o Quality System Administrator

The monitoring and coordination of the quality system.

Ensure that the requirements of ISO 9002 are implemented and maintained, at the direction of the Management Representative, especially Internal Auditing System.

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4.1.3 Responsibilities and Authorities (cont'd)

o Project Engineers

Provide engineering design on process equipment for projects.

o Senior Technical Engineer, QC

Hew and or revised product tests and equipment.

For calibration method on equipment used to test product.

Interlaboratory Checks and Interlaboratory Method Control

o Production Operators

Perform actual work tasks for a given area of manufacturing, testing, material handling, etc.

Operators process quality data pertaining to each phase of their particular operation.

Make some routine quality measurements of product vs specification.

Document and file the required processing history information for each lot.

Cast films according to Standard Operating Conditions and Procedures.

Obtain film samples for lab analysis.

Document process conditions as required.

Specific responsibilities are defined in area procedures.

o Laboratory Technicians

Performance of raw material, in-process, and product analysis, as required.

Recording results of tests and releasing product or essential ingredients per standards provided.

o Scheduler, Production Control

Review orders to ensure they are stated correctly

Notify CSC of shipment delays and document any changes.

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4.1.3 Responsibilities and Authorities (cont'd)

o Control Mechanics

Responsible for calibration systems; for the control of inspection, measuring, and test equipment used to verify the conformance of equipment used in the processes.

Primarily responsible for installation, repairing, maintaining, and calibrating equipment.

o Document Controllers

Responsible for maintaining and controlling all the documents in their area of responsibility. This includes numbering, formatting, and having reviewed before expiration.

Where Document Controller is also training coordinator, responsibility also includes coordinating and maintaining operator training.

4.1.3 Responsibilities and Authorities (cont'd)

Additional responsibilities, authorities, and interrelationship of personnel managing, performing and verifying work affecting quality are defined by Job Descriptions (as maintained by Training Coordinator), documented procedures, and the communicated wishes of said personnel's direct management.

The Area Superintendent, Quality Control will serve as the Management Representative who, irrespective of other responsibilities, shall have defined authority and responsibility for ensuring that the requirements of the Quality Management System, as defined in this Quality Manual, are implemented and maintained.

4.1.4 Management Review

The Quality Management System defined in this Quality Manual will be reviewed, at least annually, to determine its continuing suitability and effectiveness. This review will include the Site Manager, the HPF Worldwide Business Mgr, senior heads of the Employee Relations and Business Services, the Management Representative, HPF Area Supts, the QSA, and others as requested. Such reviews will include an assessment of the results of vendor performance, concessions on product release, customer complaints, outstanding corrective actions, and external and internal quality audits. Records of these reviews will be kept in accordance with appropriate sections of this manual.

Additional details are in QSP 0018.

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4.2 QUALITY SYSTEM

4.2.1 Kapton*-Teflon* Quality Manual: outlines the elements and objectives of the Plant Quality Management System and how it complies with the ISO 9002 standards.

4.2.2 Quality System Procedures:

٠.,

- o Provide the minimum features needed by Functional Areas to satisfy and comply with the elements and objectives of the Plant Quality Management System.
- o Contain specific information where a uniform system has been adopted across the Functional Areas.
- o Where no uniform system has been established, the Quality System Procedures will explain what the requirements are for a given feature. Functional Areas are then able to develop their own systems and will document them in Area Procedures.
- O An Index of Quality System Procedures is on the next page
- 4.2.3 Area Procedures: explain in specific terms how an area satisfies those requirements detailed in the Quality System Procedures.
- 4.2.4 Operating Procedures: a step by step instruction on how to perform a specific job.
- 4.2.5 Standard Operating Conditions: a set of conditions that are used to produce a given product on a given type of equipment.
- 4.2.6 Test Methods: step by step instructions on how to run specific tests in the laboratory.
- 4.2.7 Product Release Sheets: controlled set of release standards used by the laboratory to release product.
- 4.2.8 Slitting specifications, elitting charts, standard forms, flow charts: Part of the Quality System documentation explained by Quality System Procedures or Area Procedures as needed.

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QUALITY SYSTEM PROCEDURES

QSP0001	FORMAT FOR QUALITY SYSTEM PROCEDURES
Q8P0002	DOCUMENT CONTROL
QSP0003	RAW MATERIAL CONTROL
Q6P0004	PRODUCT IDENTIFICATION AND TRACEABILITY
QSP0005	STANDARD OPERATING SYSTEM
QSP0006	PROCESS EQUIPMENT CALIBRATION
QSP0007	LABORATORY EQUIPMENT CALIBRATION
QSP0008	CORRECTIVE ACTION
QSP0009	QUALITY RECORDS
QSP0010	Internal audits
QSP0011	TRAINING
Q8P0012	FORMAT FOR AREA PROCEDURES
QSP0013	NONCONFORMING PRODUCT
QSP0014	TEST APPROVALS (TA's)
QSP0015	FORMAT FOR OPERATING PROCEDURES
QSP0016	EXTERNAL QUALITY AUDIT PROCEDURE
QSP0017	PRODUCT SPECIFICATION SYSTEM
QSP0018	MANAGEMENT REVIEW

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4.3 CONTRACT REVIEW

Contract, as stated here, refers to an order for product placed by Marketing through a Customer Service Center (CSC), who in turn places an order with the plant. The Kapton-Teflon quality system starts with the receipt of the order from the Customer Service Center. Orders are received electronically by the plant.

Orders, are reviewed on the plant site after receipt to ensure that the requirements of the customer (CSC) are adequately stated or documented, and that the plant has the ability to meet those requirements. This review is performed by the Production Control function. If additional requirements are needed, or if the plant does not possess the ability to meet the requirements as stated, the requirements will be revised to accurately reflect the product which the customer will receive. Such revisions will be coordinated with the customer as needed.

Records of the orders and review will be maintained by Production Control in accordance with Section: 4.15 of this manual.

If a shipment date cannot be met, the CSC is notified and notice is documented.

Additional detail is given in Production Control Procedures.

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4.4 DOCUMENT CONTROL

All documents and data which are used to satisfy the elements and objectives of the plant Quality Management System will be controlled. Control includes the following:

- Review and authorization by specified individuals prior to issue
- o Pertinent copies of documents at locations where they are needed and used
- Documented index and distribution list for each type of document
- o Removal of obsolete documents from circulation
- o Reissue of documents when a change is necessary.

Because documents are used throughout the Quality Management System, responsibilities to control documents can be found at many levels of the operation.

Document control will be administered according to QSP 0002.

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4.5 PURCHASING

Purchase requisitions are initiated locally and executed as orders locally or submitted to Material and Logistics Regional Office for actual procurement. Each functional area is responsible for identifying those requirements and verifying the suitability of these materials.

Purchasing documentation includes a complete description of the item, suggested vendor, charge codes, authorizations for the purchase, and delivery information. Specification numbers are included on the order if it is for a raw material.

Vendors are selected based on their ability to supply the product as needed in a timely manner. Vendors have agreed on specifications for the materials they provide. Vendor performance is evaluated routinely. Additional details are given in the Business Services Purchasing Manual, and QSP 0003.

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4.6 PURCHASER SUPPLIED PRODUCT

Currently, no materials supplied by customers are incorporated into a Kapton*-Teflon* product. If materials are provided by customers in the future, the Area receiving those materials will be required to verify, store, and maintain those materials as needed in conformance with the Quality Management System. The established controls for this material will be developed to ensure that the material provided by the customer becomes part of the product which is delivered to that customer.

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4.7 PRODUCT IDENTIFICATION AND TRACEABILITY

The Kapton*-Teflon* plant maintains a system of identifying product at all stages of production such that all final products can be traced to the vendor lot numbers of the raw materials used to produce that product. Incoming materials are identified with a unique material name and number. Upon receipt of materials and during the manufacturing process, unique lot numbers are utilized or assigned to provide traceability. Once file is produced, mill roll numbers are assigned. New numbers are assigned whenever file is converted to a different product or preslit to a different size.

Since cast rolls are produced on a continuous process, tracing raw material lots or Solvent Recovery Materials is time dependent.

Additional detail is given in QSP 0004.

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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:

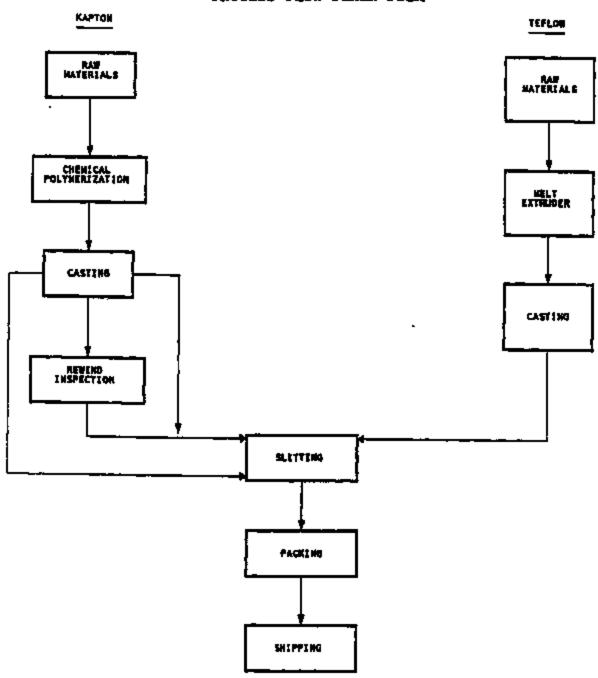
- o Production schedules, based on orders and forecasts, are communicated by Production Control to the areas. The manufacturing areas use these schedules to plan product changes.
- o Documented work instructions, Area Procedures (APs) and Operating Procedures (OPs), explain how tasks are to be performed where the lack of such instructions could significantly reduce the product's level of quality.
- o 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
- o 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
- o Additional detail is given in QSP 0005 and Area Procedures

4.8.2 New Equipment or Process

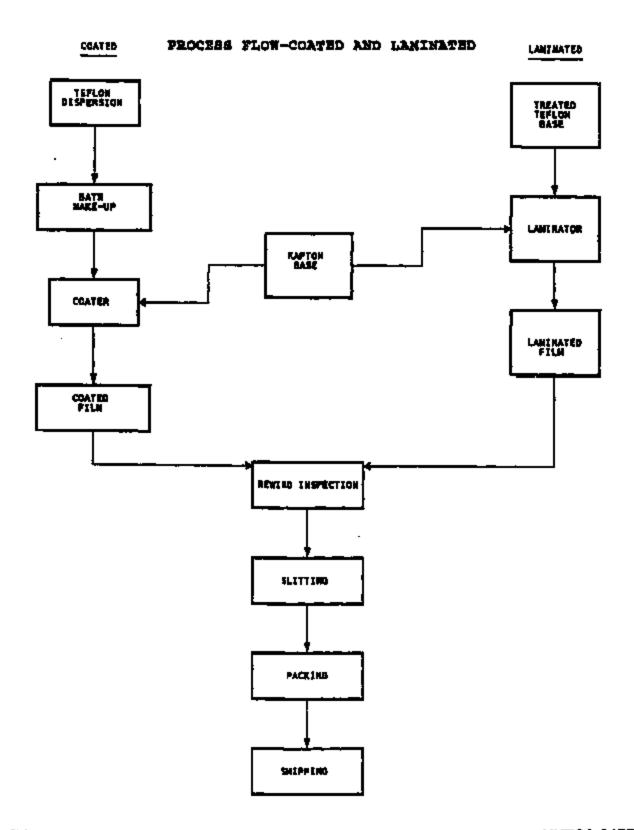
Any product manufactured on new equipment or by a new process is produced under the plant TA (Test Authorization) system. This system provides the documentation and approval system for using a non-standard process. This system is described in more detail in QSP 0014.

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PROCESS FLOW-PLAIN FILM

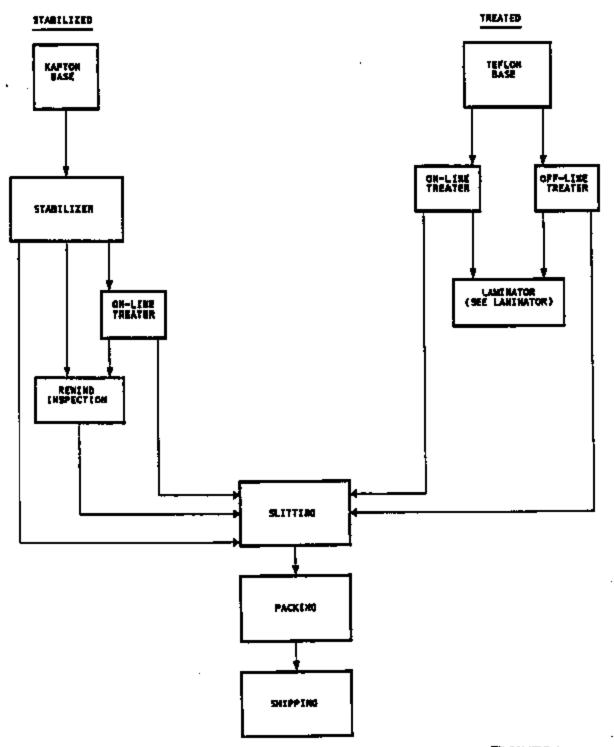


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PROCESS FLOW - STABILIZED AND TREATED



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4.9 INSPECTION AND TESTING

Material is inspected and/or tested at three stages in the production process: receiving (raw materials), in-process (partially converted material), post-process (fully converted material or final product). For any of these types of testing, the following information will be documented:

- o Frequency for performing the inspection or test
- o Procedure for performing the inspection or test
- Specifications for passing/failing the inspection or test
- Process for handling material which has passed the inspection or test
- Process for handling material which has failed the inspection or test (see 4.12)
- o The authority for releasing product

The results of all inspections and tests will be recorded to serve as evidence that the material truly passed the appropriate test. Production areas that run tests on product in the area will be responsible to forward results to the lab for recording on appropriate lab records. Tests run in the lab will be recorded by the lab tech. Tests run in Finishing will be recorded on appropriate forms in the Finishing Area.

No materials will be completely dispatched to the next production step until all tests and inspections have been executed. If urgent production needs arise and untested materials are used in a subsequent processing step, the required tests will still be performed and those materials will be identified so as to allow for recall in the case that the materials do not pass the inspection or test.

Additional detail can be found in QSF 0003 and Quality Control Area Procedures.

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4.10 INSPECTION, MEASURING, AND TEST EQUIPMENT

All equipment used to determine the disposition of the Kapton*-Teflon* materials or product will be calibrated to the required accuracy in order to ensure the ability of this equipment to measure desired material and product characteristics.

The calibration of all such equipment will be maintained regardless of whether it is owned, borrowed, or leased by any portion of the Kapton*-Teflon* plant.

Functional areas needing such equipment will identify and select equipment capable of meeting the accuracy needs. Actual calibration of this equipment will be performed by trained individuals and will include:

- o A prescribed interval for calibration
- o Documented calibration procedures
- Use of certified equipment which, where possible, is traceable to national standards
- Documented actions to be taken when equipment is found to be out of calibration
- Identification of the calibration status directly on, or as near as practical to, the calibrated equipment
- o Records of the equipment calibration.
- Appropriate environmental conditions for calibration and usage of inspection, measuring, and test equipment

Additional detail may be found in QSP 0006 and QSP 0007, as well as in Maintenance and Quality Control Area Procedures.

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4.11 INSPECTION AND TEST STATUS

Material is identified at all stages of production by the functional areas to indicate the tests which have been completed on that material and the results of those tests. The inspection authority will release product according to specifications. This is to ensure that only material which has passed inspection and test will be used in further processing. The release status of semifinished product is recorded in the PICS computer system, and is available to the areas. Mill roll tags will also carry the release status of a mill roll.

Additional information may be found in QSP 0004 and various Area Procedures.

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4.12 CONTROL OF HONCONFORMING PRODUCT

Material or product which does not conform to the specifications established for passing an inspection or test will be identified as nonconforming product. This identification will be documented and the material or product will be evaluated, segregated (when practical), and disposed of through accepted channels. Various computer systems and procedures are in place to prevent inadvertently shipping non-conforming product.

Final disposition of nonconforming product resides with the QC Lab Supervisor with authority from the appropriate Technical Representative from Marketing, as required.

Nonconforming product may be:

- Reworked to improve conformance to the pass/fail specifications
- o Retested in lab if test is suspect
- o Accepted by the customer on concession
- Regraded and used in an alternate application
- o Rejected or scrapped

Reworked materials are tested in accordance with the requirements of Section: 4.9.

Additional detail is described in QSP 0013.

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4.13 CORRECTIVE ACTION

Documented procedures are maintained by the functional areas for the following:

- o Investigating the cause of nonconforming product
- Analyzing customer complaints and service reports to eliminate existing or potential sources of nonconformances.

Any functional area which identifies nonconforming product is responsible for developing and executing corrective actions to prevent future nonconformances. This will be done to an extent corresponding with the degree of severity and/or frequency of the nonconformance.

The initial responsibility for corrective action is in the hands of the manufacturing operators. In instances where there is an adjustment to the process which can be made, the operations area is responsible for attempting to get the process back to aim and documenting what was done. If they are not successful, or if a catastrophe occurs, the appropriate Process Engineer is notified.

Corrective actions which have been initiated will be reviewed by the area instituting them to determine their effectiveness.

Changes in procedures resulting from corrective actions will be documented by the functional areas in conformance with Section: 4.4 of this quality manual, and area document control procedures.

Additional detail may be found in QSP 0008 and various Area Procedures.

_:sction: 4.14

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4.14 HANDLING, STORAGE, PACINGING AND DELIVERY

Handing, storage, packaging, and delivery of materials and products will be done in accordance with documented procedures. Areas performing these tasks will be required to maintain these procedures.

Handling is conducted in a way that prevents damage or deterioration of the materials and product.

Storage facilities are secure and designed to prevent damage or deterioration of the materials and product. Functional areas receiving or dispatching material to these storage areas will stipulate appropriate methods for doing so.

The processes and equipment used to pack, preserve, and mark product are controlled by the functional areas to ensure the fulfillment of product requirements.

The Kapton*-Teflon* plant arranges for the protection of the product's quality after final inspection and test including, when required by the order, delivery to destination. Delivery is the responsibility of the Traffic function, which is part of the Mylar Production Control Organization.

Additional details are described in Area Procedures.

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4.15 QUALITY RECORDS

Records are maintained to attest to the fact that materials and product actually meet their established specifications. Also, records demonstrate the proper and effective operation of the Quality Management System.

The plant and the functional areas are responsible for maintaining the quality records which they generate. Proper procedures for collecting, identifying, filing, storing, maintaining, and disposing of quality records are established. Retention times for all records are documented.

The following are guidelines of records kept with the following features of the Quality Management System:

	Record	<u>Location</u>
٥	Management reviews of the Quality Management System	Quality Control Superintendent
٥	Contract reviews	Production Control Business Services
٥	Approved suppliers	Purchasing
0	Corrective Action records	Area Files
٥	Slitting charts	Production Control
0	Product identification at given production stages	Quality Control PICS
0	Calibration results	Maintenance QC Lab
0	Non-conforming products and materials	Production Control QC Lab
0	Internal quality audits	Technical File Quality System Ad.
0	Training records	Area Files

These records are stored and maintained in such a way as to prevent loss or deterioration. Also, they should be reasonably available.

Additional detail can be found in QSP 0009 and various Area Procedures.

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4.16 INTERNAL QUALITY AUDITS

Internal audits are conducted by the plant in order to determine the effectiveness of the Quality Management System as well as compliance to established practices. The scope of these audits vary, but are intended to address those items which are thought to be most crucial to the quality of the product. Internal audits are conducted in each area at least twice per year. These audits are conducted by individuals independent of the work being performed, and are trained in auditing techniques.

A documented procedure is maintained which explains the audit process. The results of these audits are documented and brought to the attention of the appropriate individuals who are required to take actions in order to correct identified discrepancies.

More details of this system are described in QSP 0010.

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4.17 TRAINING

Training systems are maintained by the functional areas to ensure that individuals performing work crucial to the quality of the product are appropriately instructed in the methods for performing those tasks.

These training systems include identification of the training needs, plans for the training process, and qualification of personnel. Records showing the level of qualification of certain plant personnel are maintained.

Additional details can be found in QSP 0011 and various Area Procedures.

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4.18 STATISTICAL TECHNIQUES

Functional areas will maintain procedures as needed which identify and explain appropriate statistical techniques which are used to control products and processes. The following are examples of statistical techniques that are used where appropriate:

- o Shewhart Control Charts
- o Cusum Control Loops
- o Process Capability Studies

Details of where these are use are described in the appropriate Area Procedures.

Foster, Steve

From:

JRP2%mimi

Ter

#801828

Subject

MSG From JRF2

Date

Tue, Jun 7, 1994 7:15AM

-MSG Mi 210524 FR-JRF2 TO-SRF SENT-06/07/94 07:18 AM FR-086 ST-C DIV-0050 CO-00127 BY-JRF2 AT-08/07/94 07:18 AM

To: Steve Foster Co: Ed O'Nell

Stave, yesterday I gave you a signed copy of the pricing agreement with Dupont that went in effect on April 1, 1994. It took them a little while to get it signed and off to me. Please ensure that all future orders for Kepton are now at the "new" prices.

I have been told by the sales rep that TI will be getting a credit for till of our purchases from 4/1 to now. Please let me know when this happens. I don't want it to fall throught the system.

Also,....could you make sure this cost reduction is properly accounted for in the tracking system.

Thanks and regards,

John

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Page 1



Јшу 7, 1994

Mr. Edward C. McKensie Sr. Technical Service Representative DuPont High Perfermence Plims P.O. Box 89 Circleville, Ohio 43113

Dear Ed:

It was good to speak to you yesterday. As I mentioned, I'm back from a 2½ year stirt at one of TI's plants in Ispan. While there I was actively involved in our efforts to convince Nissan of the suitability of Kapton as a disphragm in our pressure switches. Now that I'm back in Attleboro I have been essigned to put to rest all outstanding concerns Nissan has with Kapton, and I look forward to your support to accomplishing this task.

Recioned you will find a list of questions generated by Ninsan. Where necessary I have reworded or reinterpreted the questions so that we can get the information I believe Nitsan is melly after. Since these questions relate directly to DuPont's product and processes, I will need your help in answering them. Once you've had some time to review them, I'd like to go through them one-by-one by phone. I'd appreciate if you could give me a call by the end of the week so we can start this process. In many cases additional staps many be necessary, so I'd like to get started as soon as possible.

My number is (508)699-3639, fax (508)699-3153. I look forward to bearing from you.

Sincerete

Andrew J. McKenna Design Engineer

Attachment

1b. We have previously presented data to Masan showing actual tensile strength of production runs taken on a sample basis. Now, Masan seems to be taking for a "guarantee" that all material shipped will meet a given tensile strength minimum requirement.

- * Can you provide us with such a guarantee?
- If so, what is that minimum level?
- * How do (will) you determine that minimum level? (i.e. mean 4\u03c4, etc.)
- Does such a guarantee take into account all potential worst-case scenarios, such as processing variations, beginning and end or rolls, temperature and pressure at the edge, small, undetectable pinholes, etc.?

Nissan is still worried about pinholes, especially those that are smaller that your minimum detectable size.

- * What is your minimum detectable pinhole size? A report issued by DuPout stated that your inspection system "has located" a 1 mil diameter pinhole, but does this imply all pinholes down to 1 mil can be detected?
- * How do you know?
- * How do you verify if you can detect these pinholes? Do you control the inspection process by passing material with pinholes through the inspection equipment at regular intervals?
- * What about holes that are smaller than your minimum detectable size? Also in the DuPont report was a statement that "the formation of holes less than 10 mile in diameter does not occur..." Why not? Is there a technical explanation, i.e. intermolecular bonding, the polymerization mechanism, etc. I understand some of this information might be proprietary, but our customer is requesting an explanation.
- Nissan has also asked for a correlation between the presence of pinholes and tensile strength. Can we introduce pinholes into some samples and run some tests?

1

- 1d. One question that keeps coming up is whether or not DuPont has it's own generic "guarantee" of Kapton material, separate from TT's specification. I think this may mean guarantees that Kapton material meets and/or exceeds (100% of the time) standardized tests for strength, environmental resistance, etc.
 - * Does DuPont guarantee Kapton in such a way?
 - * What performance and/or quality requirement and checks does DuPont have above and beyond customer specifications?

←

4a. Nissan asked if DuPont has any special opinion on use of Kapton under localized compression, as is the case in one of our switch designs. According a finite element analysis we conducted on this design, the Kapton is subject to some localized stress in excess of the yield point on the first few pressure cycles. After some initial "microscopic" yielding (according to the theoretical analysis), stresses remain below the yield stress. Please comment.

4g. Doce DuPont have fatigue limit data for Kapton? $M(T + f|_{e \times} + e + f) + f|_{e \times} + f|_{e \times}$

Tubbished Data in Gen

5a. Does DuPont have any stress/strain plots of tensile strength testing?

Does the material have permanent deformation up to the yield stress?

TO: PAY M.

FR: ANDY MULLINNA

LE: 89 PS KAPTUN FEA

HAT PE - OUR DIEUSTION ON THE I HAW FACTORS .

- D FIRST- I MIS RESULTS DESIRED AS CLOSE TO 8/10 AS PASSIBLE
- 3 SAME DETAIL AS LAST YR'S ANALYSIS (BELOW) IS FINE
- 3) AFTER 7/28 PLEASE WORK WITH TAVE CZAZN ×3558)
- DISC PRINCE DATA FRO HET ANALYSIS & ENCLOSED CET'S
- 3) MAT. MISTON STEEL IN APPLICATION IS 7.68 1899.

Ary questions, please contact we @ 73,771.

the Andy

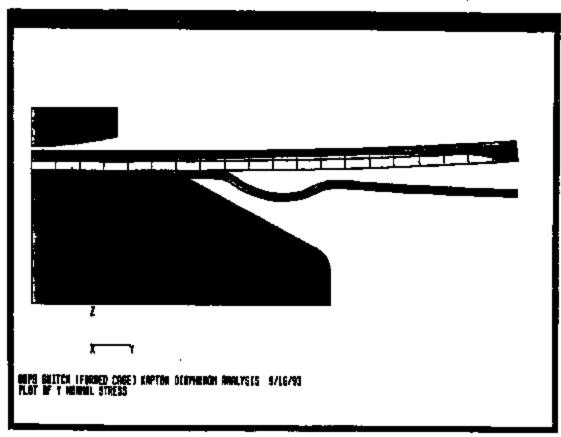


Figure 6

89-PS Disc Dimensions

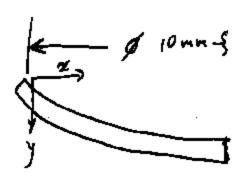
Disc thickness 8.5 mils

material 301 stail less

crown height 21 mils

pro. response

contact 13.5 mils



× (nm)	Y (um)
09 945 1,513 1,513 1,513 2,587 2,587 3,143	10.7 10.7 10.8 72.8 107.0 133.85 160.5 187.3 2 (4.0 2 3 3.3 2 51.5
3.649 4.005 4.361 4.717 5.073	269.6 281.5 293.2 299.6 303.9



DuPont High Performance Films

FAX TRANSMITTAL

DATE: 7-21-44

TO: John Porsyth

Texas Instruments - Attabura

FAX NO: (508) 699-3162

PROM: Dave Reifschneider

FAX NO: (302) 651-7464

IF THERE IS ANY DIFFICULTY WITH THIS FAX TRANSMISSION, PLEASE NOTIFY THE SENDER AT (802) 651-7462.

JMA,

As you are reading this note, I am in an airplane semembers approaching. Grankfurt, Germany, on occation. But I canded to tell you personally that a letter is being neated today by Dufont amounting a price increase for our Kaplen and Toflen films. Unfartunately, I will be out of the country until Monday, August 1, at which time I will be back in my office and happy to discuss the letter and new pricing structure with you.

Bonna Authorfield is propored with all of the information on the new pricing, and can entwer your immediate qualtient about how the updated ordering quide and poice protection can work. I'll be happy to cover that further when I get back.

Places accept any apalogies for not being immediately available - the lining caught me aff quant as much as it probably has you, and the vacation trip had been planned for quite some time. See you when I return.

John - the will not affect your contract pricing until 1/1/95.

Dave.

EI DUPTH K-T-SP CIRCLEVILLE

10:48

16/52/13



DuPont Films

July 22, 1994

Mr. John Forsyth Texas Instruments 34 Forest Street Attleboro, MA 02703-2437

Dear Mr. Forsyth:

Effective July 25, 1994, prices for Kapton® polyimide films will be adjusted according to the attached price list. The increase for most products is nominally 5%, although this varies by product and market due to the unique circumstances of each. Some products are increasing more than 5%, while a few are being reduced. I encourage you to review the attached price list carefully, as changes to the Ordering Guide reflecting how we measure, putup, and price Kapton could also affect your ultimate pricing.

Since 1990, we have established a formidable and unique "building block" product development capability to meet the emerging useds of virtually every industry. The combination of this capability, our industry focus/commitment, and believther partnerships has resulted in the creation of munerous new and innovative films that now represent a significant portion of our annual revenues. Examples include: E- and Kpolymer films for flexible circuitry and TAB, corons-resistant film for motors and magnet wire, are-resistant film for aerospace wiring, dimensionally stable and formable films for loudspeakers, film with superior roll formation and gauge control for tape applications, electrically conductive and static control films, pigmented and dimensionally stable films for bar code labels, polyimide sheet adhesive and the ability to create unique layered films, and a host of others. Most of these new and innovative offerings are now included on the price list.

Over the past five years, we have conducted four Customer Opinion Surveys in the U.S. in our quest to continuously improve the quality of our products, service, and overall value. Results of the most recent survey conducted earlier this year indicate broad satisfaction with our overall relationships, product quality/consistency, product modification efforts, sales and marketing support, delivery performance, technical support, and customer service has consistently improved and is now better than ever.

As we continue to improve, we've made notable structure changes within High and Performance Films. Global Business Leadership, Customer Service, and Sales and Marketing have been consolidated at our Circleville, Ohio manufacturing site and a global marketing presence has been established at our Bayport, Texas facility. Designed to improve responsiveness, we've already begun to see the advantages of these changes and customer feedback is very positive. Concurrent with the product development capability mentioned above, aggressive cost stewardship has resulted in fixed cost reductions in excess of 10%. In 1992, we became the first polyimide film manufacturer to secure ISO 9002 certification and the benefits are apparent. We continually work to secure more cost effective and higher quality raw materials. In short, we are investing for the future while implementing meaningful cost reductions.

We believe we have been both responsive and responsible as the industry leader. As such, we believe it is appropriate to further secure the future for the polyimide film industry through the current pricing action. Only a financially secure partner will be able to continue to support your future marketing and technical needs. We believe you should expect nothing less from the industry leader.

New prices, and the provisions of the updated Ordering Guide, will be applied to orders shipped on or after July 25, 1994. Existing customers will be afforded price protection on orders placed by August 5, 1994, specifying normal lead time. Protected volume will be based on average monthly purchases. Your DuPont Marketing Representative or Customer Service Representative is prepared to answer any questions you may have.

Our goal continues to be customer delight in all areas of quality, service, and the value of our total offering to your business. Survey results suggest that we are meeting your needs and continuously improving in these areas. We remain committed to leadership in the industries we serve to provide both of us with growth opportunities and financial health.

We greatly value our business relationships and the confidence you have placed in us through your past business. We pledge to continue to earn both your confidence and your business in the future.

Sincerely,

Larry F. Campbell

Marketing & Sales Manager

Effective July 25, 1984



DuPont High Performance Films

Kapton[®] Polyimide Film General

Kapton polyimide film is an exceptionally strong, heat registant film with an excellent combination of mechanical and electrical properties. Kapton has been used successfully in various applications at temperatures from -269°C to 400°C. It is flame resistant, does not melt, resists effects of organic solvents and has a very high resistance to high-energy radiation.

Type HN: An all-purpose, uncoated film, with toughness and dielectric integrity at very high and very low temperatures.

Type HPP-ST: A special-purpose, uncoated film with sli the properties of Type HN, surface treated for superior adhesion. Type VN: An all-purpose, unconted film with all the properties of Type HN, plus superior dimensional stability.

Type MT: A special-purpose uncoated film with thermal conductivity 3x that of mandard Kapton.

Type FN: A Type HN film coated on one or both sides with Teflor^a FEP fluorocarbon resin to impart heat scalability, provide a moisure barrier, and enhance chemical resistance.

Type XP: A Type HN film conted on one or both sides with Tefloo PFA fluorocarbon restn to Impart hear seal-shiftty, provide a moisture barrier, and enhance chemical resistance. The PFA conting is especially suited for applications requiring high bond strengths at elevated temperatures.

Please direct all inquiries and orders to: Customer Service 800-967-5997 or Product information 800-237-4367

Pricing and Yield Information

	Свеще В Туро) demina	Price		Musimum		Approximete
Тура		Thiotreau (mile)	(9/9)	(8/66)	Width Frence	(h/reit)	Viole (ft ² /list
HIM	30 HM 90 HM 105 HN 200 HN 500 HN	0.5 0.6 1.0 2.0 3.0 4.0	6722.00 272.7% 403.00 62.00 63.00 43.00	\$1.0000 1.0020 0.4632 0.9200 1.4000 2.2333	52 62 63 62 62 63	N/A N/A 8000 2800 1870 1000	485. 272 136 66 48 27
HPP-ET	100 HPF-ST 200 HPF-ST 200 HPF-ST 200 HPF-ST	1.0 2.5 3.0 8.0	64.50 64.50 64.50	0.4743 0.9486 1.4383 2.2886	62 62 50 60	8000 2800 1876 1000)30 60 48 27
٧N	109 VM 200 VM 305 VN 809 VM	1.5 2.0 3.9	68.00 68.00 68.00	5.8005 1.0000 1.8111 2.5166	51 83 40 50	8000 2806 1476 1600	136 46 46 27
MT	100 MT 180 MT 360 MT 300 MT	1.0 1.5 2.5 2.5	98.76 77.76 72.00 72.00	0.9480 0.6962 1.3645 2.1175	44 46 48	N/A N/A N/A N/A	104 70 81 34
FM"	120 FH816 150 FH011 200 FH011 200 FH818 250 FH029 300 FH021 300 FH021 400 FH023 400 FH031 500 FH031	1.2 1.5 2.5 2.6 2.6 2.6 2.6 4.0 4.0 4.0	76,50 62,56 62,56 62,56 62,56 62,56 62,56 101,50 101,50	0.7366 1.0714 1.6276 1.6276 1.6276 2.1164 2.1164 2.1164 3.0666 3.0666 3.0666 4.4130	11 11 11 11 11 11 11 11 11	4230 3400 2800 2800 2100 1870 1870 1380 1280	104 77 84 84 49 38 38 27 30
XIF	180 XP0 0 200 XP0 18 200 XP028	1.5 2.5 2.5	82'00 82'00 82'00	1.10380 1.8741 1.7347	u tu	3400 2600 2100	77 54 49

^{*} A 9% discours from list price applies to FN films slit have than 10 inches wide.

[†] Since a number of combinations of polylimids fills and Research by debting add up to the serve total gaps, it is recovered to distinguish among them. A three digit system is used in which the middle digit represent the retribute this retribute of the least Kapton film in mits. The first and third digits represent the retribute the retribute of the least in mits. The symbol if is used to represent 1/2-mit, and it to approach it follows from the country of a first process for mits. The symbol if is used to represent 1/2-mit, and it to approach it is a first process from the symbol in a second consistency of a first process from the country of a first process for with 1 mits of Tellan on one side. 1207tol to a 120-gauge structure consisting of a 1-mit bear in 170-mit country of Tellan on such side.

KAPTON® Polyimide Film

General
U.S. Price List

Du Pout Electronics

High Performance Films

Effective June 4, 1990

KAPTON polyimide film is an exceptionally strong, heat resistant film with an excellent combination of mechapical and electrical properties. KAPTON has been used successfully in various applications at temperatures from -269°C to 400°C. It is flame resistant, does not melt, resists effects of organic solvents and has a very high resistance to high-energy radiation.

Type HN: An all-purpose uncoated film, with toughness and dielectric integrity at very high and very low temperatures.

Type VN: An all-purpose uncosted film with all the properties of Type HN, plus superior dimensional stability.

Type FN: A Type HN film coated on one or both sides with TEFLON' FEF fluorocarbon resin to impart heat sealability, provide a moisture barrier, and enhance chemical resistance.

Pricing and Yield information

	Gauge & Type	Nomical Thighness Mas	Price Per Pound*			Put-Up information		
Туре				Roll Widt	h	Approx. Feet/Reii 6" (Da11" OD	Approx. Vield Sq.Pt./Lb.	Approx. Area Cost 5/8q. Ft.
			Width	Whith "hr-6"	Width 61/14" it over			
	20HN	0.3	\$897,501	\$687.60**	\$687.50°	9,4001*	451	1.53
	EOHN	0.5	228,25**	228.26ni	258.75"	6,000''	272	0.84
	100HN	1.0	61.00*	51.00*	50.25*	5,100	138	0.45
HN	200HM	2.0	60.78 ²	60.789	80.00	2,550	98	0.89
4114	100HN	3.0	60.76*	80.75*	81.00*	1,700	46	1.35
	SOOHN	6.0	61.75°	61,750	63.00°	1,000	27	2.29
	100HN	1.0	57.25**		_		136	0.42
	200100	2.0	58.50	_		Ĺ – i	68	0.83
	100VN	1,0	[]	84.75**	84.78*	5,100+	138	0.47
VN	200VN	2.0		63.26*	63.26*	2,550*	68	0.83
YM	200VN	3.0	I – I	64.75°	64.75*	1,700*	45	1.44
	BECVN	5.0	_	67.504	67.50*	1,0001	27	2.50
•	120770810	1.2	64.50*	86.50%	72.751	4,250	104	0.64
	100/74010	1.5	71.00*	72.25*	78.25°	3,400	77	0.94
	708F98011	2.0	71.00-	72.25₽	78.50°	2,560	64	1.34
FN	\$06FFH810	2.0	71.00*	72.254	78.50*	2,560	64	1.34
	200794029	2.5	70.75*	71.25*	78.50°	2,125	49	1.48
	300791021	3.0	70.75*	72.00°	78.50*	1,720	39	1.84
	300(7)1625	3.0	70.75°	72.00*	78.500	1,720	39	1.84
	40000000	4.0	70.78*	70.78°	78.2571	1,280	27	2.62
	400774831	4.0	90.50**	BQ.60°	95.75°	1,280	30	3.02
	\$00FN131	5.0	90.50**	90.609	98.75*	1,000	23	3.94

Price for 100 gauge and hemser films are for orders of a single item of \$0 lbs. or more. Add 10% for order norms of 20 lbs. to the man 50 lbs.

Baged on page for #6-6" for Type HN pad: #6-6" for Type HN Linegraph: 56-6" for Types VN and FN cad.

Based on 6" 9 4" and put-up

"Thereof on 6"xil"/" pad pultup.

⁴⁵Bessed on 3'46' pad put-up.

different on 3'x8'/" pad pul-up.

"Based on 3'x8" Universal put-up.

^{di}Based on 6"x11" ped pul-up. ⁴¹Minanum width '8".



-MSG H#= 4027011 PRANTE TO-COPY SENT-07/26/94 09:20 PM ST-C DIV-0072 CC-05801 BY-AUM3 AT-07/26/94 09110 PM

Tor RAY MANDEVILLE

RUNS

Capy: LEO PLOUFFE

PLOU

DAVID CZARN

ZARN

From ANDY MCKENNA

EMLA

Subj: FEA STUDY OF 89PS

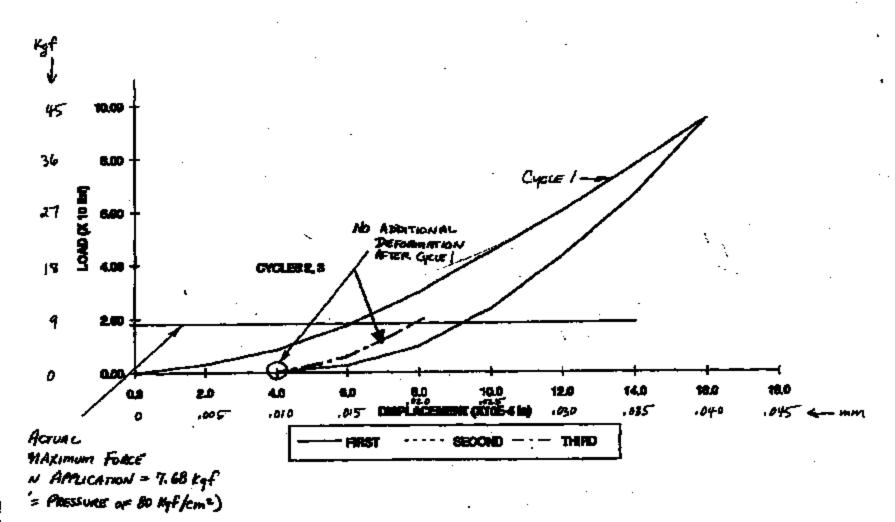
RAY, THIS IS A FOLLOW-UP MESSAGE TO OUR DISCUSSION LAST WEEK REGARDING THE 89PS KAPTON STUDY. I SENT THE ADDITIONAL REQUIRED MATERIAL TO YOU LAST WEEK THROUGH INTERNAL MAIL. I EXPECT YOU HAVE RECEIVED IT BY NOW.

AS DISCUSSED, WE HOPE TO HAVE THE FIRST-PASS ANALYSIS COMPLETE BY AUGUST 10-15. PLEASE LET US KNOW IF YOU HAVE ANY TROUBLE MEETING THIS DATE.

AFTER JULY 27, PLEASE DIRECT ALL COMMUNICATION REGARDING THIS PROJECT TO DAVE CZARN, X3558.

RECARDS, ANDY

COMPRESSIVE LOADING OF HRISON KAPTON FILM USING SOPS PISTON

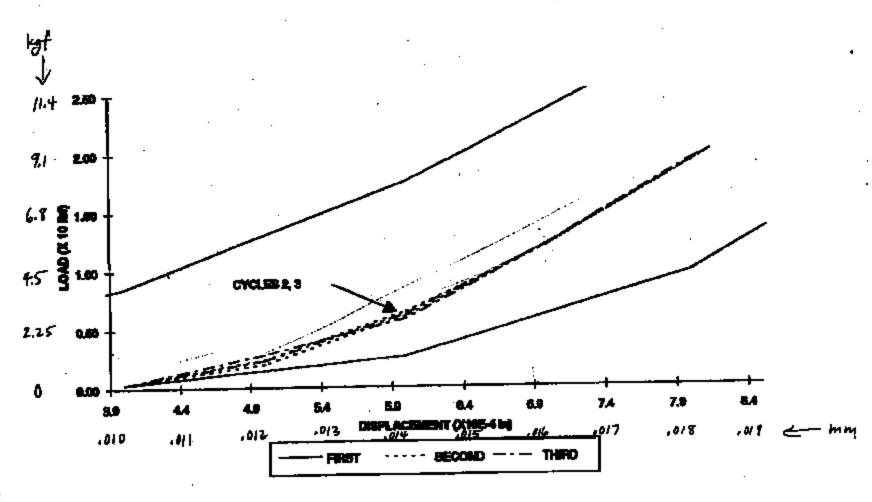


DATE OCTUBER 4, 1908

FILE KAPTON

TI-NHTSA 017598

COMPRESSIVE LOADING OF HIMMO KAPTON FILM USING SOPS PISTON

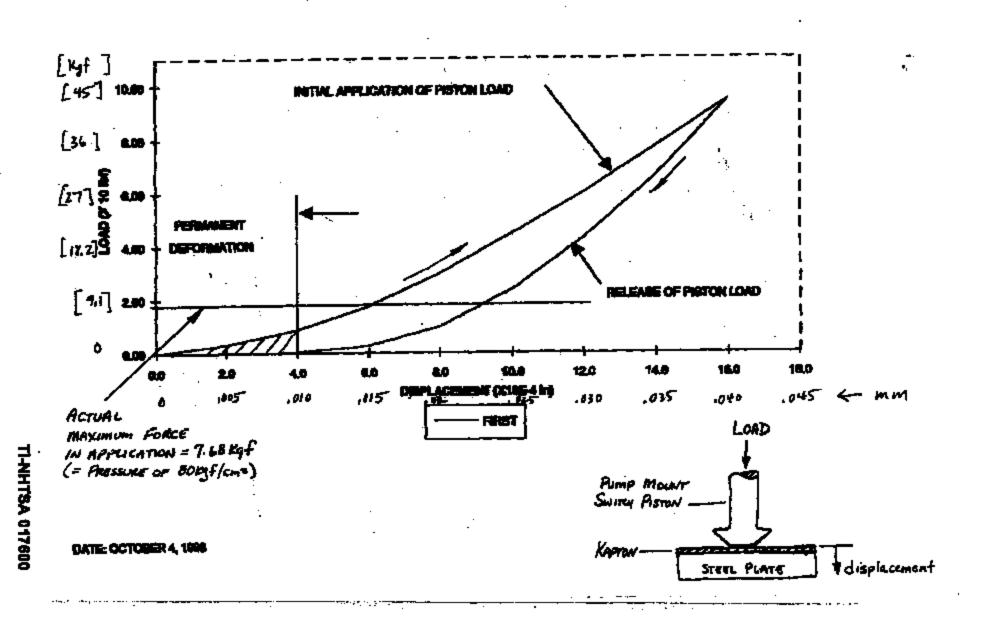


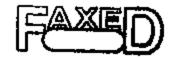
TI-NHTSA 017599

DATE: OCTOBER 4, 1983

FLE: KAPTON

COMPRESSIVE LOADING OF HISSON KAPTON FILM USING SOPS PISTON





August 9, 1994



FACSIMILE TRANSMITTAL

TO:

Name:

Mark McAlees

Location:

DuPont High Performance Films

Mal Station:

Phone Number:

614-474-0725

FAX Number:

614-474-0680

FROM:

Dave Creen

TEXAS INSTRUMENTS MS 12-29 Phone Number: (506) 699-3358

FAX Number:

(506) 699-3153

Total number of pages (including header page): 2

COMMENTS:

Mark.

You may have already seen the attached sheet via. Ed McKenzie. One of Nissan's questions is: "Please describe the material behavior during loading (provide stress/strain curve). Does the material have permanent deformation up to the yield stress?"

In a brief fax on 9/8, Ed said that the yield stress at 73 F is 10,000 psi and 3% elongation. I think we'll need to provide a little more detail to Nissan. For example, is the 3% elongation number valid under short term and long term loading, or does creep play a significant role? On the following sheet, I've attempted to break the question down into a couple of parts. I'd appreciate if you could look this over and try to help formulate a response. Perhaps a simple series of stress-strain curves, loaded to 5/10/15/20 kpsi and held for different durations would be possible. Also, we'll prosbly need to make a statement regarding the temperature effects (120C is typical max value) on the yield strength.

On a separate note, I'd like to discuss the planole testing that you performed.

Thanks and regards. Dave Czam

TI-NHTSA 017605





FACSIMILE TRANSMITTAL

TO:

Name:

Rd McKenzie

Location:

DuPout High Performance Flims

Mall Stations

Phone Numbers

614-474-0730

FAX Number:

614-474-0680

FROM:

Dave Casra

TEXAS INSTRUMENTS MS 12-29

Phone Number:

(508) 699-3558

FAX Number:

(508) 699-3153

Total number of pages (including beader page): 2

COMMENTS:

Ed.

I meant to cover another question with you, but forgot to include it. One of Nissan's questions that Andy may have reviewed with you is: "Please describe the material behavior during loading (provide stress/strain curve). Does the material have permanent deformation up to the yield stress?

On the following sheet, I've attempted to break the question down into a couple of parts. I'd appreciate if you could have someone who is knowledgeable about the stress-strain behavior of Kapton look this over and try to help formulate a response,

Thanks and regards, Dave Czara

TI-NHT9A 017606

1. What is the committee for reporting a yield states for visco-classic materials like Kapton?

If you lead a test specimen to 15th/50th/70th (for example) of its whent there is strongth, at what level does plants deformation takes place?

75% UTS
502-VB
75% UTS

on how long you keep the bend applied to reference point, assume the land is surely as a surely and applied to surely. As a reference point, assume the land is surely assist and for I minute.

Is there a value (based on a person of "ys" or UTS) to which the involvinal can be loaded without producing personnent deformation?

1-NHTSA 017607





August 9, 1994

FACSIMILE TRANSMITTAL

TO:

Name

Ed McKenzie

Lecation:

DuPont High Performance Fitms

Mail Station:

Phone Number:

614-474-0730

FAX Number:

614-474-8688

FROM:

Dave Cases

TEXAS INSTRUMENTS MS 12-29

Phone Number:

(508) 699-3558

FAX Number:

(506) 699-3153

Total number of pages (including header page): 3

COMMENTS:

Ed.

Per our discussion, please review the attached specification and comment. Once we close on the wording, I'll transfer this specification to a TI drawing that will be referenced on the prints for all of the 300HN, 500HN and 500FN131 that we use as pressure switch displacation. I'd like to have the documentation completed by the end of the month.

Regarding the test specimens - if you can provide us with 30 - 50, it would be helpful for our pinhole testing. I'm also trying to begin an additional long-term aging test in PSF, so probably 10 or 15 of these would be used for this purpose & another 20 for pinhole testing.

Thanks each for your onsoins support.

Regards, Dave Czara

TI-NHTSA 017601

Turns Instruments Material Specification for Kaptan & Film

1.0 SCOPE

This specification defines mechanical property, quality and inspection requirements for DuPont Type 300HN, 500HN and 500FN131 Kapton® and Terion® 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 roil. A mill roil is defined as a roil that is 50-60 inches wide and no longer than 10,000 feet. For the purpose of certifying strength and elongation, a new mill roil 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 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 each mili roll. The certified minimum strength is to be the minimum value recorded for all of the test specimens. It is DuPost's responsibility to increase the frequency of inspection of processing variability within the mill roll may result in strength or elongation values that are lower than those certified by the test specimens.

Minimum Voines

Ulfannie Tensile Strength	
Machine Direction (LED)	

Transverse Direction (TD)

24000 pel arkelmem 24000 pel minimum

Ulimaie Elongation

Machine Direction (MD)
Transvense Direction (TD)

50% minimum 50% minimum

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

4.2 Type 500FN131 Tellog@ 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 500HN131 film are derived more from the 300HN substrate film rather than the Teffon® laminate and b.) the Teffon® laminating process according to DePont 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 tentile 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, ploboles and inclusions. The supplier's control plan must include a means for periodically verifying that the inspection expirement is capable of locating defects.

Criteria:

- A. HOLES OF ANY SIZE ARE NOT ALLOWED
- B. INCLUSIONS OF GREATER THAN .020" IN WIDTH ARE NOT ALLOWED.

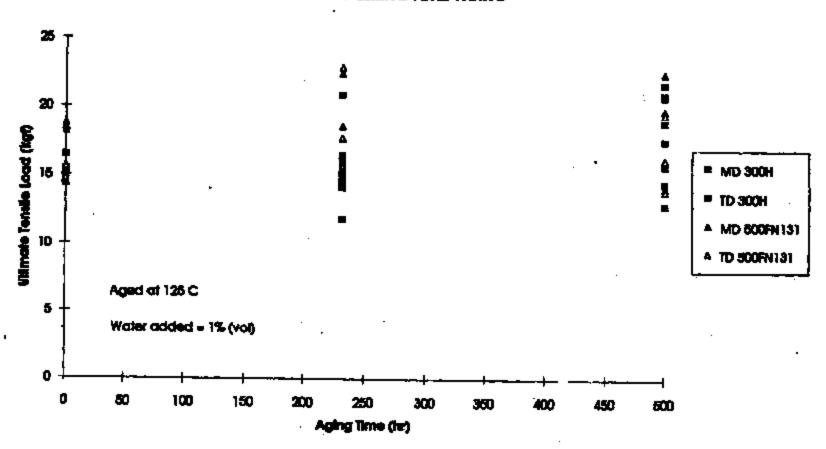
6.0 CERTIFICATION AND DATA RETENTION

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

All test data is to be maintained by DuPont for a minimum of (5) years from the date of manufacture. This includes all tentile test data and specimens, as well as defect inspection records.

16-1,57

8 V 8





August 11, 1994



FACSIMILE TRANSMITTAL

TO:

Number

Rd McKeesle

Locations

DuPont High Performance Films

Mail Station:

Phone Number:

614-474-0730

FAX Number:

614-474-0680

FROM:

Dave Czaro

TRXAS INSTRUMENTS MS 12-29

Phone Number:

(508) 699-3558

FAX Number:

(500) 699-3153

Total number of pages (including header page):

COMMENTS:

Bd.

The spec deaft I mailed to you on 8/9 did not include the minimum strength and elongation for 500HN film. As discussed, we'll be changing from 300HN to 500HN in the near future.

For one of the questions I'll be submitting to Nissan at the end of the month, I'll need to include the minimum allowable ultimate tensile strength for 500HN film. As you did last year for the 300HN film, can you provide me with minimum values for UTS and % elongation?

I'll be out of the office Friday, but will call you Monday to discuss any questions you may have.

Thanks, Dave

TI-NHTSA 017608

Texas Instruments Material Specification for Kapton® Fina

LO SCOPE

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

2.6 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 so 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 clongation, 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® FRm

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 each mill roll. The certified minimum strength is to be the minimum value recorded for all of the test specimens. It is DuPont's responsibility to increase the frequency of inspection of processing variability within the mill roll may result in strength or elongation values that are lower than those certified by the test specimens.

Minimum Values

Ultimate Tensile Strength	Type 300HN	Type 500HN
Machine Direction (MD)	24000 pai minimom	(XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
Transverse Direction (TD)	24000 pei minimum	(XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX

Ultimate Elongation

Machine Direction (MD)	50% reinimum	(XIXXXXXXXI)
Transverse Direction (TD)	50% minimum	(XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX

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

4.2 Type 500FN131 Tellog® laminated Kapton®

Tensite testing of SOCFN131 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 SOCFN131 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 SCOFN131 film if either a.) the 300HN certification data is unavailable or b.) there is resson 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 Tefion® 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 DRFECTS (All film types)

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

Criteria:

- A. HOLES OF ANY SIZE ARE NOT ALLOWED
- B. INCLUSIONS OF GREATER THAN ,020° IN WIDTH ARE NOT ALLOWED

6.9 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 test data is to be maintained by DuPont for a minimum of (5) years from the date of manufacture. This includes all tensile test data and specimens, as well as defect inspection records.

4.2 Type 500FNI31 Teffon® laminated Kapten®

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 Tetlon® laminate and b.) the Tetlon® 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 unevallable 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 tensite test. The minimum strength and clongation 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.

Criterie:

- 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 fixelign 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 finialized product shipped to TI.

6.0 CERTIFICATION AND DATA RETENTION

When the print specifies that maintial 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 DuPout for a minimum of (5) years from the date of manufacture.





August 11, 1994

FACSIMILE TRANSMITTAL

TO:

بمستد

Ed McKenzie

Locations

DuPout High Performance Flore

Mail Station:

Phone Number:

614-474-0730

FAX Number:

614-474-0680

FROM:

Dave Cases

TEXAS INSTRUMENTS MS 12-29

Phone Number:

(508) 699-3858

FAX Number

(506) 699-3153

Total number of pages (lackeding header page):

×3

COMMENTS:

Ed.

The spec destit I mailed to you on 8/9 did not include the minimum strength and elongation for 500HN film. As discussed, we'll be changing from 300HN to 500HN in the near fature.

For one of the questions I'll be submitting to Nissan at the end of the month, I'll need to include the minimum allowable utimate trackle strength for SOHN film. As you did last year for the 300HN film, can you provide me with minimum values for UTS and % elongation?

I'll be cut of the office Priday, but will call you Manday to discous any questions you may have.

Thanks, Dave

Texas instruments incorporated + 34 forest street + attleboro. Ma 42743

Turns Lastroments Material Specification for Kapton® Fire

1.0 SCOPE

This specification defines mechanical property, quality and inspection requirements for DuPont Type 300HN, 500HN and 500HN131 Kapton® and Terion® laminated Kapton® film supplied to Texas Instruments. Tols specification applies when it is referenced on the print for the material or finished coreponent.

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® Flux.

Tensile test specimene are to be taken from increments along the width of the roll including locations at both ceter 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 each mill roll. The certified minimum strength is to be the minimum value recorded for all of the test specimens. It is DuPont's responsibility to increase the frequency of inspection of processing variability within the mill roll may result in strength or elongation values that are lower than those certified by the test specimens.

Minimum Values

Ulfmate Tendle Strength	Type 300EN	Type 500HN
Machine Direction (MD)	24000 pet minimum	(XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
Transverse Direction (TD)	24000 get minimum	(ALEXANDER)

Uffereit Electrifier

Machine Direction (MD)	50% minimum	(XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
Transvense Direction (TD)	50% minimum	(XIEREKIEK)

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

4.2 Type 500FN131 Tellog® luminated 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 remaining is that a.) the mechanical properties of the 500FN131 film are derived more from the 300HN substrate film rather than the Telion® luminate and b.) the Telion® luminating process according to DuPost does not negatively affect strength or elongation properties.

It is DuPont's responsibility to test Type SOUFN131 film if either a.) the SOOFN 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 Tedou's film from the Kapton's substrate to get a more accurate and repeatable tentile 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 supplier's control plan must include a means for periodically verifying that the inspection equipment is capable of locating defects.

Criteria:

- A. HOLES OF ANY SIZE ARE NOT ALLOWED
- B. INCLUSIONS OF GREATER THAN ,020" IN WIDTH ARE NOT ALLOWED

6.0 CERTIFICATION AND DATA RETENTION

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

All test data is to be maintained by DuPout for a minimum of (5) years from the date of manufacture. This includes all tensile test data and specimens, as well as defect inspection records.

4.2 Type 50@N131 Toller@ laminated Kapton®

Tensile testing of SOCFN131 film in not required provided the SOCFN Repton® 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 SOCFN131 film are derived more from the SOCFN substrate film rather than the Tedon® luminate and h.) the Tedon® luminating process according to DuPont does not negatively affect strength or elongation properties.

It is DuPout's responsibility to test Type SOCEN131 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 Telion® film from the Kaptan® substrate to get a more accurate and repeatable tendle test. The minimum strength and clongation 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 files, as well as the 300HN used as the substrate for 500HN131 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 fixelign matter in all 300EIN and 500EIN film, as well as the 300EIN used as the substrate for 500EN131 film using an online camera inspection system. Inclusions of £125" or greater must be detectable by the system and are not allowed in finished product shipped to TL.

6.8 CERTIFICATION AND DATA RETENTION

When the print specifies that material cartification is required, the supplier cartifies that the material was produced in accordance with that specification.

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

	DEVICE	#87P\$		TITLE	MATERIA				A	75051	CLI 1	
	PROJ. #	3423				APTON (<u> </u>	75951	ו .חכ	
75951 9H.1	1.0	RECUIRE	MENTS FO IR LAMI ECIFICAT	ir dupon Nated K 'Ion app	T TYPE : APTON (LIES WH	OOHN.! FILM NIT!	SOOHN SUPPL	船郭	XOFNL3	TY AND INSP I KAPTON (R S INSTRUMEN HE PRINT FO	TEAND	
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		CRITERI												
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	i i	FOR 500 OF .025 ALLONED	PECTION 300HN A FN131 F F OR GR) IN FIN	ND 500 TLM US EATER TISHED	HN F ING HUST PRODI	(LM, A AN ON BE DE UCT SH	S WELL LINE C TECTAE IPPED	. AS TI	HE 300	HN USE CTION	D AS 1 SYSTEM	THE SU 4. IN	BSTRAT CLUSTO	ie Jns
	6.0	SUPPLIE	CATION E PRINT R CERTI ECIFICA	FIES T	1 F 1 F 8	THAT	MATERI	AL CE	RTIF3C PRODUC	ATION ED IN	is ret Accord	DANCE	THE WITH	
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										•				

Turns Instruments Material Specification for Kapton® Film.

1.0 SCOPE

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

2.0 TRACRABILITY

Material supplied to this specification must be traceshie 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 azill roll should be designated after any process changes that may affect the certified minimum strength and elongation values.

3.4 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 BLONGATION 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 (MD) from each of 5 locations across the width of the sull roll. The certified minimum attength 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.

Ministern Values

Uramete Temile Strength

Machine Direction (MD)

Transverse Direction (TD)

24000 pai minimum

24000 pai minimum

Ulimaio Escasion

Milithine Direction (MD) 50% minimum
Transverse Direction (TD) 50% minimum

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



CIRCLEVILLE PLANT

P.O. Box 89 Circleville, OH 43173

ADDRESSEE(S):

Date & Time: 9.8.44 2:389 Mar

FACSIMILE TRANSMISSION COVER SHEET

Name

Company or Department

Location

PANE CZARN

TEXAS INSTRUMENTS

AUCUSAR

COPY:

SENDER:

Name

DuPont - Kapton

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And Location

Conspany or Department

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Location

Conspany

DuPont - Kapton

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Special Instructions/Information to Recipions:

observe versaments to consider to reschious

CIRCLEVILLE FAX NUMBER FOR THIS TRANSMISSION IS 1-800-879-4481. SHOULD PROBLEMS OCCUR WHILE SENDING, CONTACT 1-800-967-6607.

*** CONFIDENTIALITY NOTE ***

The deciments accompanying this infecept transmission contain information from Bullent Thus which is confidential under legally privileged. The information is intended only for the use of the individual or easily according this transmission short. If you are not the individual confidence, you are hereby notified that any distinction, congring, distribution, or the colony of any action in relicence on the contents of the information in strictly probabiled, and that the documents should be returned to Bullets Thus immediately. In this request, if you have received this telescopy in arrow, pieces notify us by talephone (1-005-007-5007) immediately so that we are accompanied for the return of the original documents to us at no cast to you.

(FAX AII)

Charting a Course for Excellence

2.000 miles (0.1/2)

9/8/94

TO: DAVE CZARN

FR: KD MXXXH21B

have, I am sorry for the delay in setting back to you. I have been traveling and things have been quite hectic since my return.

· Updates:

- 1. Test results of tensiles, etc on the film with laser drilled holes.
 - control samples were well within expected values.
 Holes, regardless of size, created a stress concentration point, resulting in a reduction in tensile strength to about 15% vs about 70%. This was very consistent. So consistent that we did not pull all the samples. See the attached curves date.
- 2. 500 HM spec values for teneils and elongation:

MD, TD, minimum tensile strength: 24000 psi MD, TD, minimum elemention: 50 %

These are the seme as 300HN

- Yield stress or the point where Kapton leaves the electic range and permanent deformations takes place is about 3% elongation. and 10000 pei. at 73 degrees F.
- 4. Meeting at Circleville, possible dates:

September 29. or 30 Thursday or Friday October 6. or 7 Thursday or Friday

l will be involved with a customer visit today, but will try to reach you tomorrow. Friday. Thanks for your patience....

Rá

59, 59, 54 - 08:43 PM - --

CONTROL MD

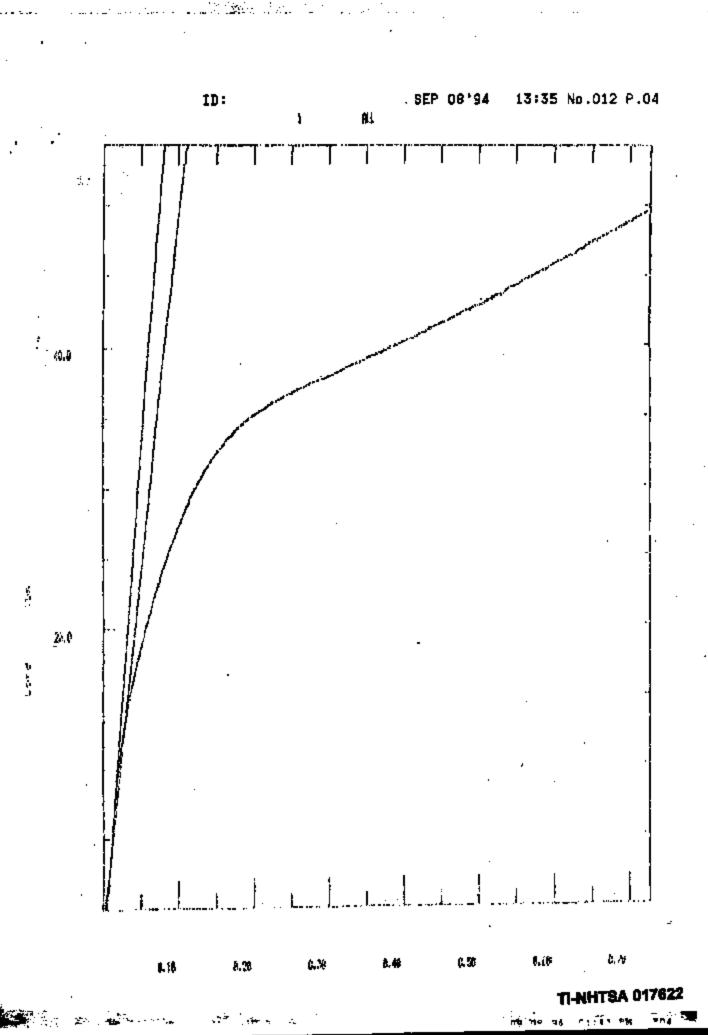
E. I. NUPOKE CIRCLEVIELL UK.

Sample identification: L

Tool Lute: 31 Aug 1996

out of I specience, 0 excluded.

Specimen Naubet	Streen at Max.leed (Kpui)	4 Strein et Maxilosd (t)	Hedulas (uer lies) (Kpai)	Load el Kay Lead (Iht)
1	23,01 231-6-5	72.46	460.2	49,64
Heam:	33,09	72.46	499.2	49,64
Slamdard Deviation:	4. #841.5777	•1,		
Kiniow:	33.09	17,46	60.2	49,64
Heriane:	22.09	77.46	400.2	49,64
Cof of War				



ID:

SEP 08'94 13:35 No.012 P.05

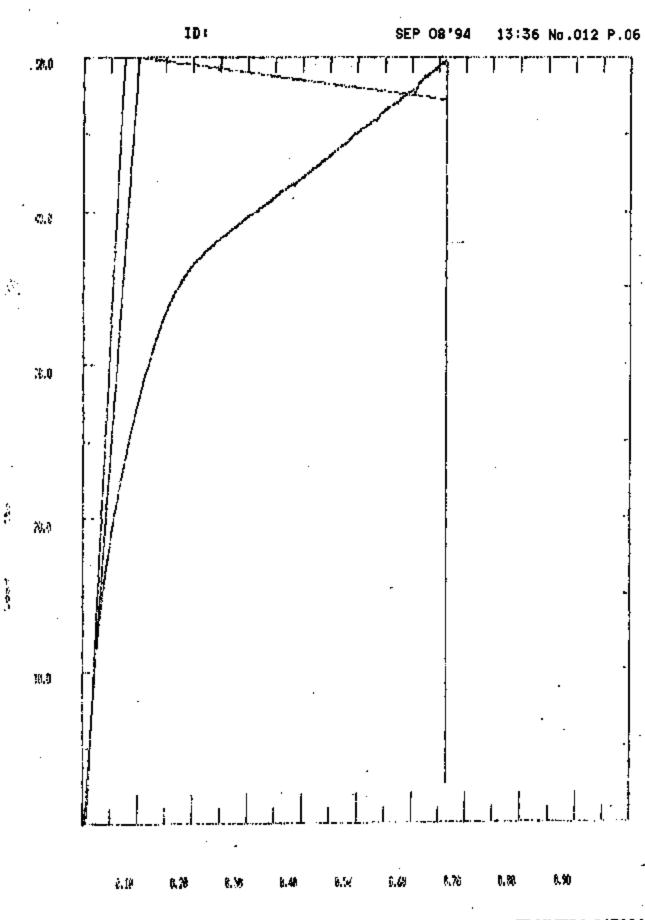
CONTROL TO E. I, SUPORT EXPORT ROMO CIRCLEVILLE OR.

Sample Eduntification: 3

Test Oale: 31 Mag 1994

Out of) specimene, 0 excluded.

Specinon Number	Stress at Nax.Load (Kpel)	& Strain et Kan,Logd (%)	Modelva (usr line) (Kpai)	i éad ét Kez Load (téa)
1	32.19	65.97	485,1	49.78
Nesa:	33,19	45.97	486.1	49.76
Standard Deviations		*****	bb	
Hinimus:	32.15	65.97	483.1	49.78
Meximum:	23,19	65,57	485.1	49.70
Caf of War:	********			



TI-NHTRA 017624

De 68. 94 01:47 PM

CAPPOID.A

E. B. CAPPAIT DUPONT RAND CORCLEVATOR ON

Sample Mostification: 1

Took Date: 01 Sep 1994

(a) of t specimens, D excluded.

Specimen Number	et reed le (Legs)	t Girasu et Nov.Loop (1)	(abs.) (abs.) (abs.)	load at Mar,Load (Ida)	
]	27.59	16,00	465.7	33.66	
Keep:	77.59	16.99	465.7	33.88	
Standord beviotions		44-4-44 14-7		•	•
Hipjayat	22,39	16.89	465.7	33.68	
Mas) aux:	22.59	14.14	465,7	33.66	
caf af Kar		********		PPP18+1:+	

13:37 No.012 P.08 ID: AL. 38,6 **አ**ሊስ iac 6.12

Marin Cantral Marin Marin Contraction Cont

D.014# 1750

F. J. DAPART DUPORT ROAD CONCLEYFLER OIL

Sample identification: 2

Tout Dale: 31 Aug 1994

Out of 1 specimens, 0 excluded.

Sproimen Number	Struse al Max.Load (Kpsi)	t Strain al Max.Load (4)	Hodeles (ver lime) (Kpal)	t end at Nax ,1 ced (26e)
)	21.97	13,69	506.7	12.94
Henn:	21.97	ta.e9	506.7	32.96
Standard Poviation:				*******
Kibinan:	21.97	13.41	506.7	37.96
Hazirum:	21.97	13,49	\$86.7	37.96
tof of Mars				41 001-4-

ID: 13:38 No.012 P.10 \$.8 31.3 10.D 8.2 0.17 1.0 Ç,£

0.00

TI-NHTSA 017628

. C. OH US pto

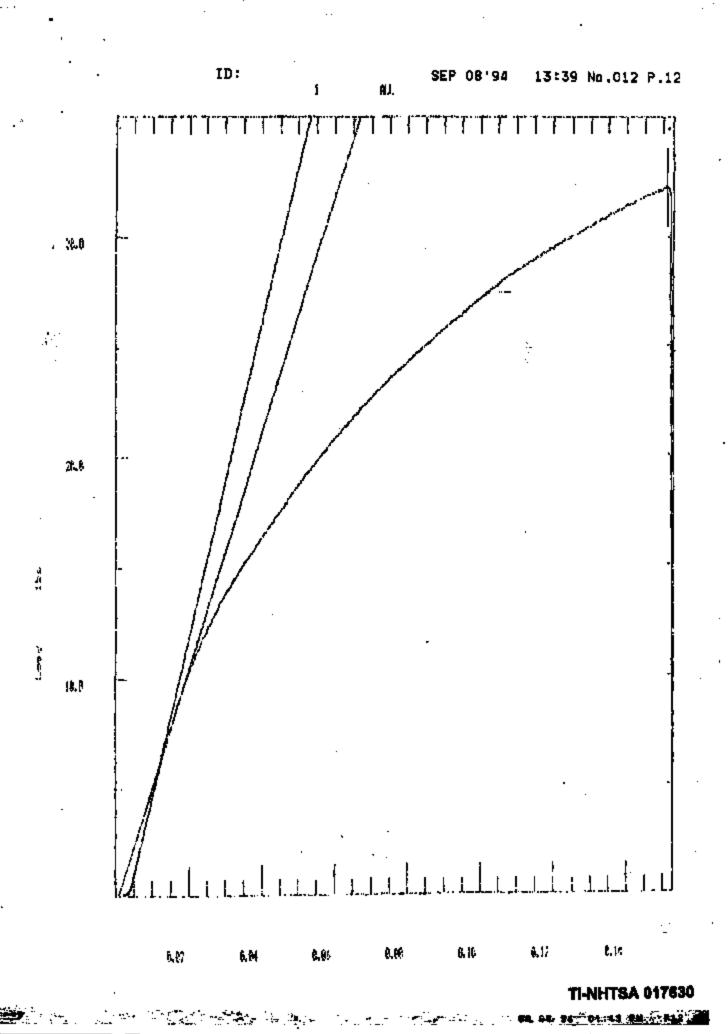
E. 1. DEPONT DUPONT ROAD CTRCLEVILLE OR.

Sample identification: 1

Tout Date: 31 Aug 1996

Out of 1 specieons, 0 excluded.

Specials Number	Stress al Mag., topå (isaj)	elected for the section (4)	Modulus (usr lies) (Kpel)	toed at Nax.Loed (1be)
1	21.54	15.02	478.7	22.31
Kees:	21,54-	15.02	476.7	37.31
Standeró Deviation:		4	*******	
Kininunt	21,54	16.02	479.7	32.21
Kasigum:	21.54	16.62	478.7	32.31
Cof of Var	******	,.		.



B . 013 2 10

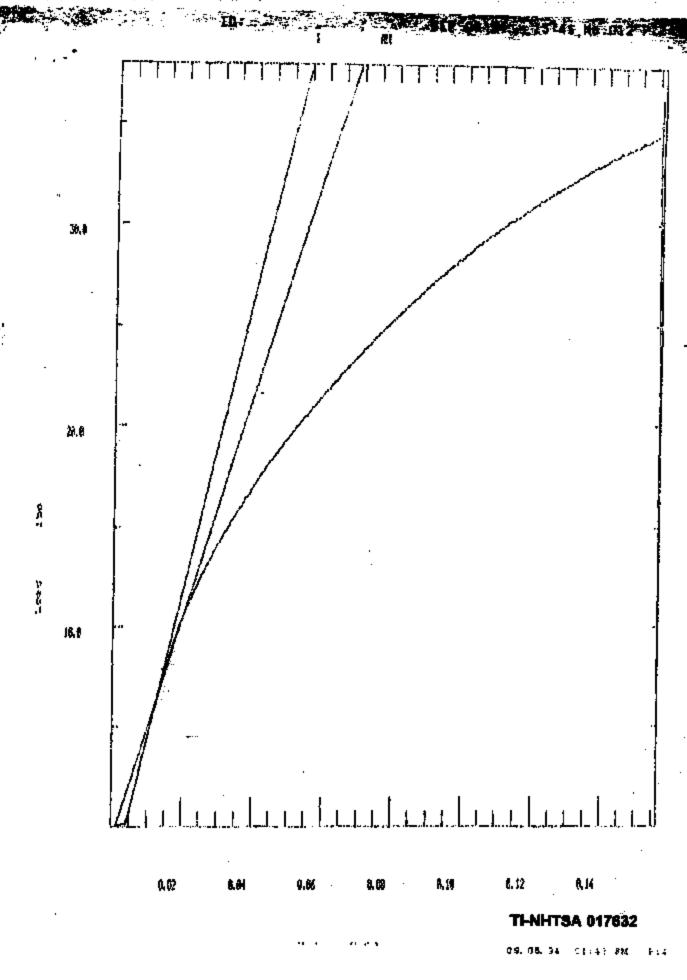
F. J. MATURT DEPENT ROAD LINCLEVILLE OIL

Sample Identification: L

Took Dale: 31 Aug 1996

Out of I specimens, 0 excluded,

Speciaca Number	Stress at daz.lond (Kpeł)	t Strain at Max.toad (t)	Modelus (wer line) {Kpsi}	Lood at Kaz.I sad (]hp)
l	22.97	15.44	494.4	34.46
Kess.	22.97	15.44	496.4	¥.46
Standard Deviation:				
Ni alaum:	22.97	15.44	494.4	34,45
Kātikon!	27.97	15.44	64.4	34.46
Cot of Wer:				PPE



â.

B.011#172

E. 1. SUPPORT BUMONT NORM CINCLEVIZIN ON.

Sample identification: 1

Test Date: 31 Aug 1994

Out of I sectimens, O excludes.

phocines Procines	(Khai) War'loaq ar giidab	# Elrojs sk Max.Load (%)	(Keel)	i sed et Kra . Load (3bc)
)	23.15	15.44	499.8	34.76
Keno:	23.1B	25.44	499.8	31.74
Standard Neviation:	465		*********	·
Minimum:	23.18	16.44	199.0	31.76
Anxinum:	23.18	15.44	199.8	34.76
Col of Yer:	.,,,-,-		,,,,	

E. I. DEPON! DEPON ROAD CJECTEVILLE DI.

Arthur M. Arthurson

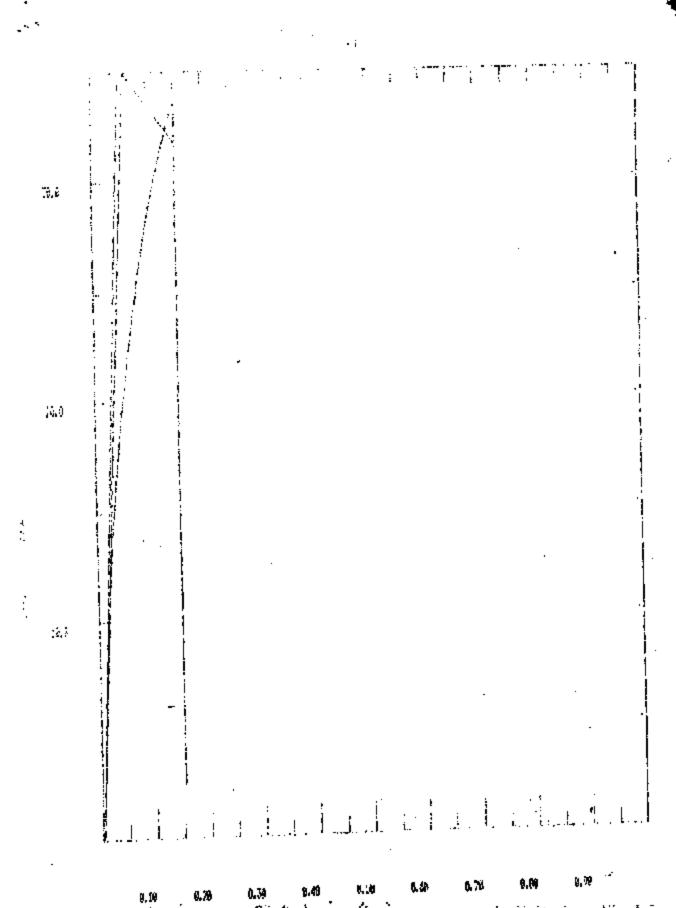
Sample Identification: A.Signify Alb

1881 Pale: 30 Aug 1994

Out of 1 specimens, 0 excluded.

Specimen Number	SLIMES AL Max.Load (Kpg1)	i Sirain at Kar.Loss (i)	Modelus (uni lint) (Epsi)	Load et Hez.load (1be)
1	22.47	14.89	14.5	39.63
Hogh:	22.42	14.59	₹ % .5	33.63
Standard Deviation:		**********		
Biniqua:	22.47	14.89	(94.5	37.63
Adalaon:	27.47	14.89	194 .5	39-43
Col of Yer:	******			**





Cattle or 28, 1994

The Teve Szarn Teace Instruments Attleboro, MA

Fr: Ed MoMenzie Dafont Circleville, OH

COPRIDGE ON DRAFT MATERIAL SPECIFICATION

Sections, 1.0, 2.0, 3.0 - OK as written.

Geolios 4.1 30000, 50000 1. Nacqui Values

'llitmate Tensile Strength	Type 30002	Type 500HN
Mechine direction (MD)	24000 pei	24000 pai
Tangverse direction (TD)	24000 psi	24000 pai

-.'inate highwayan Machine sprestion (MD) 50% 50% Transferace direction (TD) 60% 60%

We measure tensiles and elongation at start up. and every other mil.

section 4.2, b00FM181 - OK as written

Coursing R.O. DEFECTS

NUMBER OF STREET

At hills of any size not allowed

- Differt will improve all 300HM and 500HM, as well as the 300HM substrate for 500FM; at product with on line camera system for holes. If holes are detected the film will not be used for 71 orders. For specification runpuses, we can agree to an autitor to detect nodes, bubbles and craters form to 50 rates. I will contrain with Technical to see if we can apacify smaller size. Reset on our bulual inversence on line
- b: Suffer will imager, all 3000M and 500MR, as well as the 1990K substrate for 500Fe131 product with on line camera system for inclusions. The actual 500FM131 laminate will be inspected with the least off line system. For specification purposed we can agree to a minimum detection capability of 50 mile. If inclusions are detected in the film, the location will be marked, and the footage flagged for removal in slitting.

TI-NHTSA 017636

معتمونين وجريات بالأراف فالمريغة برايدات

Rection 6.0 Cortification and data retention

We can provide certification to the specification. Carrently we realn the tensile and elongation information on microfilm for the required time frame. However we retain defect maps on our detabase as long as space allows (approximately 3 years). We do not maintain any ISO procedures for recention of the defect maps. It is our contention that defect maps are for use in slitting out defects. Once the film has been processed, the defect map is now for a mill roll that doesn't exist.

Please call call me temerrow to discuss any of the above points.

Presented

TLNHTSA 017632







FACSIMILE TRANSMITTAL

TO:

Rd McKemile

Locations

DuPont High Performance Films

Mell Station:

Phone Number:

614-474-9730

FAX Number:

614-474-0680

FROM:

David Canna

TREAS INSTRUMENTS MS 12-29

Phone Number:

(506) 679-3558

FAX Number:

(506) 699-3586

Total number of pages (including beader page): 1

COMMENTS:

Thanks for the response on the material spec. I've updated the spec with most of your inputs, but we need to take a ciceer look at the hole criteria. What we've talked shout in the past is the ability of the camera. importion system to detect a hole as small as 1 mil, and the fact that DuPost has not witnessed any holes less than 10 mile. With these thots, I was surprised to see a spec of 50 mile. It seems like an overly conservative number if, in that, what we've discussed in the past relative to pinholes still holds true. In our applications, if we receive any material with holes in it, if a problem.

I'd like you to sak that you review this - as you indicated in your fax - with the Technical department, so we can further discuss. It's clear to say that this is solve to be a significant leave with Nissan if it samelas spec'ed as it's shown.

It looks like we're still echeduled for a visit on the 18th (andving in the morning) with the following salendoes:

Mr. Nacid Yuzuriba

Group Project Engineer

Nissen R&D - Detroit

Mr. Occident

Quality Engineer

Mr. Chris Giesson Mittuo Sayama

Product Release Engineer

Ti Oyuma, Japan

Keen Nekenishi

Merbedas Merbering

TI Attieboro

Thanks and regards. Dave Czara.

Texas instruments incorporated * 34 forest street * atitleboro, ma *2743



CIRCLEVILLE PLANT

P.C. Bat 29 Circleville, OH 48113 PAZNO: 508-699 -3586

DOMESKE (8)e Name COPY: renzie --- 2 PACE(S) TO FOLLOW THIS COVER SERET-

CIRCLEVILLE PAY NUMBER FOR THE TRANSMISSION IS 1,400-179-4401. SHOULD PROBLEMS OCCUR WHILE SENDENG, CONTACT 1-800-907-5007.

GAZAK A LANGE AND Charting a Course for Excellence October 14, 1994

Fax Message

TO: Dave Czarn Azis Rehman

From: Ed HcKensie Du Pont

Subj: TI/Nissan meating at Circlevilla on Tues. Oct. 18, '94.

Plens

- 1. Review of Process -As I imagine we will be tight for time, we will give a process overview during our lunch in the conference room. I feel the overview is important, as our Niesan quests may not be familiar with film processing and web handling.
- 2. Process capability
 - I plan to review the following:

 - 3 mil and 5 mil historical data on Tensiles, elongation. Data on variation across the web (Transverse of TD)
 - Review stress/strain curves at ambient and 125 degrees Colsius for 300HN.
- 3. Defect Detection

 - Ristorical performance Camera system and capability
 - Lager system
- 4. Specification Review, especially around Defects

Dave: For your information, setting maximum defect sise:

Roles:

Minimum detectable hole size will be 25 mils, due technical limitations (software, analyzing speed). However, we still stand behind our belief that smaller holes are extremely unlikely to be produced during our casting process, and G. Maroscher will address this issue.

Other defects:

Inclusions: Minimum detectable size will be 25 mils (versus 20 mils), due to the limitations of the equipment.

Debris:
Debris is on the surface of the film, and is airborne or transferred by rollers, usually attracted by the static buildup associated with Kapton* film. It is difficult to set any minimum size: Once it is detected, it could fall off in subsequent processing or more could be attracted.

Our recomendation for specification of Defects

- All 3 mil and 5 mi HN for TI will be camera inspected, including 3 mil substrate for 500FM131.
- 2. Maximum Defect size:

Holes: 25 mils (holes less than 25 mils are unlikely to occur during conversion to polyimide film).

Inclusions in the Kapton* film: 25 mils

3. Inclusions in the laminate saterial: maximum of 50 mils. Necessary since we do not have the camera capability for the Teflon* film manufacturing or for the laminator.

We are still struggling with a way to check calibration on laser equipment - for now we still rely on electronic calbration.

4. TI material will be pre-milt on a machine with a non contact film cleaning capability. This procedure has helped reduce contamination in film sold to the flexible printed circuit industry.

I will be in on Monday, so please call if you have any question or comments.

A few comments about the agenda I sent earlier this week:

Ralph Hutton may be traveling - if so Tom Clyde, HPP Industry Segment Manager will fill in.

I may need to move the Defect detection discussion up, as Gerhard Maroscher will need to catch a plane later that afternoon also.

Thanks Ed Cretarill - 1100 complayers, 750 acres, non union, 24 ha operation

KARTON Produced in Circleville of Bay port. TX & Tokai, ilapen (TDC)

Tellor onlygin Condeville

Tellor laminated Kap ton only in Conclusive

May tom, Tellor, my far , SP Resum for bropal of Peijin Dupont films (polyce folyon films in substants for and a finite topen (

Kapton:

Flax circuits

Magnit win way

Metalizing.

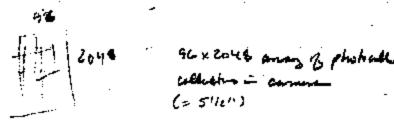
Purchase fonts

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- Change colorent to may talk black
- (1) hist 1 x 204 & block

 get to 3cm change; I value

 at next piece in crownst-



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@ ilm abances, I then charge in voltage is notified to The next 1'x cors senso fields

Densether mayging is done, and the change is compatified

is ampetipied & Ames, 505 Mars is ampetipied & apperent realls in lang Storato

(nevention? – ቬ'ነተራሳ'ም higher MW PE autid by Vagor pressur hertolog -> get a pantite to mulestone to 3 mil - 15 meto lizvid 5 miles 25 mbland In 3 mil film, he never observed anything & 36 mil in sige Camera has detected 25 mil holes in Trumme The Dany women for contaminants blum layers of film when winding? 1) yes, but no absorve motion bother layers I yes, need to control , for example, for customer metallying film 25 mil holes / bubbles or orates me needly whent fable by system 10 holes in >3m saft of find (~ 115 mill holes) Line Vanuel -> >50 mils = laren detection on laminatal Rhm. PTFE- paste extradul (se "cold" extraded) any concern for holes in FEP? ... that yes, but of here is a particle -large enough to beat mongh the tien reant inspect to holes in FEP after laminated ... also, FET is clear TI-NHTSA 017643

500 FU 131 in material of in tapton, will prod to hole (of inclusion is larged mough) Q how can we develop a tet to live duability @ various agale rate A run J-6 test on scratched film. # run J-6 tot on "transition" rolls of 300HN that have greater bullent & delect Showers to have stat test method for fatigue of films? (Ed) + tot rioults of field returns a translate I kroug memo on field analysis.

missim/Tiles Instruments at DU Pomr Circleville, Ohio October 18, 1994

34 EE D

11:15	Arrive at Circleville	
11:30	Welcome	Tom Clyde HPP Segment Hgr
11:45 - 12:30	Lunch Process Overview	Plum Room
12:30 - 1:30	Defect Detection	Gerhard Maroscher
	- Experience with On Li Camara System - Laminates, Off Line System	Lne
1:30 - 03:00	Specification Raview	
	- Thickness, Tensiles, Elongations - Process Capability	
3:00 - 4:00	Plant Tour	
	- Teflon* - Kapton* - Leminator - Finishing	Jim Prinsler Ed McKenzie
	- QC Lab	Kadijah Smith
4:00 - 4:30	Review and Path Forward	
4:30	Leave for Airport	

NISSAN/TEXAS INSTRUMENTS at By PCHT Circleville, Chic Cotober 18, 1994

AGE DA

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4:30	Leave for Airport	

NISSAN TO DUPONT VISIT(10/18/94)

ACTIONS

WHAT	WHO	WHEN
1. EAPTON DURABILITY PERFORMANCE DATA		
- NIESAN WILL NOTIFY TUXUPONT ABOUT THE TEST METISOD	MARRIN	TED
- Submit mit teft or finglar test data	DRIPONT	TED
2. SCRATCH, DOMR, FINERILE INFLUENCE ON KAPTON STRENGTH		e/a
- Scienty the test reports to show how the above defects on kapton strength	DUPONT	190
3. KAPTON HANDLING		,
- RECONSIDER KAPTON RESL PACKAGING * POTENTAL SCRATCE ON KAPTON MATERIAL	π	TRD
* CARTON DUST ON REEL SURPACE		

10/24/94

KN

0050-175



Dear Valued "Kapton" Customer:

We have good news. The DuPont Films' site at Bayport, Texas, has been registered to the ISO 9002 International Quality System Standard by Underwriters Laboratories, Inc. With this registration, Bayport's "Kapton" quality system joins seven other DuPont Films' sites and/or processes that--including "Kapton" and "Teflon" at Circleville, Ohio--have met the rigorous ISO 9000 registration criteria.

ISO 9002 is an international quality standard that is recognized in more than 90 countries around the world. Today, more and more businesses are seeing the value of becoming ISO registered, as well as working with partners who meet the stringent requirements of its auditors. Worldwide, DuPont has 238 ISO 9000 registrations.

ISO 9002 registration ensures you will benefit from a comprehensive system for quality assurance. Calibration, document control, product traceability and quality records were just a few of the 18 elements we were tested on before we gained this prestigious registration. Regular visits by ISO auditors will ensure the effectiveness of our quality system is maintained.

While we are certainly enjoying the success of this achievement, be assured Bayport's high performance work teams are continually striving to provide value-added services to you, our customer. We view this ISO registration as an integral part of our commitment to quality and yet another step in DuPont Films' partnership building process.

Lynn Millikin

Business Director,

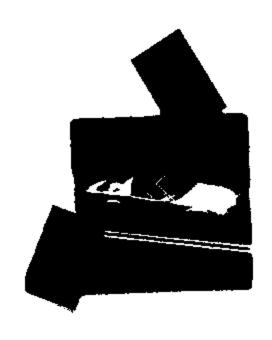
DuPont High Performance Films

Ed Roosa

DuPont Films' Plant Manager

Bayport, Texas

DuPont KAPTON*

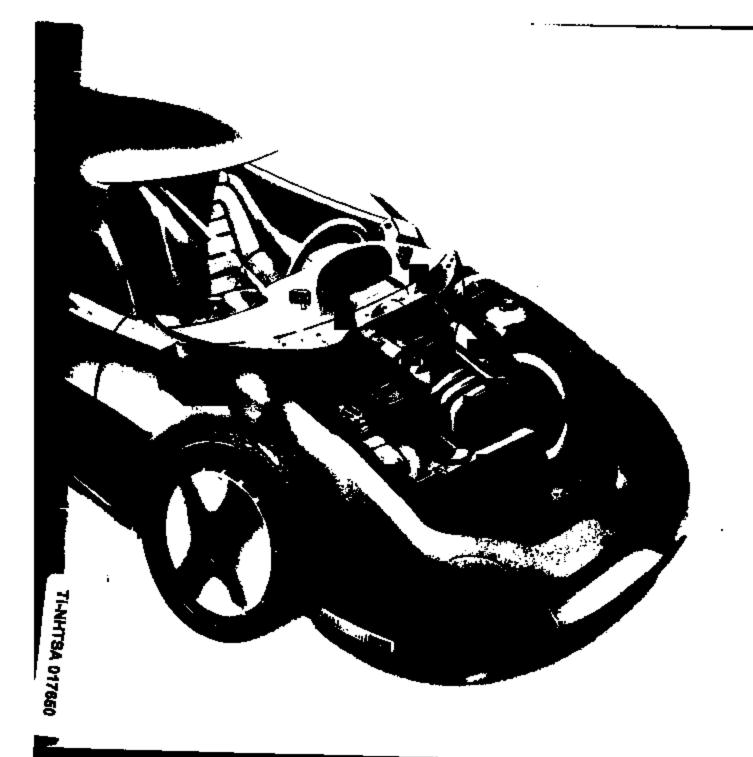




The thermal, physical, chemical resistance and electrical properties of KAPTON are exceptional. And, the benefits don't stop there. KAPTON can be easily fabricated by a wide variety of techniques, including die cutting, punching and thermoforming. It offers excellent adhesive bondability as well.

And, KAPTON is backed by a team of DuPont experts who are ready to provide technical support to designers, fabricators and original equipment manufacturers. In addition, the DuPont KAPTON Marketing Development Group offers a unique opportunity to form partnerships in selling products to the automotive industry.

We hope that this brochure has helped you discover how KAPTON can accelerate your design ideas for cars of the future. For more information of to talk to a DuPont Representative, please call 1-800-237-4357.



Spark Plug Boot

- Speaker Parts cones dornes spiders
 - Surrounds Voice coils
- Switches air conditioning system (pressure, punched) button for under-the-hood thermostat (punched) transmission pressure vacuum electrical

rent and Potential



- Alternator Heat Sink Insulator Pads
- Diaphragms air bag air conditioning system fuel pressure regulator oil pressure switch power steering switch pressure switch in brake systems (punched)
- Disposable Pin Carrier for PCB Interconnections
- Flexible Circuit for Dashboard
- Fuel Pulsation Dampener
- Fuse Plane
- Gasket (under the hood, punched)
- Miniature Pressure Transducer
- Radiator Plug
- Seals for Air Conditioning System

Sensors

accelerator pedal
air conditioning system (pressure)
automatic windshield wipers (membrane)
brake pedal
brake system (pressure)
clutch slave cylinder
door buzzer
EGR

memory seat shock height temperature throttle position transmission





Thermal Properties

Useful Temperature Range, °C (°F)

ULT-94 Rating

UL Thermal Index (100,000 hours)

Melting Point

-269 to 400 (-452 to 752)

V-0

240°C (464°F)

None

Physical Properties

Ultimate Tensile Strength at 23°C (73°F), MPa (psi)

Yield Point at 3% at 23°C (73°F), MPa (psi)

Stress to Produce 5% Elongation at 23°C (73°F), MPa (psi)

Ultimate Elongation at 23°C (73°F), %

Tensile Modulus at 23°C (73°F), GPa (psi)

Impact Strength at Z3°C (73°F), N°cm (ft*lb)

Polding Endurance at 23°C (73°F) (MIT), cycles

231 (33,500)

69 (10,000)

90 (13,000)

72

2.5 (370,000)

78 (0.58)

265,D00

Electrical Properties

Dielectric Strength, kV/mm (V/mil)

Dielectric Constant at 1 kHz

300 (7,700)

3.4

Chemical Resistance

Most organic chemicals, solvents, fuels, lubricants





KAPTON® is used in fuel pulsation dampeners, fuse planes, wiring harnes replacements, power steering switches, EGR sensors, ABS components and a host of other automotive applications. In addition to outstanding chemical resistance, KAPTON features a UL 9-94 V-O rating for flammabilit

It Provides Excellent Electrical Performance

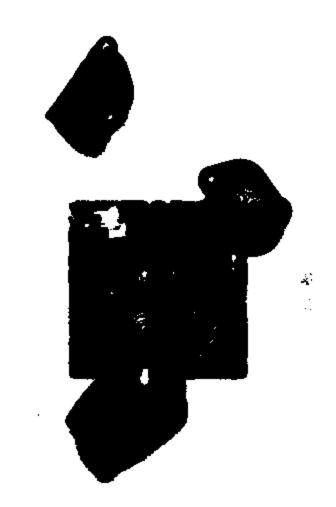
KAPTON plays

a key role in insulating and providing static drain of electromagnetic and radio frequency interference (EMI/RFI) due to its high dielectric strength (7,700 volts/mil) and high-temperature resistance. Certain KAPTON films have unique, combined properties, such as greatly enhanced thermal conductivity with heat resistance. These combinations can be critical in auto motive parts where both properties must play a role in performance, such as the characteristics needed in temperature sensors for instrumentation.

of 240°C (464°F) and can operate at temperatures ranging from -269°C to 400°C (-452°F to 752°F).

Even If It's Flexed a Million Times Although thin and light-weight, KAPTON is amazingly flexible and resilient. It can withstand flexing without developing cracks or tears, which are typical problems encountered with rubber and other common materials. KAPTON enables diaphragms and other parts that work "in movement" under high pressure to remain flexible and functional, while performing for millions of cycles.

And Exposed to Almost Any Solution KAPTON resists most organic chemicals, solvents, lubricants and fuels. In fact, its unmatched resistance to fuels, fluids and other harsh chemicals is the reason





Time and time again, KAPTON® stands up to the harshest conditions – temperature extremes, mechanical stress and contact with organic solvents, to name just a few – while performing better than ordinary materials. That's why more and more automotive engineers and parts designers are specifying KAPTON for diaphragms, insulators, gaskets and parts that must withstand harsh operating environments, such as those found under the hood.

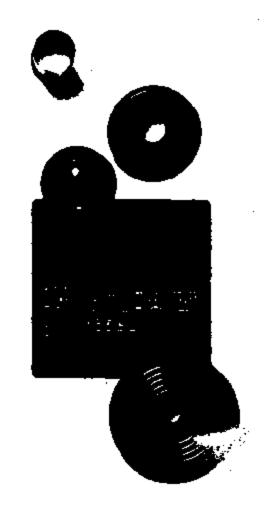
KAPTON Can Take the Heat Because today's and tomorrow's engines will run at increasingly elevated temperatures, high-temperature stability is a critical concern for any under-the-hood part. But temperature extremes are no problem for KAPTON, which carries a UL® Thermal Index

automotive, aerospace and electronics industries. These engineers have seen first-hand that KAPTON can take brutal punishment and keep on performing like few other materials.

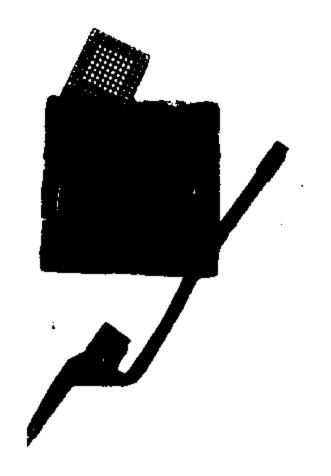
For example, automotive engineers have used KAPTON in a newly designed throttle position sensor that helps maximize fuel efficiency.

Aerospace engineers have sent KAPTON to the moon as a radiation shield on the Lunar Excursion Module and as the multilayer insulation blankets that protect cargo and crew from the intense heat of lift-off and reentry.

And, electrical engineers have come to rely on KAPTON as insulating and shielding material for a broad range of applications – from microwave and satellite communications systems to electronic medical diagnostic equipment and computer components.



TI-NHTSA 017657



When you take a look into the future of the automotive industry, what do you see? Engines that will run hotter than ever before? Extended factory warranties? Stricter safety and emissions requirements? More and more challenges?

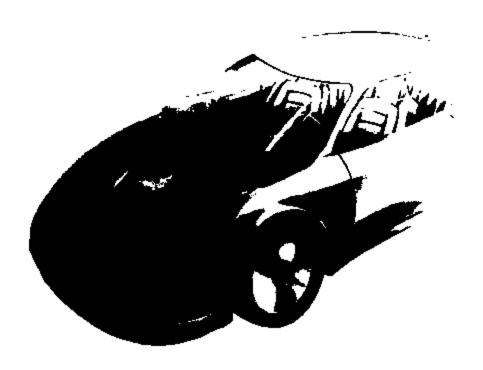
Meeting these challenges will be a tough bill to fill. Ordinary materials, such as silicone, metals, rubbers and plastics, may stall your innovative designs. They simply don't offer high-temperature stability, flexibility, durability, chemical resistance and space and weight savings.

KAPTON polyimide film can help you meet whatever challenges you're likely to face in the future by offering all these benefits and more.

Known for its outstanding thermal, mechanical and electrical properties, KAPTON is an advanced material used by engineers in the

How to

DuPont KAPTON°







DuPont Films

1989-1995



CUSTOMER

SATISFACTION

SURVEY



TLNUTSA 017850

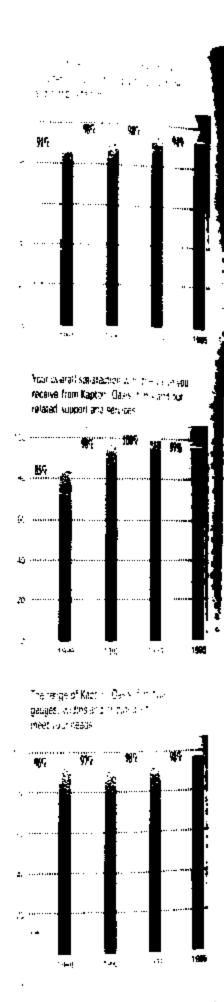
Dear Customer and Partner:

Thank you for your candid responses to the 1995 Customer

Satisfaction Survey for DuPont Kapton' polyimide and Oasis*

composite films. This year's survey — our fifth since 1989 — was mailed to 169 customers at 92 different companies in the United States and Canada. We heard back from 50% of those companies, and 94% provided us with additional comments. Your valuable feedback continues to be particularly important in guiding our ongoing efforts to better meet your needs and increase our value as your supplier of high-quality, high-performance film products.

This year marks the first time we have shared complete survey results with you. In the past, we reported summary responses in key business areas, such as quality, sales and marketing, technical support, business relationships and overall satisfaction. Now, with the results of five surveys in our database and a better indication of performance trends, we are pleased to be able to share a more detailed description of our findings with you. We will continue to share comprehensive results of our three most recent surveys with you on an annual basis, using 1989 as the baseline.



TI-NHTSA 017860

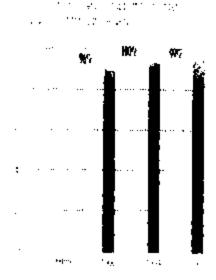
Overall, 97% of you reported being satisfied with the quality of your business relationships with DuPont. In fact, nearly 60% of you indicated that you are "very satisfied" or "delighted" with your business dealings with us, an assertion we find particularly gratifying. The quality of our business relationships has been—and continues to be—a top priority for our organization. Each member of our team understands the importance of meaningful, two-way communications. From sales and marketing to researchers, engineers, management and line workers, all of our people recognize the significance of having a customer-oriented focus.

In addition to the quality of our business relationships, this year's survey drew high marks in other areas. For example, satisfaction levels were at 95 percent or greater in 14 of the 24 survey areas, including technical service, customer service, overall quality, and sales and marketing support. At the same time, you commented on improvements in other aspects of our performance, including our help in developing new applications or business opportunities for you, as well as our leadership in new product development in support of your business.

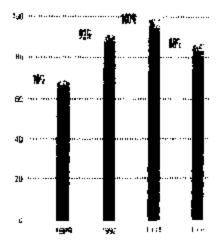
One area where we saw a drop in your level of satisfaction was in our ability to meet requested delivery dates — a decrease we can attribute to last year's high demand for DuPont polyimide film.

Traditional U.S. businesses were strong in 1994, and their global export economics were relatively healthy. As a result, the use of Kapton* increased in both the U.S. and European markets in applications tike audio speakers and flexible circuits. It also was a good year for locomotive manufacturing, an industry that tends to be cyclical. In addition, a number of development initiatives helped fuel an already vigorous demand for polyimide and composite films, including advancements in polyimide adhesive technology for adhesiveless circuits, higher modulus films for tape automated bonding, corona-resistant films for high-voltage electrical applications and specialty films for general conversion.

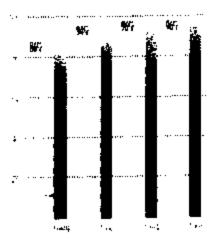
New opportunities helped open new markets. Unfortunately, the increased demand also stretched order lead times and sometimes hindered our ability to meet scheduled delivery dates. We have taken a number of steps to address these issues and maintain the traditional two-week timeframe for shipments. We have added a third shift to accommodate the increase in orders and streamlined



Our performance in meeting your requested delivery dates



Our speed and faimess in handlery perpression-related complaints



TI-NHTSA 017662

our finishing area, where film is coated, laminated, treated, slit and converted for use in specific industry applications. We guarantee that if a shipment date cannot be met, one of our customer service representatives will call you five days in advance. If you are not completely satisfied, we want to hear about it. Please call Leah Artedge, our Integrated Operations Superintendent, at (614) 474-0430.

While we are working hard to meet shipment dates and provide you with the highest quality film for your short-term needs, we also are committed to providing for long-term growth. To this end, we've invested more than \$35 million over the past three years to strengthen manufacturing flexibility and improve our product offering, including:

Leading the industry in new product development. In the last three years, we have introduced 32 new film products. New product development is critical to ensuring market growth, and we've shortened cycle times and improved our development process to help us meet your current and future needs.

Continuing our ongoing commitment to quality initiatives.

In addition to continuous improvement of product quality,
we've maintained the most rigorous quality and safety

standards for our manufacturing and service facilities.

Our global plant sites in Bayport (Texas). Circleville (Ohio), Luxembourg (Europe) and Tokai (Japan) all are ISO certified, which ensures you'll receive the highest quality film possible.

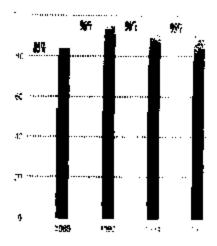
Expanding the breadth of our capabilities. We are continually adding to and improving upon our array of technology and process expertise. We've recently created an applied technology laboratory and a small-lots research manufacturing facility in Circleville to develop new products. Our Bayport site also has small-lots manufacturing capabilities.

Additionally, we have adopted an aggressive plan to double our worldwide polyimide business by the year 2000. Through a series of investments and industry partnerships, we will significantly expand our technological capabilities and develop new products. Together with our key customers, we will use these advances to create additional markets.

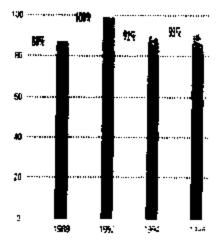
For example, we plan to invest an additional \$16 million to quadruple the capacity for base film production at our Bayport site by 1998.

During this same timeframe, we will be implementing productivity

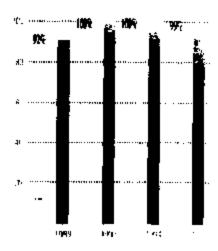
Contemporary and community and starting improvements and contemporary and



Our contribution to improving your operational efficiency



Your overall satisfaction with the technical support we provide



improvements to increase capacity at our Circleville plant, as well as at our Tokai facility, which we operate with our joint venture partner. Toray. These sites, combined with our Luxembourg plant, compose our global manufacturing network for worldwide growth.

DuPont remains committed to being the world leader in the manufacture and diversification of high-performance polyimide and composite films. We will continue to partner with you to improve our understanding of your market needs and develop superior products and services that best meet those needs.

Working with you, we look confidently ahead to continuing market growth, strengthening our global business and expanding your opportunities for innovative uses of Kapton* and Oasis* films into the twenty-first century. We greatly appreciate your business and your input to the survey. Thank you.

Sincerely,

Lynn K. Millikin

Worldwide Business Director

DuPont High Performance Films

Nissan Status

- · Early/mid 2995 decision point for myg7 switch of 300HN
- · NOW then april, TI will complete open test items, finishing TI/DuPont matil spec, etc.

DuPont - opent

During the 1418/94 vioit, Nissam was searching for existing data on that they could relate to Kapton's directly under cyclic stress particularly. The mir fly toot was discussed as one means to thow some directly data. While Nissam agreed to provide a specific toot procedure; so for this hamit happened. We should help move this class along by previding any results we can.

ACTION:

DuPont - Submit + MIT test data a similar

Wissen wanted to see results of strength felongeton with typical defects; is, scienteles, domes/creaters, and pinholes. Dothert.

Action:

DuPont - Generate data on above defects

2 pc Kapton Feeding - adherive

- 300 UN Sight PIN for - DIA" product = dragshias - of any hours detected; est 80.900 yield.

- lootupii improvement

Dwg change to SUTENISK = will designate Mis

- nearl to change way part is adual (som)

E Direct to part in writing what change is to 1316.

@ durant to provide match into motor

hydrolysis - or & tempo win industry publin@ bend.

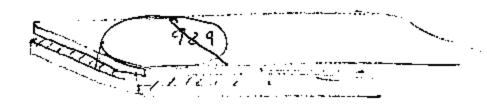
Deprom I f III add the composition

o JP film is more amorphous, gently more better them resist.

; easin forming; improved hydroly hi stability.

Plastiz Pin GIPS. Non-Kapton diaphragm body grandel & HPW - comp. mount. Data Argunition - , A/C system set-up Seef - cycle. Stamped hoscup. S.O. P.S - soumented. Test Speas on network non-leaded mall plan. PsvHch date that / date retruse / stry injurience ! System / Set up documentation of Rtm Lab analysis (failure analysis lab) 89Ps seal redsqu (non-kapton) Waterproof comp. mount switch.

TI-NHTSA 017669



- D. Ed to inv PSM analysis to see of Makin companison of 2 Kaptons on same PSM is valid check.
- T. provide DePart of Dex II/I addition with

D. A.C E. Coulson J. Forsyth (Wigner

Du Pont E. Hckonsie E. Hiller

Kupton Application

- speaker. - flx concerts - deaphragues.

Kapton Process

all natural for diaphagen subjected to hale optical energeter 500 FN DLL is disgration for laser inspection

print change: Fot 500 FN 131L (lacer inspected, to clarify point ordering "DIA" note to Octost internal trucking.

- exotopic film difficult und to wasen section inotify 80% slift in the fire criteria

TI-NHTSA 017672

Formability of Kapton

Can do difficult need high temp

- Hupton IP

more formability slight

high elregation

merene resistance to leychanicisi

name territe strayth (a bit lowe) -

Thrian - April decision for MY 97

2/15/95 500FN1S1 Production, 1992

Gage/Type	Mill Roll	Date	Thickness Min	Thickness Max	Thickness Avg
500FN181	4117641	01/07/92	4.95	5.14	5.04
500FN131	4117642	01/07/92	4.89	5.11	5,01
500FN151	4117643	01/07/92	4.94	6.12	5,03
500FN181	4117829	07/28/92	4.75	4.99	4.86
600FN131	4117830	07/23/92	4.75	4.900	4.83
600FN131	4117681	07/27/92	4.71	4.82	4.78
600FN181	4117632	07/28/92	4.73	4.84	4.79
500FN131	4117889	07/27/02	NA.	NA	NA
500FN181	4117940	11/05/92	4.74	4.96	4.56
500FN181	4117941	11/05/92	4.81	4.92	4.58
500FN181	4117942	11/05/92	4.84	4.98	4.900
500FN181	4117948	11/06/92	4.73	4.91	4,81
500FN131	4117970	12/09/92	4.81	4.95	4.87
600FN181	4117070	12/15/92	NA.	NA.	NA
600FN191	4117980	12/00/02	4.800	4,91	4.85
600FN121	4117981	12/09/92	4.80	4.97	4.900

Analysis

Property	Count	Average S	tenderd	Minimum 	Maximum	
Thickness	14	4.89	0.08	4.78	5.4	04
Upper apeol	fication limit: fication limit;	5.50 m 4.50 m				
CPK-1	J CPK-I	<u>.</u>				
2.45	1.5%	3				
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	4.09	4.93
500FN131	41 18041	02/23/93	4.77	4.98	4.87
500FN181	4118042	02/23/93	4.58	5.01	4.95
500FN181	4118049	02/23/93	4.72	4.91	4.81
600FN131	4118044	02/23/93	4.78	4.86	4.83
500FN181	4118104	05/23/93	4.91	5.06	4.90
500FN181	4116223	06/11/93	4.88	5.01	4.93
500FN131	4116224	06/17/93	4.95	5.09	5.02
500FN181	4115247	07/07/93	4.85	4.98	4.900
500FN181	4118248	07/08/93	4.900	5.08	4.98
600FN131	4118300	08/05/99	4.83	5.08	4.93
500FN131	4118301	08/05/93	4.800	5.13	4.93
500FN131	4118906	08/25/93	4.97	5.14	6.03
500FN181	4116321	09/21/99	4.84	4.96	4.88
500FN1\$1	4118322	09/22/93	4.900	5.06	5.00
500FN181	4118828	09/22/98	4.78	4.98	4.86
500FN131	4118345	10/21/93	4.66	5.05	4.95
500FN181	4118346	10/21/98	4.65	5.01	4.95
500FN181	4116347	10/21/93	4.900	5.01	4.95
600FN131	4118577	11/30/93	4.95	5.05	5.00

Analysis

Property	Count	Average St	enderd Mink	mum Maxi	mum
Thiokness	20	4.94	0.06	4.81	5.C3
	ification limit: Bioation limit:	5.50 m 4.50 m	•		
CPK-I	U CPK-				
3.00	3 2.54	.			

CPK = 2.34

93fn131a

2/15/96 --500FN131 Production, 1994

Gege/Type	MIII floil	Deta	Thickness Min	Thickness Max	Thickness Avg
600FN131	4116392	01/03/94	4.79	4.59	4.85
500FN131	4118309	01/04/94	4.81	5.00	4.95
500FN131	4118394	01/04/94	4.79	5,03	4,91
500FN131	4118415	01/91/94	4.88	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	4118458	03/03/94	4.50	5.09	4.89
500FN131	4118467	03/03/94	4.75	4.95	4.66
500FN131	4118480	03/03/94	4.05	5.08	5.00
500FN131	4118518	05/10/94	4.77	4.900	4,64
500FN131	4116519	05/10/94	4.67	5.13	5.00
500FN131	4118609	00/09/94	4,500	4.96	4.66
500FN131	4116610	08/09/94	4.91	5.04	4.97
600FN131	4116611	06/09/94	4.84	5.02	4.95
500FN131	4118612	06/09/94	4.96	5.03	4.93
500FN181	4116624	08/18/94	4.63	4.98	4.92
500FN181	4118625	06/18/94	4.91	5.04	5.00
500FN131	4118877	10/03/94	4.74	4,900	4.51
500FN131	4118678	10/03/94	4.75	4.91	4.84
500FN131	4116715	10/31/94	4.84	4.95	5.00
500FN181	4118718	10/31/94	4.82	4.99	4.93
500FN131	4116738	11/09/94	4.79	4.98	4,88
500FN181	4116737	11/09/94	4.40	4.95	4.78
600FN131	4116736	11/10/94	4.78	4.08	4.87
500FN1\$1	4116759	11/10/94	4.92	4.53	4.87

Analysis

	Average			
Thickness	4.91		4.78	5.08

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

CPK-U CPK-L

2.53 1.85

CPK = 1.86

94m131a

2/15/95 500FN131 Production, 1995 YTD

Gage/Type	Mill Holl	Date	Thickness Min	Thickness Max	Thickness Avg
500FN181	4118794	01/09/95	4.81	5.01	4.900
500FN191	4118795	01/09/96	4,87	5.00	4.94
500FN181	4118798	01/09/95	4.900	5.00	5.00
500FN131	4118797	01/10/95	4.83	5.05	4.94

95/n131a



DuPont High Performance Films

Kapton® Polylmide Film **General**

Kapton polyimide film is an exceptionally strong, best resistant film with an establish combination of motivated and electrical properties. Kepton has been used attenuabilly in various applications at temperatures from -269°C to 400°C. It is Game resistant, does not mail, racists affints of organic solvents and has a very high resistance to high-energy radiation.

Type HM: An all-purpose, uncosted film, with toughness and dielectric integrity at way high and way low temperatures.

Type HPP-ST: A special-purpose, successed film with all the properties of Type HN, surface treated for paperior educates.

Please direct all inquiries and orders for Curtomer Service 800-967-5607 or Product Information 800-237-4357

Type MT: A special-purpose uncosted film with thermal

properties of Type HN, plus superior disagnisms stability.

Type VIC As all-purpose, uncosted film with all the

readedivity 3X that of standard Kapton.

Type NN: A Type HN film costed on one or both sides with Teffen® FEP freezonation resin to impact host suitability. provide a maintern barrier, and enhance characted resistance.

Type XP: A Type EN film control on one or both sides with Tollon PPA fluorecurbon resis to impart hant englability. provide a maisture harrier, and subsect chemical statutures. The FFA costing is especially suited for applications requiring high bond strengths at elevated temperatures.

	Mangin I Tulakan		P	Prima		Standard Conglic	Approximate
Type	Gange & Type		(3/2)	(\$/\$)	(lenhar)	(Modif)	(6 ¹ /b)
MM	30 HW	4.1	fi 836'00	Î 1.8022	32	N/A	455
- 1	10 HBC	4.3	\$313.00	3 1.1501	\$2	N/A	272
- 1	100 304	1.6	2 71.50	2 0.5257	52	3000	136
- 1	200 (BY	24	\$ 71.50	\$ 1,45[3	23	2500	A
- 1	300 HB4	3.0	\$ 71.50	\$ 1.5800	52	L670	45
	500 HW	5.0	\$ 75.00	\$ 1777\$	52	1000	27
17-ST	100 HPP-ST	1.0	\$ 73.50	\$ 0.5404	52	3000	136
	100 HFP-ST	20	2 73.50 I	\$ 1,0000	纽	2300	61
- 1	200 HPP-6T	5.0	3 73.50	\$ 1.6313	50	1670	45
- 1	300 X33-81,	1.0	3 76.30	\$ 2.2313	30	1000	27
	800 HP7-ET	6.0	3 30.00	1 3.6522	JD	#25	23
- 1	700 HIP-III	7.0	\$ 130,00 (\$ 6,8421	30	720	<u></u>
72	(65 VN	LÓ	\$ 74.50	3 83625	32.	5000	136
	200 VN	20	1 76.50	3 L.1230	32	Z100	63
- 1	300 VN	10	\$ 76.50	\$ 1,7000	58	1670	1 43
- 1	500 VM	5.0	5 41.00	8 3-9600	56	1000	27
MT	LCO MT	1.0	2 LOEGO	3 L4000	4	N/A	101
	150 MT	LS	\$ \$45,50	\$ 1.2614	ä	AVA.	72
- 1	200 MT	10	3 41.00	å 1.1000	45	N/A	34
- 1	300 MT	10	2 21.00	\$ 1,2500	45	N/A	36
360	120 FM16	13	\$ \$6.50	3 4.8317	4	4320	104
· I	130 FN019	1.5	2 93.50	\$ L2143	44	3480	77
- 1	200 PN(1)	2.0	\$ 93.30	S L7315	44	2500	34
	200 774719	20	\$ 93.30	S 1.7313	44	2500	34
	250 FM029	2.5	\$ 93.50	\$ 1.9022	44	2100	49
	100 FNOZZ	3.0	\$ 93.50	3 23974	44	LETO	39
- 1	100 TN929	3.0	8 93.50	5 2,3974	44	1670	39
1	400 FN022	4.0	\$ 93.50	\$ 3,4630	44	[250	27
- 1	400 FN031	4.0	3 115.00	\$ 3.8333	44	1250	30
1	500 FN131	5.0	3 115,00	\$ 5,0000	44	1000	25
XP	130 XP019	<u>ت</u>	\$ 97,54	\$ 12597		3400	77
	200 X2919	20	\$ 97.54	\$ 1,7693	44	2500	54
- 1	230 X2028	2,5	\$ 97.56	2 1.9796	44	2100	49

TI-NHTSA 017678

P/N 27225-1

DuPont Films

OurPart Fine U.S. Route 23 & Buildent Road P. O. Sax III Circleville, QH 43112 Tal. (614) 474-4724

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 Plims' status versus these requirements follows:

I. Traceability

Repton® 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 new materials can also be provided. TI should track this number on route slips in order to assure this level of traceability.

2. <u>Inspection and Test Data</u>

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 Tellon® FEP film on each side. Kapton® and Tellon® 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 intrinated 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.

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

Sincerely,

Edward C. M. Kenzie Edward C. McKenzie

Sr. Technical Service Representative

cc: Jon Mayer, TI MS 12-01 B. Miller, DuPont CESTON THER.

FAIL NO. 508 698 3568

7. OI

May 34, 1996

DuPont Films

May 25, 1995

Maith Rosiallo Tauta Instrumenta, Inc. M 12-29 14 Porest St. Attleboro, EL 02703

Dear Keith,

Thank you for the opportunity to review the final druft of the specification for Emphasis film products. We can accept the specification as written, with no changes required. For our costoner films, could you arrange to have a copy of the drawings meet to my ettention? By address in:

MA McKangle Defeat Films
TO Box 65
Touts 23 South and Defeat Boad
Circleville, CE 43123

Floars lot us have if you have any additional questions regarding Dubout's Sarrame bile products.

Sincerely,

Morard C. McKansie Technical Specialist

FACSIMILE TRANSMITTAL

TD:

Di McKessle

Lecutions

Duffout High Performance Prime

Mail Backers

Phone Numbers

414-074-0726

FAX Numbers

G1-61488

FROAL

Kalab Banjadio

TEXAS BETTERMENTS ME 12-39

(300) 256-1264

JAX Number:

(500) 234-3353

Tend member of pages (including bander yegs): 8

COMMENTS

I am a design engineer in Dava's group. He has given my the exponeitable to firthe off the Kapton sport. Residenly I have put the agest, as discussed between yourself, and Dave, on a TI print. Could you give it a more over, militag has changed. I included a copy of the agence upon the comparison. Please let me know if I may clear this issue or if a __ -- w. Clacker any further changes.

Theoles. Knith

* DuPont Registered Trademark

TEXAS INSTRUMENTA DICORPORATED * PO BOX 2064 * IN POREST STREET * ATTLEBORG, MA 6076.

71-NHTSA 017881

Defendan US Remail & Defendant P & Bertin وروس باعضما le Builde



General Specifications

High Performance Files

Kapton[,]

General Specifications

Introduction

Dafford High Performance Films consultations and sells a variety of high-quality physic film products to conformance with 180 0002 confirmation.

These specifications describe the values and aslessaces for Kapson* filtry properties. Where necessary for thomogh understanding, cost stellards and procedures have been included.

Any aspects of the specifications that maple flasher integrantion or christonion should be discussed with appreciations of DoPous High Performance Films.

Types of Kapton' Polylanide Film

DePost makes several types of Kapton* film.
Types RN, FN, and VN are used most community.

Types H. F. and V are alternative, special versions of these sundered types. The specifications in this bulletin apply to there as well. In addition to these three types of Kupton⁵. Element wellable with the following attributes:

- 4 Andrew
- ibernally conductive
- polyimides for fine line chooling
- cryopersic insulation
- соны пейдалі
- niemental for color
- conformable
- other films tuilened to meet customers' needs

Date for these films are covered in separate product bulleties, which can be obtained from your Duffers. High Performance Films representative.

Type HH Plica

Kapant* Type HN is a taugh, accounte polytanide film, exhibiting an excellent haloner of physical, chemical, and alacarical properties over a wide taugustature range, particularly at measurely high temperatures. Chemically, its polytonidu polyton meksan is the most of a polytonidus polyton meksan protectific dismby chiefe and A-d'dismbodiphenyl other. Kapant* FN is a unitable in the following gaugus: 30 (7.5 μm.), 50 (12.7 μm.), 160 (25.4 μm.), 200 (50.8 μm.), 300 (76.2 μm.), and 500 (107 μm.). Other gauges, such as 75 (19.1 μm.) and 400 (102 μm.), are available by spacial veducits.

Type AN Fibe

Rapton^a Type PN film is a heat statable grade that retains the unique balance of properties of Kapton^a Type HN own a wide numperature range. This is achieved by combining Type HN with DuPour Teffon^a FEP fluorecarbon resin its a composite structure. Table 1 lists the common types of FN film available. Other combinations are available. Consult your DuPout High Preferenance Films marketing representative for further information.

Table 1 Espton* 20 Polyinide Film Types

	Case	Commettee, will (urs)					
والإجبال والم	TEP .	H	钳				
12E-MAP	A10 (2.5)	1.00 (26.4)	0.10 (2.6)				
120FN6168	E15 (Z.E)	加坡森	D.16 (0.2)				
16074019		1.08 (25.4)	0.50 (13.7)				
200FH@10	0.50 (12.7)	100 (25.4)	0.50 (12.7)				
200F4611		140 (25.4)	1.86 (28.4)				
250Féanni		280 (602)	0.50 (12.7)				
304FN421		240 508	1.00 (25.4)				
308-NE26	0.80 (12.7)	2.00 PSO.M	E50 (127)				
40071072		2.00 (50.E)	2.08 (SLB)				
560FN 131	1.80 (26.4)	100 (TLZ)	109 254				

Type VN Film

Kapton[®] Type VN is the same rough polyimide film or Type HN Film, exhibiting on excellent balance of physical, chemical, and electrical proporties over a wide temperature range, with superior dimensional stability at elevated temperatures. This product is available in 50 (12.7 µm), 75 (19.1 µm), 100 (25.4 µm), 200 (50.8 µm), 300 (76.2 µm), and 500 (127 µm) gauges.

Cortification

Kapaco^a is certified to meet the requirements of the military specification MIL-P-46112 B and ASTM D-5113-99 is addition to the items covered by this specifications bulletle. Written confirmation is available with cach delivery upon request.

Thornal Durability

The thermal duzability of Kapton* film depends on the environmental conditions under which it is need and textual his fifetime depends on the criterion of finiture. Kapton* is reasinely tested at the manufacturing size in the following manner:

Sheets of film 8.5" × 11" (216 opt × 279 mm) are freely suspended in an over at a temperature of 400°C ±2°C (752°F ±3.6°F), monitored with a thermocouple to ensure accuracy. Sheets are removed after 2 in (1 lin for 30 (7.6 µm)) and 50 (12.7 µm) gauge film) and tested on an Instron Tensile Tester as described in Table 2. The cloogation of the film at 23.5°C (74.3°F) should not be less than 30°C after this uping at 400°C (753°F). This conforms to MIL-P-46112B "Elongation After Aging at 400°C" requirement (Table 2).

In addition, Kapton* conforms to ASTM D-5213-95, Standard Specification for Polymeric Resin Film for Electrical Insulation and Dielectric Applications.

Underwriters Laboratories, Inc. lists a thermal index of 200 to TEPC (392 to 428°F) (depending to pange and type) for mechanical properties and 200 to 240°C (428 to 464°F) (depending on gauge and type) for electrical properties, under their file number E39505 for Kapton* polyivaide film.

Properties of Type FN Film Heat Seel Strength

Piles to Plan Seels

The pect strength of hear seals between the descend and uncessed sides of one-side conted Kapton® or banvara the coased sides of both one- and two-side coated Kapton® is descripted as follows.

Scals are made in a jow sealer at 350°C (662°F), 20 pti (1.4 bar), with a 20-sec dwell time. After cooling, the seals are cut into 1° (25.4-cars) wide strips using a Thwing-Aftert JDC sample cutler or its equivalent. The seal strength is measured with an instructorype testile tester. Seal strength is defined at the peak instruments strength occurring in each seal. Five specimen values are averaged.

The minimum pool strength between the context sides of one- or two-side context Kapton* Sim will be 700 gfm (2.7 N/cm), except for 120FNb16 and 120FNb168, which will be 450 gfm (1.7 N/cm). The minimum peel strength between the context and notated side of one-side context Expton* will be 450 gfm (1.7 N/cm).

Film-to-Copper Seals

The ability of FEP film to achieve to copper is measured using the same heat seal peel strength technique as described in "Film-to-Film Seals."

The peal strength is recovered with the FEP side scaled to the untramed side of 1 mil (25.4 µm), 8 nz GT copper foil: it will be a minimum of 300 p/m (1.2 N/em).

As Received Scoroptic (Cold Proc) of Borrds Batterian Expirer Type HN and Teffort Layers The bond between the Kapters' Type HN and Teffort Roomearbon resis layers on all Type FN products except 120FN6 to and 120FN6 168 will have a minimum peel strength of 225 p/in (0.87 NATE), measured using an Instrum-type tensile tester and a 180° peel.

Whith Tolerance

The experiment varieties in film width from the specified on the order shall be as follows:

| Sh Whith Rough | Televante | 1%" (35 mm) orders | ±0.605" (0.76 mm) | 1%" to 4" (35 mm to 100 mm) | ±0.660" (0.76 mm) | >3" (>100 mm) | ±0.660" (0.76 mm) |

Lapaneshaury Supply

Cores shall be of millioner strongth to proven calligning from handling. Lastenthourg supplies and rolls in widths below 997 (240 year) and automatic wound polls.

Standard core internal distances for Laurenbourg is 3" (76 mm) (nominal 3" ±0.005" (76 mm. ±0.2 mm)).

Standard cores for pad rolls are paper cores, except for widths below 15" (13 mms), where it will be obserte.

Standard universal: core lesson

2.8"±0.05" (76 mm ±2 mm) (split core)

Wide universal; core length

4.3° ±0.06" (1:10 mm ±2 mm) (non-splis core)

A different pre-up called Step-Pur²⁶ is smalleble from the U.S. Commer your DePour High Purificaswance Plans representation for range information.

White Television

The matches in writing in film width from first appointed on the order shall be as follows:

Sik White Fange 0.9" (22 mm) or less Universal	Tellerance 0.008" (0.36 max)
6" (152 mm) er han Pari spile	0.026" (0.40 mm)
6" to 915" /353 charto 240 chart	0.04" (1.40 ****)

Paints

Outside dismoser tolerance: ±0.4" (10 mm)

Table 4 Kaptes' Polyheida Film Spacifications and Telepasses.

	Timber.	Thirdenn Talencya		With June		Heir Weight			
		-	iie.				- Charge		Faprice
	<u> </u>	المرا البه		أجمار دا			تعو		
	(3073)	634 M D	410 (2.1)	XILE	31 (1994)	7.0	K		924
	(تحرر فقد	化二甲基		W- HUR	200	148	*	772	9.7
H	10年656年	LEGA	1.662	74 H.M	12 (D21)	327	39.3	1	21
200000	7.00 (CCT)	はみ付き	225(62.3)	W. K.	200		17.6	_	4.5
3000	3.00 (PA.2)	172 (m. 17	1362	*= (C.D)	R CORP	1844	1134	-	21
	E-40 (1727)	4.65 MHz	5.36 (Chi)	144.0	52 (1996)	10.5	114	ž	15
	الحراقه	i Se pe sp	0 HI CO.44	**	Reserve	ж	24	272	1
	18054	4404	1.002	****	1428	227	202	199	27.0
200	والشعر فنية	LAMES	225673	% (A.B)	2105		77.1	.	24
	38062	271 (ML)	1361	N-KE	M (1279)	(24.9	TI5.4	#	42
500770	9.60 (127)	4条6件	325(00)	1414	3 (374)	446	W24	2)	ű
	1.30 (19.5)	1.70 (27.0)	1.00	₩ (LB)	4014	(14	44.	194	313
1201	1.20 (254)	120 (10.3)	1,5100.4	7×14.00	e (HE	674	41		*1
19774819	1.50 (58.1)	LEDIS	17/43	14 M.B	W. (TITLE	13.0	7Ú	77	15.4
	2866	1,7610.2	230 (4.4)	+ 1.0	46[E118]	77.	704	34	ZLI
MF1dto	250604	1.70 (43.8)	230 (20.4)	H- H-D	41716	778	34	×)I.I
	2.99 (43.5)	2267	27409	Ta M.Si	M(I)II	P4	TOU	4	
	38052	2000	1004	- N.M.	#Ind	1113	104	~	18.0 6.0
307420	10(62)	2 0 6	34000	Tall B	# Jung	1113	VCIA	ā	ü
4074002	4 (0)(0)	3.96 GEL 51	45 maj	14 (4.8)	44 fitte	MEED	***	77	
500F9131	5 10 (10)	4.0014	4.9 (146)	相相	# 117 U	45,0	200	7	6.5 6.7
		11114				_ ===		-	-1

[&]quot;Approved ASTA B-374-15, Madeal A.C. or D.

The spinal districtions of part 19th are 31 (FE made) i.D. • B" (ES made) or \$" (250 mad) extrinin depicture (0.0) for weights up to 4" (ES made) in Luminocy or 155 made). 150 made (0.0) for weight or 150 made) in Luminocy or 150 made) in Luminoc

Roll Types

Kapuse* polytoide film is supplied in time types of ralk: pad, universal, and Sup-Pac*** wind.

Pad Ball Specifications

- Core width will be the filts width +½" (+3.2 mm), -0.
- Cross adjust shall not project most than %."
 (1.6 mm) beyond the roll face on either side.
- Core shall one be uncessed on either side.
- The purish and starting each of the film shall be fairned in a resource to proven agreementing.
- "Dishing" or "capping" stay not named %"
 (1.6 mm), measured with a straightedge account for Associated and the roll.

Universit and Step Pas ** Roll Specifications

- The difference harvoon the language of the projecting core on each side shall not exceed Vs." (4.8 mm).
- Film shall our project from the unit budy of the roll must than M* (3.2 proj).
- The matride and starting code of the film shall be fastened in a matrim to prevent upwinding.
- Roll face depression, the difference between the highest and invest points of the toll, naturated, shall not exceed %6" (4.8 mm).

Table 7 Reference Guide: Standard Laugth verses. Red G.D. (ILS. Supply)

	-	1 00			
Type	Lingth Reill	2" Core Lib.	C Corpt D.		
MAN	5,000 R	l'se"	117		
	(1,625.44)	241 mmi	1278 many		
	10,000 R	147	14"		
	(3, 85 0 m)	(27 9 mm)	COSE comp		
200NN	2.500 tc	tra*	11"		
	(763 m)	(241 rom)	(278 Mon)		
3000466	1,670 8	3%*	117		
	(595 m)	(241 mm)	(275 mm)		
E00H44	1.000 ft	BW*	117		
	(3 95 m)	4241 rame)	(275 ear)		

ججنتام

وويزاع عدور

Three types of splice are available.

- Myler* polyester film-based yellow tape (manifed).
- Expected polytraide files-based cape (special protections cells).
- Heat seal spline, 12" (305 year) or less in width. (Type FN).

Splices will be extracted on the joint to ±14" (thi mm). They will be spaced) and available-face to evoid distortion of the adjacess files layers in the roll.

Tape Spilons

Tape splices are numbered on all gauges, of FIN and VIII film more than 12" (305 was) wide.

Tage splices are made with the bow edges of the film covered on both sides with pressure-sensitive administrators. Two-lack (50 mm) wide splining tage is used.

Heat Seet Splines

Overhip hear seal splices are made on all FN films, moust 200FN(PS), with an overlap that is a minimum of N° (9.5 mm) wide.

On 1989-2029, a bast splice is made using 1209-2016 as the joining cape applied on the FEP sadace. The bast splice is oriented with the 1209-2016 cape on the top of the filter as it unwinds from a waterstall portup and on the bostom as it unwinds from a pad.

Overlap hant sent splices for one-side and two-side PEP composites are drimmed with the leading edge of the new film on the bottom for universal and Step-Pac" put-ups. Pad put-ups of one- or two-side FEP composites have the leading edge of the new film on the top.