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Main project #: PE #:

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Project director(s):
RIX G J CIVIL ENGR (404)894-2292

Sponsor/division names: AMOCO FABRICS COMPANY /
Sponsor/division codes: 250 / 005

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Sponsor amount	New this change	Total to date
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Title: LABORATORY INSTALLATION DAMAGE TESTS

PROJECT ADMINISTRATION DATA

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Security class (U,C,S,TS) : U ONR resident rep. is ACO (Y/N): N
Defense priority rating : supplemental sheet
Equipment title vests with: Sponsor GIT
NOT ADDRESSED.
Administrative comments -
INITIATION.

GEORGIA INSTITUTE OF TECHNOLOGY
OFFICE OF CONTRACT ADMINISTRATION

NOTICE OF PROJECT CLOSEOUT

Closeout Notice Date 09/27/95

Project No. E-20-W67 Center No. 10/24-6-R8552-0A0

Project Director RIX G J School/Lab CIVIL ENGR

Sponsor AMOCO FABRICS COMPANY/

Contract/Grant No. AGREEMENT DTD 950530 Contract Entity GTRC

Prime Contract No.

Title LABORATORY INSTALLATION DAMAGE TESTS

Effective Completion Date 950815 (Performance) 950815 (Reports)

Closeout Actions Required:	Y/N	Date Submitted
Final Invoice or Copy of Final Invoice	Y	
Final Report of Inventions and/or Subcontracts	Y	
Government Property Inventory & Related Certificate	N	
Classified Material Certificate	N	
Release and Assignment	N	
Other	N	

Comments

Subproject Under Main Project No.

Continues Project No.

Distribution Required:

Project Director	Y
Administrative Network Representative	Y
GTRI Accounting/Grants and Contracts	Y
Procurement/Supply Services	Y
Research Property Managment	Y
Research Security Services	N
Reports Coordinator (OCA)	Y
GTRC	Y
Project File	Y
Other	N
	N

NOTE: Final Patent Questionnaire sent to PDPI.

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September 17, 1995

Mr. Luke van't Hoog, P.E.
Amoco Fabrics and Fibers Company
900 Circle 75 Parkway, Suite 300
Atlanta, GA 30339

Dear Luke,

Enclosed is a draft copy of our report describing the supplemental series of laboratory installation damage tests on Amoco's woven, slit-film geotextiles. Please review the draft report at your convenience and contact me regarding any corrections, changes, etc. you would like me to make. I have also sent a draft of the report to Tom Baker for his review and comment.

I still remain interested in preparing a technical paper describing the results of this study. Please let me know how you would like to proceed towards that goal.

Very truly yours,

Glenn J. Rix
Associate Professor of Civil and
Environmental Engineering

School of Civil and Environmental Engineering

Installation Damage to Woven Polypropylene Geotextiles

Supplemental Report

Glenn J. Rix, Ph.D.

Kevin W. Cargill

Amoco Fabrics and Fibers Company

September 1995

Report No. GIT-CEE/GEO-95-4

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INTRODUCTION

Geotextiles have found widespread use in many civil engineering applications. As a result of damage to the geotextile during installation, creep-related phenomena, and chemical or biological degradation, the mechanical properties of the material (e.g., wide-width tensile strength, fatigue strength, burst strength, etc.) may be significantly different after placement than before construction. To calculate an allowable strength for use in design, engineers typically use partial factors of account for the uncertainty in the strength of the geotextile during the life of the structure:

$$T_{allowable} = T_{ultimate} \bullet \frac{1}{F_{installation} \bullet F_{creep} \bullet F_{degradation}} \tag{1}$$

where $T_{allowable}$ is the design strength, $T_{ultimate}$ is the ultimate strength of the undamaged geotextile, $F_{installation}$ is the partial factor of safety to account for installation damage, F_{creep} is the partial factor of safety to account for creep potential, and $F_{degradation}$ is the partial factor of safety to account for chemical and biological degradation. Because of the harsh construction environment, significant damage and strength loss may occur during installation. In the absence of information for a particular fabric, default factors of safety are used to determine the design strength. Significant savings are often possible if the default value can be reduced by using the results of tests on specific fabrics to establish actual factors of safety.

This report presents the results of laboratory installation damage tests on woven polypropylene geotextiles (2044, 2006, and 2002) manufactured by Amoco Fabrics and Fibers Company. The three fabrics are all woven, fibrilated tape yarn (slit film) geotextiles (Baker, 1994). The nine laboratory installation damage tests performed as part of this study supplement an earlier series of field and laboratory installation damage tests performed by Rix et al. (1995). The two series of tests are intended to (a) compare strength loss observed in laboratory installation damage tests to that observed in field tests, (b) evaluate the relative severity of different backfill/subgrade conditions, and (c) compare the amount of installation damage measured under test conditions that simulate different end uses. The present test series adds to the variety of subgrade and backfill conditions used in the earlier tests.

PRIOR INSTALLATION DAMAGE STUDIES

A complete review of prior installation damage studies is presented in Rix et al. (1995). Of particular relevance to this supplemental study is a series of tests performed by Koerner et al. (1993). Koerner et al. (1993) assessed field installation damage to several polyester and polypropylene geotextiles for two different subgrade and backfill conditions. The results of tests performed on a woven slit film geotextile are summarized in Table 1 and indicate the percent strength retained ranged from 20 to 100 percent with distinct differences between the stone/stone and sand/sand subgrade and backfill conditions. Two of the tests performed in this study are intended to reproduce to the stone/stone subgrade and backfill conditions used by Koerner et al. that resulted in the low percentage of strength retained by the geotextile.

Table 1 Installation Damage Results from Koerner et al. (1993)

Geotextile Type	*Weight (oz./yd²)*	*Direction*	*Percentage of Strength Retained*	
			Stone/Stone	*Sand/Sand*
Woven Slit Film (PP)	6.0-7.0	Warp	20	84
		Fill	26	100

PET - Polyester
PP - Polypropylene

LABORATORY INSTALLATION DAMAGE TESTS

In the two series of tests, laboratory installation damage tests were performed on 29 different combinations of geotextile, subgrade, and backfill as shown in Table 2. Nine of the 29 tests noted in Table 2 were performed in the supplemental series of tests. Sections W1 through W6 were intended to model wall-reinforcement applications; sections R1 through R17 were chosen to model roadway separation applications; sections E/S1 and E/S2 were selected to model embankment and slope reinforcement applications; and sections K1 and K2 were chosen to reproduce the tests performed by Koerner et al. (1993). The six sections shaded in gray in Table 2 had identical geotextile/subgrade/backfill conditions as six sections constructed in the field. This allowed the validity of the laboratory testing procedure to the assessed. The comparison between laboratory and field tests is discussed by Rix et al. (1995).

Soil Properties

Several different soils have been used in the laboratory installation damage tests. A reddish-brown, silty sand (SM) with 5 percent fine gravel, 65 percent coarse to fine sand, and 30 percent fines was used as both the subgrade and backfill in many of the tests. The clay and mica contents in this residual soil vary depending on the degree of weathering and location. One of the other soils was a State of Georgia-approved Graded Aggregate Base (GAB). This soil is a gray, well graded gravel (GW) with 55 percent subrounded to subangular fine gravel, 40 percent coarse to fine sand and 5 percent fines. Two of the tests involved another well graded gravel (GW) with 65 percent angular fine gravel and 35 percent coarse to medium sand known as "Washed 89." A blended, poorly graded gravel (GP) was used as both the subgrade and backfill in sections K1 and K2. The grain size distribution of the gravel was selected to match the soil used by Koerner et al. (1993). Koerner et al. describe this material as a crushed stone; as such, it is presumed that the material is angular or subangular.

Table 2 Summary of Laboratory Test Sections

Section	*Geotextile*	*Subgrade*	*Specified Subgrade Density*	*Backfill*	*Specified Backfill Density*	*Specified Backfill Thickness (in.)*
W1	2044	GAB	95% std	GAB	95% std	6
W2	2044	GAB	95% std	GAB	95% std	12
W2A*	2044	GAB	95% std	GAB	95% std	12
W3	2044	Washed 89	95% std	Washed 89	95% std	6
W4	2044	Washed 89	95% std	Washed 89	95% std	12
W5	2044	Silty Sand	95% std	Silty Sand	95% std	6
W6	2044	Silty Sand	95% std	Silty Sand	95% std	12
R1	2016	Silty Sand	CBR = 5	GAB	95% mod	6
R2	2016	Silty Sand	CBR = 5	GAB	95% mod	12
R3	2006	Silty Sand	CBR = 5	GAB	95% mod	6
R4	2006	Silty Sand	CBR = 5	GAB	95% mod	12
R5	2002	Silty Sand	CBR = 5	GAB	95% mod	6
R6	2002	Silty Sand	CBR = 5	GAB	95% mod	12
R7	2044	Silty Sand	CBR = 2	GAB	95% std	6
R8	2044	Silty Sand	CBR = 2	GAB	95% std	12
R9	2016	Silty Sand	CBR = 2	GAB	95% std	6
R10	2016	Silty Sand	CBR = 2	GAB	95% std	12
R11	2006	Silty Sand	CBR = 2	GAB	95% std	6
R12	2006	Silty Sand	CBR = 2	GAB	95% std	12
R13*	2002	Silty Sand	CBR = 2	GAB	95% std	6
R14*	2002	Silty Sand	CBR = 2	GAB	95% mod	6
R15*	2002	Silty Sand	CBR = 5	GAB	95% std	6
R15A*	2002	Silty Sand	CBR = 5	GAB	95% std	12
R16*	2006	Silty Sand	CBR = 2	GAB	95% mod	6
R17*	2006	Silty Sand	CBR = 5	GAB	95% std	6
E/S1	2006	Silty Sand	95% std	Silty Sand	95% std	6
E/S2	2006	Silty Sand	95% std	Silty Sand	95% std	12
K1*	2006	GP	95-100% mod	GP	95-100% mod	10
K2*	2044	GP	95-100% mod	GP	95-100% mod	10

* denotes a test performed as part of the supplemental series

A summary of the laboratory index tests performed on these materials is shown in Table 3. The grain size distribution curve for the poorly graded gravel is shown along with the grain size distribution of the gravel used by Koerner et al. (1993) in Figure 1. Because of the percentage of large particle sizes contained in the GP soil, it was not possible to perform a modified Proctor density test using 4-in. or 6-in. diameter molds. ASTM D1557-91 stipulates that the method applies only to soils with 70 percent or more passing the 3/4-in. (19.0-mm) sieve. The GP soil has only about 35 percent passing this sieve. Furthermore, although ASTM D4718-87 describes corrections to be used for soils containing oversize particles, the GP does not meet the requirements of that standard (Section 1.3). Vulcan Materials Company

uses large-diameter compaction molds to accommodate larger particle sizes. They reported (Brown, personal communication) that the maximum dry density of the GP soil from a modified Proctor test is approximately 102 pcf. Grain size distributions, standard and modified Proctor data, and CBR data for the other soils used in the original series of tests are presented in Rix et al. (1995).

Table 3 Summary of Index Tests on Soils Used in Laboratory Installation Damage Tests

Test	*Silty Sand*	*GAB*	*Washed 89*	*GP*
Standard Proctor (ASTM D698-91)	X	X	X	
Modified Proctor (ASTM D1557-91)		X		X*
CBR (ASTM D1883-87)	X			
Grain Size (ASTM D422)	X	X	X	X

* test performed by Vulcan Materials Company

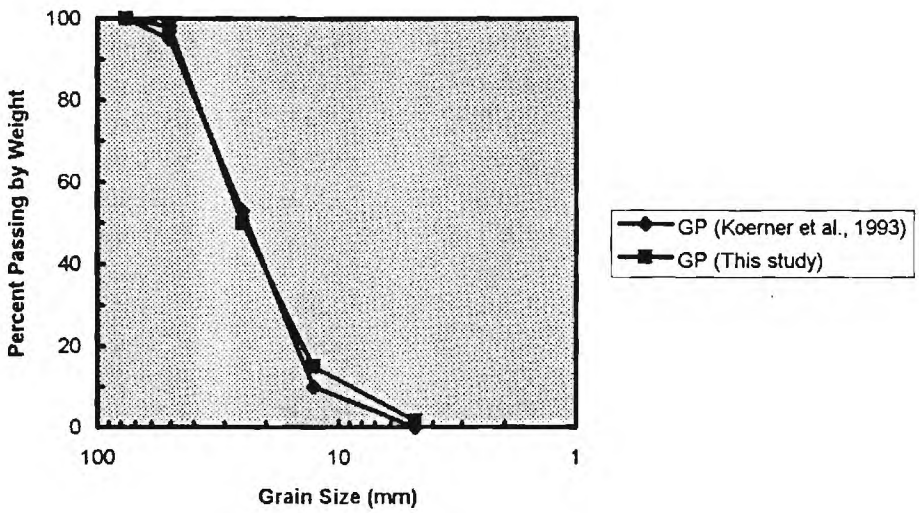

Figure 1 Grain Size Distributions of GP Soils Used by Koerner et al. (1993) and in This Study

Test Procedures

Laboratory installation damage tests were performed in a 4 ft by 4 ft square box approximately 7 ft deep. The same box was employed for the original series of tests. Rix et al. (1995) describe the test box and procedures used to perform the laboratory installation damage tests.

A summary of the percent compaction achieved in the supplemental laboratory installation damage tests is shown in Table 4. With the exception of the subgrade backfill in Sections K1 and K2, the desired compaction was obtained. The lower subgrade densities in Sections R13 through R17 correspond to the

		Subgrade				Backfill			
Section	*Geotextile*	*Soil*	*Maximum Density (pcf)*	*Actual Density (pcf)*	*Percent Compaction*	*Soil*	*Maximum Density (pcf)*	*Actual Density (pcf)*	*Percent Compaction*
W2A	2044	GAB	133.5	131.2	98.3%	GAB	133.5	127.8	95.7%
R13	2002	Silty Sand	108.0	89.3	82.7%	GAB	133.5	130.9	98.1%
R14	2002	Silty Sand	108.0	88.8	82.2%	GAB	136.5	133.1	97.5%
R15	2002	Silty Sand	108.0	94.5	87.5%	GAB	133.5	130.1	97.5%
R15A	2002	Silty Sand	108.0	98.3	91.0%	GAB	133.5	130.1	97.5%
R16	2006	Silty Sand	108.0	88.3	81.8%	GAB	136.5	132.4	97.0%
R17	2006	Silty Sand	108.0	99.1	91.8%	GAB	133.5	129.4	96.9%
K1	2006	GP	102.0	82.6	81.0%	GP	102.0	85.8	84.1%
K2	2044	GP	102.0	78.6	77.1%	GP	102.0	88.6	86.9%

* Shaded areas denote sections that did not meet design specifications

Table 4 Summary of Percent Compaction Achieved in Supplemental Installation Damage Tests

desired CBR values of 2 and 5. Appendix A contains the test summary sheets for the laboratory moisture-density tests. We believe that the low percent compactions obtained in Sections K1 and K2 are attributable to two factors:

- the inability of the nuclear moisture-density gauge to accurately measure the density of a soil composed of larger particles with very few fines and
- the inability to compact a coarse, angular, poorly graded gravel using a relatively small pneumatic compactor such as the one used in this study.

Since we were unable to achieve the desired compaction, we alternately compacted and tested the density of the subgrade and backfill in Sections K1 and K2 until no additional increase in the measured density was observed.

STRENGTH TESTING OF GEOTEXTILES

Test Procedures

Wide width tensile tests (ASTM D 4595) and grab tensile tests (ASTM D 4632) were used to assess the damage incurred by the geotextile during installation. All strength testing was performed at the Amoco Fabrics and Fibers Company Research and Development Center. Rix et al. (1995) describe the strength testing program in more detail.

Test Results

A series of baseline tests were performed on control specimens from the same rolls used in the laboratory and the field testing. Specimens for lab and baseline tests were cut from the same sample roll. Either 10 (2002 and 2006) or 20 (2044) control specimens were tested to determine the baseline strengths. The baseline strength was defined as the mean peak load of the baseline specimens. Table 5 shows the baseline strengths and associated standard deviations for the materials tested in both the warp and the fill directions.

Table 5 Summary of Average Baseline Ultimate Strengths for the Test Geotextiles

	Wide Width Tensile		*Grab Tensile*	
Geotextile	*Warp (lbs/in.)*	*Fill (lbs/in.)*	*Warp (lbs)*	*Fill (lbs)*
2002	154.8 (3.6)	171.9 (5.7)	261.0 (16.0)	225.0 (10.0)
2006	242.5 (4.4)	250.8 (7.1)	376.0 (17.0)	335.0 (10.0)
2044	465.5 (15.3)	438.0 (7.5)	N/A	N/A

Standard deviations are given in parentheses

Installation damage was assessed by a percent strength retained parameter, which is the ratio of the average peak strength of the exhumed specimens to the average baseline strength multiplied by 100 percent. Table 6 summarizes the percent strength retained for all wide width tensile and grab tensile testing on the 2002, 2006, 2016 and 2044 geotextiles for both the original and supplemental test series. Note that in some tests the strength measured for the installation damage specimens *exceeded* the baseline strength. The occurrence is attributed to normal variability in the strength of the geotextile and in the strength testing procedures. These tests are shown in Table 6 as having 100 percent retained strength.

Tables 7 and 8 summarize the variability in the strength test results and in the percent strength retained for both wide-width (Table 7) and grab tensile (Table 8) tests. In most cases, the standard deviation of the percent strength retained is on the order of three to seven percent. The largest standard deviation is 11 percent.

Table 6 Installation Damage Test Results

						Percentage of Strength Retained			
						Laboratory		*Field*	
Section	*Geotextile*	*Subgrade*	*Backfill*	*Backfill Thickness*	*Direction*	*Wide Width*	*Grab*	*Wide Width*	*Grab*
W1	2044	GAB	GAB	6 in.	Warp	87		86	
					Fill	100		100	
W2	2044	GAB	GAB	12 in.	Warp	98		86(91)*	
					Fill	100		100(100)*	
W2A	2044	GAB	GAB	12 in.	Warp	94			
					Fill	100.0			
W3	2044	Washed 89	Washed 89	6 in.	Warp	95			
					Fill	100			
W4	2044	Washed 89	Washed 89	12 in.	Warp	98			
					Fill	100			
W5	2044	Silty Sand	Silty Sand	6 in.	Warp	98		100	
					Fill	100		100	
W6	2044	Silty Sand	Silty Sand	12 in.	Warp	99		94	
					Fill	100		100	
E/S1	2006	Silty Sand	Silty Sand	6 in.	Warp	84	83	87	89
					Fill	94	99	99	100
E/S2	2006	Silty Sand	Silty Sand	12 in.	Warp	87	87	83	83
					Fill	97	97	100	100
K1	2006	GP	GP	10 in.	Warp	63	66		
					Fill	70	76		
K2	2044	GP	GP	10 in.	Warp	84			
					Fill	93			

Table 6 Installation Damage Test Results (continued)

						Percentage of Strength Retained			
						Laboratory		*Field*	
Section	*Geotextile*	*Subgrade*	*Backfill*	*Backfill Thickness*	*Direction*	*Wide Width*	*Grab*	*Wide Width*	*Grab*
R1	2016	Silty Sand	GAB	6 in.	Warp	93	91		
					Fill	85	87		
R2	2016	Silty Sand	GAB	12 in.	Warp	96	91		
					Fill	93	97		
R3	2006	Silty Sand	GAB	6 in.	Warp	75	82		
					Fill	86	96		
R4	2006	Silty Sand	GAB	12 in.	Warp	86	88		
					Fill	94	94		
R5	2002	Silty Sand	GAB	6 in.	Warp	62	63		
					Fill	75	86		
R6	2002	Silty Sand	GAB	12 in.	Warp	78	78		
					Fill	92	100		
R7	2044	Silty Sand	GAB	6 in.	Warp	94			
					Fill	100			
R8	2044	Silty Sand	GAB	12 in.	Warp	98			
					Fill	100			
R9	2016	Silty Sand	GAB	6 in.	Warp	93	91		
					Fill	90	92		
R10	2016	Silty Sand	GAB	12 in.	Warp	98	90		
					Fill	95	97		
R11	2006	Silty Sand	GAB	6 in.	Warp	79	78		
					Fill	94	94		
R12	2006	Silty Sand	GAB	12 in.	Warp	85	85		
					Fill	94	90		
R13	2002	Silty Sand	GAB	6	Warp	78	70		
					Fill	86	89		
R14	2002	Silty Sand	GAB	6	Warp	69	66		
					Fill	84	83		
R15	2002	Silty Sand	GAB	6	Warp	80	72		
					Fill	91	94		
R15A	2002	Silty Sand	GAB	12	Warp	81	79		
					Fill	100	98		
R16	2006	Silty Sand	GAB	6	Warp	75	70		
					Fill	92	91		
R17	2006	Silty Sand	GAB	6	Warp	72	76		
					Fill	91	87		

* denotes results obtained from the "TLC" section

(a) Laboratory Installation Damage

		Warp							Fill						
		Control		Damaged		Percent Retained			Control		Damaged		Percent Retained		
Section	Geotextile	Mean Strength (lbs./in.)	Strength Variance (lbs./in.)^2	Mean Strength (lbs./in.)	Strength Variance (lbs./in.)^2	Mean	Variance	Std. Dev.	Mean Strength (lbs./in.)	Strength Variance (lbs./in.)^2	Mean Strength (lbs./in.)	Strength Variance (lbs./in.)^2	Mean	Variance	Std. Dev.
W1	2044	465.5	234.1	406.2	313.3	87%	0.23%	4.76%	438.0	56.3	445.8	372.5	102%	0.22%	4.74%
W2	2044	465.5	234.1	454.4	86.5	98%	0.14%	3.78%	438.0	56.3	473.0	112.4	108%	0.09%	3.05%
W2A	2044	465.5	234.1	439.0	134.6	94%	0.16%	3.98%	438.0	56.3	452.8	278.9	103%	0.18%	4.20%
W3	2044	465.5	234.1	439.9	98.01	95%	0.14%	3.76%	438.0	56.3	453.4	361.0	104%	0.22%	4.69%
W4	2044	465.5	234.1	454.2	134.56	98%	0.16%	4.06%	438.0	56.3	487.3	515.3	111%	0.30%	5.52%
W5	2044	465.5	234.1	457.2	316.84	98%	0.25%	5.00%	438.0	56.3	495.7	272.3	113%	0.18%	4.24%
W6	2044	465.5	234.1	459.4	324	99%	0.25%	5.05%	438.0	56.3	488.9	580.8	112%	0.34%	5.82%
R1	2016	204.7	20.3	190.1	44.9	93%	0.15%	3.86%	283.0	75.7	241.5	75.7	85%	0.16%	4.04%
R2	2016	204.7	20.3	195.6	51.8	96%	0.17%	4.10%	283.0	75.7	264.4	193.2	93%	0.32%	5.69%
R3	2006	242.5	19.4	182.6	179.6	75%	0.32%	5.69%	250.8	50.4	216.3	372.5	86%	0.65%	8.07%
R4	2006	242.5	19.4	207.3	125.4	85%	0.24%	4.87%	250.8	50.4	236.1	16.0	94%	0.10%	3.11%
R5	2002	154.8	13.0	95.7	136.9	62%	0.59%	7.69%	171.9	32.5	128.3	349.7	75%	1.24%	11.16%
R6	2002	154.8	13.0	120.6	13.7	78%	0.09%	3.00%	171.9	32.5	158.3	38.4	92%	0.22%	4.73%
R7	2044	465.5	234.1	437.6	222.0	94%	0.20%	4.45%	438.0	56.3	467.9	62.4	107%	0.07%	2.57%
R8	2044	465.5	234.1	456.9	243.4	98%	0.22%	4.65%	438.0	56.3	490.9	77.4	112%	0.08%	2.78%
R9	2016	204.7	20.3	189.3	10.2	92%	0.07%	2.56%	283.0	75.7	254.8	13.0	90%	0.09%	3.05%
R10	2016	204.7	20.3	199.8	29.2	98%	0.12%	3.40%	283.0	75.7	269.1	26.0	95%	0.12%	3.43%
R11	2006	242.5	19.4	191.8	121.0	79%	0.23%	4.76%	250.8	50.4	235.7	98.0	94%	0.23%	4.76%
R12	2006	242.5	19.4	206.7	193.2	85%	0.35%	5.94%	250.8	50.4	236.0	72.3	94%	0.19%	4.31%
R13	2002	154.8	13.0	120.5	108.2	78%	0.48%	6.96%	171.9	32.5	147.1	156.3	86%	0.61%	7.81%
R14	2002	154.8	13.0	106.5	125.4	69%	0.55%	7.41%	171.9	32.5	144.5	123.2	84%	0.49%	7.03%
R15	2002	154.8	13.0	123.8	56.3	80%	0.27%	5.19%	171.9	32.5	156.1	84.6	91%	0.38%	6.14%
R15A	2002	154.8	13.0	125.1	27.0	81%	0.15%	3.85%	171.9	32.5	174.6	6.3	102%	0.13%	3.67%
R16	2006	242.5	19.4	181.6	201.6	75%	0.36%	6.01%	250.8	50.4	229.9	163.8	92%	0.33%	5.73%
R17	2006	242.5	19.4	174.0	130.0	72%	0.24%	4.88%	250.8	50.4	227.3	104.0	91%	0.23%	4.81%
E/S1	2006	242.5	19.4	204.5	18.5	84%	0.05%	2.34%	250.8	50.4	236.5	127.7	94%	0.27%	5.24%
E/S2	2006	242.5	19.4	211.6	49.0	87%	0.11%	3.29%	250.8	50.4	243.6	43.6	97%	0.14%	3.81%
K1	2006	242.5	19.4	153.7	36.0	63%	0.07%	2.73%	250.8	50.4	176.0	88.4	70%	0.18%	4.24%
K2	2044	465.5	234.1	390.4	734.41	84%	0.41%	6.44%	438.0	56.3	406.8	1218.01	93%	0.66%	8.13%

(b) Field Installation Damage

		Warp							Fill						
		Control		Damaged		Percent Retained			Control		Damaged		Percent Retained		
Section	Geotextile	Mean Strength (lbs./in.)	Strength Variance (lbs./in.)^2	Mean Strength (lbs./in.)	Strength Variance (lbs./in.)^2	Mean	Variance	Std. Dev.	Mean Strength (lbs./in.)	Strength Variance (lbs./in.)^2	Mean Strength (lbs./in.)	Strength Variance (lbs./in.)^2	Mean	Variance	Std. Dev.
W1	2044	465.5	234.1	398.0	174.2	85%	0.16%	3.99%	438.0	56.3	440.6	445.2	101%	0.26%	5.12%
W2	2044	465.5	234.1	400.9	299.3	86%	0.22%	4.67%	438.0	56.3	452.5	605.2	103%	0.35%	5.89%
TLC	2044	465.5	234.1	425.4	552.3	91%	0.35%	5.87%	438.0	56.3	472.5	428.5	108%	0.26%	5.07%
W5	2044	465.5	234.1	468.3	185.0	101%	0.19%	4.41%	438.0	56.3	504.9	151.3	115%	0.12%	3.43%
W6	2044	465.5	234.1	435.5	954.8	94%	0.54%	7.32%	438.0	56.3	465.6	153.8	106%	0.11%	3.37%
E/S1	2006	242.5	19.4	211.5	51.8	87%	0.11%	3.36%	250.8	50.4	249.0	56.3	99%	0.17%	4.10%
E/S2	2006	242.5	19.4	201.0	94.1	83%	0.18%	4.27%	250.8	50.4	258.5	161.3	103%	0.34%	5.84%

Table 7 Summary of Variance and Standard Deviation of Measured Wide-Width Tensile Strengths and Percent Strength Retained for (a) Laboratory and (b) Field Sections

(a) Laboratory Installation Damage

		Warp							Fill						
		Control		Damaged		Percent Retained			Control		Damaged		Percent Retained		
Section	Geotextile	Mean Strength (lbs.)	Strength Variance (lbs.)^2	Mean Strength (lbs.)	Strength Variance (lbs.)^2	Mean	Variance	Std. Dev.	Mean Strength (lbs.)	Strength Variance (lbs.)^2	Mean Strength (lbs.)	Strength Variance (lbs.)^2	Mean	Variance	Std. Dev.
R1	2016	326.0	361.0	294.9	185.0	90%	0.45%	6.72%	374.0	289.0	327.1	812.3	87%	0.74%	8.59%
R2	2016	326.0	361.0	296.3	400.0	91%	0.66%	8.11%	374.0	289.0	362.4	98.0	97%	0.26%	5.14%
R3	2006	376.0	289.0	309.8	761.8	82%	0.68%	8.23%	335.0	100.0	320.1	151.3	96%	0.22%	4.65%
R4	2006	376.0	289.0	331.3	116.6	88%	0.24%	4.91%	335.0	100.0	315.5	408.0	94%	0.44%	6.65%
R5	2002	261.0	256.0	164.6	219.0	63%	0.47%	6.86%	225.0	100.0	192.9	234.1	86%	0.61%	7.79%
R6	2002	261.0	256.0	202.2	295.8	77%	0.66%	8.12%	225.0	100.0	228.2	67.2	101%	0.34%	5.80%
R9	2016	326.0	361.0	297.2	408.0	91%	0.67%	8.16%	374.0	289.0	345.7	204.5	92%	0.32%	5.68%
R10	2016	326.0	361.0	294.7	246.5	90%	0.51%	7.14%	374.0	289.0	363.2	176.9	97%	0.32%	5.67%
R11	2006	376.0	289.0	292.9	176.9	78%	0.25%	4.99%	335.0	100.0	314.3	479.6	94%	0.51%	7.11%
R12	2006	376.0	289.0	319.7	547.6	85%	0.54%	7.32%	335.0	100.0	302.3	252.8	90%	0.30%	5.46%
R13	2002	261.0	256.0	182.8	39.7	70%	0.24%	4.93%	225.0	100.0	200.5	501.8	89%	1.15%	10.71%
R14	2002	261.0	256.0	173.5	64.0	66%	0.26%	5.10%	225.0	100.0	187.4	408.0	83%	0.94%	9.71%
R15	2002	261.0	256.0	187.8	376.4	72%	0.75%	8.64%	225.0	100.0	211.2	75.7	94%	0.32%	5.69%
R15A	2002	261.0	256.0	206.6	100.0	79%	0.38%	6.18%	225.0	100.0	220.4	84.6	98%	0.36%	5.97%
R16	2006	376.0	289.0	262.7	561.7	70%	0.50%	7.05%	335.0	100.0	304.8	590.5	91%	0.60%	7.75%
R17	2006	376.0	289.0	285.3	924.2	76%	0.77%	8.78%	335.0	100.0	291.6	213.2	87%	0.26%	5.07%
E/S1	2006	376.0	289.0	311.9	130.0	83%	0.23%	4.82%	335.0	100.0	331.4	424.4	99%	0.47%	6.82%
E/S2	2006	376.0	289.0	326.2	1115.6	87%	0.94%	9.71%	335.0	100.0	325.5	380.3	97%	0.42%	6.50%
K1	2006	376.0	289.0	247.3	876.16	66%	0.71%	8.42%	335.0	100.0	253.3	870.25	76%	0.83%	9.09%

(b) Field Installation Damage

		Warp							Fill						
		Control		Damaged		Percent Retained			Control		Damaged		Percent Retained		
Section	Geotextile	Mean Strength (lbs.)	Strength Variance (lbs.)^2	Mean Strength (lbs.)	Strength Variance (lbs.)^2	Mean	Variance	Std. Dev.	Mean Strength (lbs.)	Strength Variance (lbs.)^2	Mean Strength (lbs.)	Strength Variance (lbs.)^2	Mean	Variance	Std. Dev.
E/S1	2006	376.0	289.0	334.0	1369.0	89%	1.13%	10.63%	335.0	100.0	345.0	169.0	103%	0.25%	4.95%
E/S2	2006	376.0	289.0	312.0	400.0	83%	0.42%	6.51%	335.0	100.0	340.0	144.0	101%	0.22%	4.69%

Table 8 Summary of Variance and Standard Deviation of Measured Grab Tensile Strengths and Percent Strength Retained for (a) Laboratory and (b) Field Sections

SUMMARY OF RESULTS

The results summarized in Table 6 reveal that the wide width and grab tests generally yielded similar retained. As a result, wide width and grab test results are averaged in the following discussions of the results for each geotextile. As in the original series of tests, the strength retained in the fill direction is generally greater than the strength retained in the warp direction. In the discussion below comparing the effects of different subgrade and backfill conditions, the reported strength retained is the average of the four individual values of the wide width and grab tensile tests in the warp and fill directions.

The results obtained for Sections R13 through R17 allow a more thorough comparison of the influence of subgrade strength and backfill compactive effort on the percentage of strength retained. Table 9 shows the percentage of strength retained for the 2002 geotextile with a silty sand subgrade and 6 in. of GAB backfill. The values indicate that a higher compactive effort results in more damage to the specimen. There is no clear distinction in percentage of strength retained for the two different subgrade conditions.

Table 9 Influence of Subgrade Strength and Backfill Compactive Effort on Percentage Strength Retained for 2002

	Percentage of Strength Retained	
	Backfill: 95% of Standard	*Backfill: 95% of Modified*
Subgrade: CBR = 2	81%	76%
Subgrade: CBR = 5	84%	72%

Table 10 shows the test results for 2006, a heavier-weight geotextile. The different subgrade strengths and backfill compactive efforts do not have any statistically significant influence on the percentage of strength retained.

Table 10 Influence of Subgrade Strength and Backfill Compactive Effort on Percentage Strength Retained for 2006

	Percentage of Strength Retained	
	Backfill: 95% of Standard	*Backfill: 95% of Modified*
Subgrade: CBR = 2	86%	82%
Subgrade: CBR = 5	82%	85%

A comparison of Sections R15 and R15A yields additional information regarding the influence of backfill thickness on installation damage. In the original series of tests, thicker backfills caused less

installation damage, possibly as a result of improved load distribution. This trend is confirmed by Sections R15 and R15A. Section R15 with a 6-in. thick backfill experienced more damage (84% strength retained) vs. Section R15A with a 12-in. thick backfill (90% strength retained).

Section W2A was performed to check the repeatability of results obtained on Section W2 in the original series of tests. Test results for the two sections are shown in Table 11. On the basis of the average values and the corresponding standard deviations, the tests appear to be repeatable.

Table 11 Comparison of Percentage of Strength Retained for Sections W2 and W2A

	Percentage of Strength Retained	
Section	*Warp*	*Fill*
W2	98% (3.8%)	108% (3.1%)
W2A	94% (4.0%	103% (4.2%)

Note: Standard deviations are shown in parentheses

Sections K1 and K2 were intended to reproduce test conditions used by Koerner et al. (1993) to test a woven, slit-film geotextile with a weight of 6.0 to 7.0 oz./yd^2. Table 12 shows the comparison of the percentage strength retained for these two sections along the values obtained by Koerner et al. (1993). Clearly, the laboratory installation damage tests were unable to reproduce the field conditions present in the Koerner et al. (1993) study. There are several possible explanations including:

- Placement and compaction of the subgrade and backfill differed substantially between the field and lab. This is a likely cause as evidenced by the inability to compact the course, angular GP material adequately in the lab tests.

- Despite the similarity in grain size distributions, the GP material used by Koerner et al. may have differed from the GP used in this study.

It is encouraging, however, that the heavier geotextile (2044) resulted in approximately 20% more strength retained than the lighter geotextile (2006).

Table 12 Comparison of Percentage of Strength Retained for Sections K1 and K2 and Koerner et al. (1993) Results

		Percentage of Strength Retained	
Section	*Geotextile*	*Warp*	*Fill*
K1	2006	65%	73%
K2	2044	84%	93%
Koerner et al. (1993)	6.0-7.0 oz./yd^2	20%	26%

CONCLUSIONS

Taken together, the original and supplemental test series have provided an opportunity to quantify installation damage on four geotextiles under a variety of subgrade and backfill conditions. Both laboratory and field tests were performed. Results of these tests indicate the following trends:

- for a given geotextile, subgrade and backfill soils with larger, more angular particles result in greater installation damage,
- for a given subgrade and backfill combination, lighter weight geotextiles experience more installation damage,
- based on a limited number of tests, higher compactive effort in the backfill appears to result in more installation damage for lightweight geotextiles,
- based on a limited number of tests, subgrade strength does not appear to influence installation damage,
- thicker backfills result in less installation damage, possibly because of improved load distribution resulting in reduced stress on the geotextile,
- three of the four geotextiles (2002, 2006, and 2044) retained more strength in the fill direction than in the warp direction,
- laboratory installation damage tests provide a reasonable simulation of the damage sustained by a geotextile under field construction procedures, and
- specimens subjected to field installation damage tests should be exhumed carefully to minimize additional damage (e.g., foot traffic) not related to construction.

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REFERENCES

Baker, T.L. (1994). "Production of Woven, Tape Yarn Geotextiles," 8th Geosynthetics Research Institute Conference, December.

Koerner, G.R., Koerner, R.M., and Elias, V. (1993). "Geosynthetic Installation Damage Under Two Different Backfill Conditions," *Geosynthetic Soil Reinforcement Testing Procedures*, ASTM STP 1190, S.C. Jonathan Cheng, Ed., American Society for Testing and Materials, Philadelphia, pp. 163-183.

Rix, G.J., Lydon, J.P., and Rhodes, P.B. (1995). "Installation Damage to Woven Polypropylene Geotextiles," Report No. GIT-CEE/GEO-95-2, School of Civil and Environmental Engineering, Georgia Institute of Technology, 185 pp.

Appendix A - Laboratory Density Measurements

LABORATORY MOISTURE - DENSITY RESULTS

Project:	**Amoco Textiles**	**Test No.:**	**K1**
Date:	**6/16/95**	**Geotextile Type:**	**2006**
Moisture Standard Count:	**3588**	**Subgrade:**	**6" Crushed Stone (GP)**
Density Standard Count:	**6023**	**Overburden:**	**10 " Crushed Stone (GP)**

SUBGRADE

Test Location	*Test Penetration (in.)*	*Density Reading*	*Wet Unit Weight (pcf)*	*Moisture Reading*	*Moisture Weight (pcf)*	*Moisture Content (%)*	*Dry Unit Weight (pcf)*	*Percent Standard (%)*
A(1)	BACKSCATTER	3446	82.7	272	1.70	2.1%	81.0	**
A(2)	BACKSCATTER	3512	81.3	262	1.57	2.0%	79.8	**
B(1)	BACKSCATTER	3196	88.1	273	1.71	2.0%	86.4	**
B(2)	BACKSCATTER	3279	86.3	234	1.22	1.4%	85.0	**
C(1)	BACKSCATTER	3493	81.7	243	1.34	1.7%	80.4	**
C(2)	BACKSCATTER	3439	82.8	250	1.42	1.7%	81.4	**
D(1)	BACKSCATTER	3520	81.2	263	1.59	2.0%	79.6	**
D(2)	BACKSCATTER	3165	88.8	257	1.51	1.7%	87.3	**
				Average Dry Unit Weight (pcf):			82.6	**

OVERBURDEN

A(1)	BACKSCATTER	3398	83.7	192	0.70	0.8%	83.0	**
A(2)	BACKSCATTER	3322	85.3	198	0.78	0.9%	84.6	**
B(1)	BACKSCATTER	3692	77.8	170	0.43	0.6%	77.4	**
B(2)	BACKSCATTER	3263	86.6	193	0.71	0.8%	85.9	**
C(1)	BACKSCATTER	3008	92.5	171	0.44	0.5%	92.1	**
C(2)	BACKSCATTER	3000	92.7	202	0.83	0.9%	91.9	**
D(1)	BACKSCATTER	3254	86.8	194	0.73	0.8%	86.1	**
D(2)	BACKSCATTER	3264	86.6	212	0.95	1.1%	85.6	**
				Average Dry Unit Weight (pcf):			85.8	**

LABORATORY MOISTURE - DENSITY RESULTS

Project:	**Amoco Textiles**	**Test No.:**	**K2**
Date:	**6/16/95**	**Geotextile Type:**	**2044**
Moisture Standard Count:	**3588**	**Subgrade:**	**6" Crushed Stone (GP)**
Density Standard Count:	**6023**	**Overburden:**	**10 " Crushed Stone (GP)**

SUBGRADE

Test Location	*Test Penetration (in.)*	*Density Reading*	*Wet Unit Weight (pcf)*	*Moisture Reading*	*Moisture Weight (pcf)*	*Moisture Content (%)*	*Dry Unit Weight (pcf)*	*Percent Standard (%)*
A(1)	BACKSCATTER	3377	84.1	272	1.70	2.1%	82.4	**
A(2)	BACKSCATTER	3357	84.6	254	1.47	1.8%	83.1	**
B(1)	BACKSCATTER	3767	76.4	253	1.46	2.0%	74.9	**
B(2)	BACKSCATTER	3969	72.7	229	1.16	1.6%	71.5	**
C(1)	BACKSCATTER	3406	83.5	227	1.14	1.4%	82.4	**
C(2)	BACKSCATTER	3365	84.4	249	1.41	1.7%	83.0	**
D(1)	BACKSCATTER	3594	79.7	280	1.80	2.3%	77.9	**
D(2)	BACKSCATTER	3863	74.6	249	1.41	1.9%	73.2	**
				Average Dry Unit Weight (pcf):			78.6	**

OVERBURDEN

A(1)	BACKSCATTER	2924	94.6	196	0.75	0.8%	93.9	**
A(2)	BACKSCATTER	3035	91.9	207	0.89	1.0%	91.0	**
B(1)	BACKSCATTER	3225	87.5	187	0.64	0.7%	86.8	**
B(2)	BACKSCATTER	3185	88.4	203	0.84	1.0%	87.5	**
C(1)	BACKSCATTER	3632	78.9	182	0.58	0.7%	78.4	**
C(2)	BACKSCATTER	3183	88.4	147	0.14	0.2%	88.3	**
D(1)	BACKSCATTER	3135	89.5	180	0.55	0.6%	89.0	**
D(2)	BACKSCATTER	2923	94.6	188	0.65	0.7%	94.0	**
				Average Dry Unit Weight (pcf):			88.6	**

LABORATORY MOISTURE - DENSITY RESULTS

Project:	**Amoco Textiles**	**Test No.:**	**R-13**
Date:	**06/05/95**	**Geotextile Type:**	**2002**
Moisture Standard Count:	**3563**	**Subgrade:**	**12" Silty Sand CBR = 2**
Density Standard Count:	**6070**	**Overburden:**	**6" GAB 95% std.**

Test Location	*Test Penetration (in.)*	*Density Reading*	*Wet Unit Weight (pcf)*	*Moisture Reading*	*Moisture Weight (pcf)*	*Moisture Content (%)*	*Dry Unit Weight (pcf)*	*Percent Standard (%)*
SUBGRADE								
A	6	8640	105.1	1423	16.2	18.2%	88.9	82.3%
C	6	8438	106.3	1469	16.7	18.6%	89.6	83.0%
				Average Dry Unit Weight (pcf):			89.3	82.6%
OVERBURDEN								
D	BACKSCATTER	1702	138.0	650	6.46	4.9%	131.5	98.5%
B	BACKSCATTER	1754	135.4	540	5.08	3.9%	130.3	97.6%
				Average Dry Unit Weight (pcf):			130.9	98.1%

LABORATORY MOISTURE - DENSITY RESULTS

Project:	**Amoco Textiles**	**Test No.:**	**R-14**
Date:	**06/05/95**	**Geotextile Type:**	**2002**
Moisture Standard Count:	**3563**	**Subgrade:**	**12" Silty Sand CBR = 2**
Density Standard Count:	**6070**	**Overburden:**	**6" GAB 95% mod.**

Test Location	*Test Penetration (in.)*	*Density Reading*	*Wet Unit Weight (pcf)*	*Moisture Reading*	*Moisture Weight (pcf)*	*Moisture Content (%)*	*Dry Unit Weight (pcf)*	*Percent Standard* (%)*
SUBGRADE								
B	6	8315	107.2	1511	17.26	19.2%	89.9	83.3%
D	6	8740	104.5	1471	16.76	19.1%	87.7	81.2%
				Average Dry Unit Weight (pcf):			88.8	82.3%
OVERBURDEN								
B	BACKSCATTER	1664	139.9	694	7.01	5.3%	132.9	97.4%
D	BACKSCATTER	1660	140.1	680	6.83	5.1%	133.3	97.6%
				Average Dry Unit Weight (pcf):			133.1	97.5%

* Percent of Modified was used for overburden calculations

LABORATORY MOISTURE - DENSITY RESULTS

Project:	**Amoco Textiles**	**Test No.:**	**R-15**
Date:	**06/06/95**	**Geotextile Type:**	**2002**
Moisture Standard Count:	**3595**	**Subgrade:**	**12" Silty Sand CBR = 5**
Density Standard Count:	**6080**	**Overburden:**	**6" GAB 95% std.**

Test Location	*Test Penetration (in.)*	*Density Reading*	*Wet Unit Weight (pcf)*	*Moisture Reading*	*Moisture Weight (pcf)*	*Moisture Content (%)*	*Dry Unit Weight (pcf)*	*Percent Standard (%)*
SUBGRADE								
A	6	8123	108.5	1481	16.70	18.2%	91.8	85.0%
C	6	7657	111.7	1300	14.47	14.9%	97.2	90.0%
				Average Dry Unit Weight (pcf):			94.5	87.5%
OVERBURDEN								
C	BACKSCATTER	1786	134.0	579	5.51	4.3%	128.5	96.3%
D	BACKSCATTER	1740	136.2	506	4.6	3.5%	131.6	98.6%
				Average Dry Unit Weight (pcf):			130.1	97.4%

LABORATORY MOISTURE - DENSITY RESULTS

Project:	**Amoco Textiles**	**Test No.:**	**Botch**
Date:	**06/02/95**	**Geotextile Type:**	**2002**
Moisture Standard Count:	**3563**	**Subgrade:**	**12" Silty Sand CBR = ?**
Density Standard Count:	**6050**	**Overburden:**	**12" GAB 95% std.**

Test Location	*Test Penetration (in.)*	*Density Reading*	*Wet Unit Weight (pcf)*	*Moisture Reading*	*Moisture Weight (pcf)*	*Moisture Content (%)*	*Dry Unit Weight (pcf)*	*Percent Standard (%)*
SUBGRADE								
B	6	6523	120.0	1966	22.97	23.7%	97.1	89.9%
D	6	5976	124.7	2145	25.21	25.3%	99.5	92.1%
				Average Dry Unit Weight (pcf):			98.3	91.0%
OVERBURDEN								
A	BACKSCATTER	1772	134.3	550	4.96	3.8%	129.3	96.9%
C	BACKSCATTER	1757	135.0	470	4.2	3.2%	130.8	98.0%
				Average Dry Unit Weight (pcf):			130.1	97.4%

LABORATORY MOISTURE - DENSITY RESULTS

Project:	**Amoco Textiles**	**Test No.:**	**R-16**
Date:	**06/06/95**	**Geotextile Type:**	**2006**
Moisture Standard Count:	**3595**	**Subgrade:**	**12" Silty Sand CBR = 2**
Density Standard Count:	**6080**	**Overburden:**	**6" GAB 95% mod.**

Test Location	*Test Penetration (in.)*	*Density Reading*	*Wet Unit Weight (pcf)*	*Moisture Reading*	*Moisture Weight (pcf)*	*Moisture Content (%)*	*Dry Unit Weight (pcf)*	*Percent Standard* (%)*
SUBGRADE								
B	6	8641	105.2	1515	17.31	19.7%	87.9	81.4%
D	6	8467	106.3	1527	17.5	19.7%	88.8	82.2%
				Average Dry Unit Weight (pcf):			88.3	81.8%
OVERBURDEN								
D	BACKSCATTER	1634	141.7	754	7.68	5.7%	134.0	98.2%
B	BACKSCATTER	1726	136.9	625	6.08	4.6%	130.8	95.8%
				Average Dry Unit Weight (pcf):			132.4	97.0%

* Percent of Modified was used for overburden calculations

LABORATORY MOISTURE - DENSITY RESULTS

Project:	**Amoco Textiles**	**Test No.:**	**R-17**
Date:	**06/02/95**	**Geotextile Type:**	**2006**
Moisture Standard Count:	**3585**	**Subgrade:**	**12" Silty Sand CBR = 5**
Density Standard Count:	**6042**	**Overburden:**	**6" GAB 95% std.**

Test Location	*Test Penetration (in.)*	*Density Reading*	*Wet Unit Weight (pcf)*	*Moisture Reading*	*Moisture Weight (pcf)*	*Moisture Content (%)*	*Dry Unit Weight (pcf)*	*Percent Standard (%)*
SUBGRADE								
D	6	5934	125.0	2121	24.75	24.7%	100.2	92.8%
B	6	6508	120.1	1910	22.12	22.6%	98.0	90.7%
				Average Dry Unit Weight (pcf):			99.1	91.8%
OVERBURDEN**								
A	BACKSCATTER	1791	133.3	417	3.54	2.7%	129.8	97.2%
C	BACKSCATTER	1811	132.4	403	3.36	2.6%	129.0	96.6%
				Average Dry Unit Weight (pcf):			129.4	96.9%

** These Measurements were taken on June 4 , 1995 using a MSC of 3363 and a DSC of 6048

LABORATORY MOISTURE - DENSITY RESULTS

Project:	**Amoco Textiles**	**Test No.:**	**W-2A**
Date:	**06/12/95**	**Geotextile Type:**	**2044**
Moisture Standard Count:	**3609**	**Subgrade:**	**6" GAB 95% std.**
Density Standard Count:	**6041**	**Overburden:**	**12" GAB 95% std.**

Test Location	*Test Penetration (in.)*	*Density Reading*	*Wet Unit Weight (pcf)*	*Moisture Reading*	*Moisture Weight (pcf)*	*Moisture Content (%)*	*Dry Unit Weight (pcf)*	*Percent Standard (%)*
SUBGRADE								
D	6	1751	135.7	572	5.42	4.2%	130.3	97.6%
C	6	1733	136.6	494	4.45	3.4%	132.2	99.0%
				Average Dry Unit Weight (pcf):			131.2	98.3%
OVERBURDEN								
D	BACKSCATTER	1801	132.8	513	4.66	3.6%	128.1	96.0%
B	BACKSCATTER	1800	132.8	562	5.27	4.1%	127.5	95.5%
				Average Dry Unit Weight (pcf):			127.8	95.8%

Appendix B - Wide Width and Grab Tensile Test Results

AMOCO FABRICS AND FIBERS COMPANY
RESEARCH AND DEVELOPMENT CENTER
PHYSICAL TESTING LABORATORY

WIDE WIDTH W LOAD @ 2%, 5%, 10%, 15%, AND 20%
INSTRON MODEL 4505 - TEST METHOD 41
Proprietary - To Be Maintained In Confidence

Test type: Tensile

Instron Corporation
Series IX Automated Materials Testing System 1.34

Operator name: JCR

Test Date: 17 Aug 1995

Sample Identification: 952229W

Sample Type: ASTM

Interface Type: 4500 Series
Machine Parameters of test:
Sample Rate (pts/sec): 25.00
Crosshead Speed (in/min): .409

Humidity (%): 50
Temperature (deg. F): 73

STYLE/EPR NUMBER: 2044 - W2A
P T LAB NUMBER: 95222000
DIRECTION: WARP
DESCRIPTION: GEORGIA TECH DURABILITY STUDY
COMMENTS:

Dimensions:

	Sample
Width (in)	3.0000
Thickness (in)	.10000
Spec gauge len (in)	4.0000
Grip distance (in)	4.0000

Out of 8 specimens, 0 excluded.

Specimen Number	Sample Weight (osy)	Peak Load (lbs/in)	Strain at Peak Load (%)	Load @ 2% Elongation (lbs/in)	Load @ 5% Elongation (lbs/in)	Load @ 10% Elongation (lbs/in)	Load @ 15% Elongation (lbs/in)	Load @ 20% Elongation (lbs/in)
1	.0000	434.7	28.05	4.953	35.27	142.7	254.3	347.1
2	.0000	450.7	27.03	5.668	42.37	153.9	268.1	368.1
3	.0000	438.7	24.88	5.455	27.42	131.0	255.5	366.1
4	.0000	428.4	24.05	8.809	49.33	167.6	289.0	381.1
5	.0000	455.6	24.23	12.660	57.41	174.6	293.1	391.2
6	.0000	449.2	26.28	8.121	47.29	163.2	280.8	375.8
7	.0000	424.1	22.55	18.040	68.03	188.2	301.1	392.2
8	.0000	430.5	22.50	26.880	85.96	219.0	317.2	404.2
Mean:	.0000	439.0	24.94	11.320	51.63	166.4	282.4	378.2
Standard Deviation:	.0000	11.6	2.05	7.676	18.69	25.1	22.1	18.0
Mean - 2.00 * Sdv:	.0000	415.8	20.89	-4.029	14.26	116.1	238.1	342.2
Mean + 2.00 * Sdv:	.0000	462.2	29.00	26.680	89.01	216.7	326.7	414.2
% Var:	----------	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

AMOCO FABRIC AND FIBERS COMPANY
RESEARCH AND DEVELOPMENT CENTER
PHYSICAL TESTING LABORATORY

WIDE WIDTH W LOAD @ 2%, 5%, 10%, 15%, AND 20%
INSTRON MODEL 4505 - TEST METHOD 41
Proprietary - To Be Maintained In Confidence

Test type: Tensile

Instron Corporation
Series IX Automated Materials Testing System 1.04

Operator name: JCR

Test Date: 17 Aug 1995

Sample Identification: 952229F

Sample Type: ASTM

Interface Type: 4500 Series
Machine Parameters of test:
Sample Rate (pts/sec): 25.00
Crosshead Speed (in/min): .400

Humidity (%): 50
Temperature (deg. F): 73

STYLE/EPR NUMBER: 2044 - W2A
P T LAB NUMBER: 95222000
DIRECTION: FILL
DESCRIPTION: GEORGIA TECH DURABILITY STUDY
COMMENTS:

Dimensions:

	Sample
Width (in)	8.0000
Thickness (in)	.10000
Spec gauge len (in)	4.0000
Grip distance (in)	4.0000

Out of 8 specimens. 0 excluded.

Specimen Number	Sample Weight (osy)	Peak Load (lbs/in)	Strain at Peak Load (%)	Load @ 2% Elongation (lbs/in)	Load @ 5% Elongation (lbs/in)	Load @ 10% Elongation (lbs/in)	Load @ 15% Elongation (lbs/in)	Load @ 20% Elongation (lbs/in)
1	.0000	482.5	21.00	97.89	192.2	325.0	427.5	479.4
2	.0000	448.7	20.17	55.44	150.5	286.4	394.0	446.6
3	.0000	456.9	20.58	88.75	182.9	316.9	412.8	456.1
4	.0000	462.9	25.83	50.04	136.5	274.8	378.7	442.2
5	.0000	448.6	25.17	42.43	132.9	269.0	372.1	433.9
6	.0000	459.0	26.50	91.82	186.0	317.4	409.6	447.4
7	.0000	428.5	23.15	73.12	168.0	293.2	381.4	420.0
8	.0000	435.5	26.28	67.58	163.9	291.5	381.1	426.8
Mean:	.0000	452.8	23.58	70.89	164.1	297.0	394.6	444.1
Standard Deviation:	.0000	16.7	2.70	20.65	22.6	20.7	19.9	16.3
Mean - 2.00 * Sdv:	.0000	419.3	18.19	29.58	119.0	255.7	355.0	407.1
Mean + 2.00 * Sdv:	.0000	486.3	28.97	xxxxx	209.3	338.4	434.3	481.1
[illegible]	----------	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

AMOCO FABRIC AND FIBERS COMPANY
RESEARCH AND DEVELOPMENT CENTER
PHYSICAL TESTING LABORATORY

WIDE WIDTH W LOAD @ 2%, 5%, 10%, 15%, AND 20%
INSTRON MODEL 4505 - TEST METHOD 41
Proprietary - To Be Maintained In Confidence

Test type: Tensile

Operator name: JCR

Sample Identification: 952223W
Interface Type: 4500 Series
Machine Parameters of test:
Sample Rate (pts/sec): 25.00
Crosshead Speed (in/min): .400

Instron Corporation
Series IX Automated Materials Testing System 1.04
Test Date: 15 Aug 1995

Sample Type: ASTM

Humidity (%): 50
Temperature (deg. F): 73

STYLE/EPR NUMBER: 2002-R13
P T LAB NUMBER: 95222000
DIRECTION: WARP
DESCRIPTION: GEORGIA TECH DURABILITY STUDY

Dimensions:

	Sample
Width (in)	8.0000
Thickness (in)	.10000
Spec gauge len (in)	4.0000
Grip distance (in)	4.0000

Out of 6 specimens, 0 excluded.

Specimen Number	Sample Weight (osy)	Peak Load (lbs/in)	Strain at Peak Load (%)	Load @ 2% Elongation (lbs/in)	Load @ 5% Elongation (lbs/in)	Load @ 10% Elongation (lbs/in)	Load @ 15% Elongation (lbs/in)	Load @ 20% Elongation (lbs/in)
1	.0000	109.5	12.05	38.23	66.33	102.6	85.52	48.92
2	.0000	128.2	15.60	30.24	59.59	100.7	127.40	74.61
3	.0000	107.1	11.52	37.69	66.18	101.7	70.00	25.75
4	.0000	119.5	13.60	32.42	61.25	101.3	117.50	65.45
5	.0000	126.1	14.40	37.52	66.50	106.5	122.90	68.01
6	.0000	132.5	14.86	35.79	65.32	106.4	131.80	68.39
Mean:	.0000	120.5	13.68	35.32	64.19	103.2	109.20	58.52
Standard Deviation:	.0000	10.4	1.61	3.27	3.00	2.6	25.27	18.22
Mean - 2.00 * Sdv:	.0000	99.8	10.46	28.78	58.20	96.0	58.63	22.08
Mean + 2.00 * Sdv:	.0000	141.2	16.89	41.85	70.19	108.3	159.70	94.97
Coef of Var:	---------	8.60	11.76	9.25	4.67	2.49	23.15	31.14

AMOCO FABRIC AND FIBERS COMPANY
RESEARCH AND DEVELOPMENT CENTER
PHYSICAL TESTING LABORATORY

WIDE WIDTH W LOAD @ 2%, 5%, 10%, 15%, AND 20%
INSTRON MODEL 4505 - TEST METHOD 41
Proprietary - To Be Maintained In Confidence

Test type: Tensile

Operator name: JCR

Sample Identification: 952223F
Interface Type: 4500 Series
Machine Parameters of test:
Sample Rate (pts/sec): 25.00
Crosshead Speed (in/min): .400

Instron Corporation
Series IX Automated Materials Testing System 1.04
Test Date: 15 Aug 1995

Sample Type: ASTM

Humidity (%): 50
Temperature (deg. F): 73

STYLE/EPR NUMBER: 2002-R13
P T LAB NUMBER: 95222000
DIRECTION: FILL
DESCRIPTION: GEORGIA TECH DURABILITY STUDY

Dimensions:

	Sample
Width (in)	8.0000
Thickness (in)	.10000
Spec gauge len (in)	4.0000
Grip distance (in)	4.0000

Out of 6 specimens, 0 excluded.

Specimen Number	Sample Weight (osy)	Peak Load (lbs/in)	Strain at Peak Load (%)	Load @ 2% Elongation (lbs/in)	Load @ 5% Elongation (lbs/in)	Load @ 10% Elongation (lbs/in)	Load @ 15% Elongation (lbs/in)	Load @ 20% Elongation (lbs/in)
1	.0000	163.1	9.750	83.92	122.9	161.70	40.15	----------
2	.0000	150.1	9.925	59.72	101.0	149.80	54.61	----------
3	.0000	138.7	9.050	66.59	105.7	118.30	63.38	32.04
4	.0000	159.9	10.550	61.65	103.4	157.70	46.95	14.15
5	.0000	136.2	8.625	62.03	102.3	73.33	45.75	----------
6	.0000	134.4	8.625	71.38	110.6	47.01	38.96	----------
Mean:	.0000	147.1	9.421	67.55	107.7	118.00	48.28	----------
Standard Deviation:	.0000	12.5	.780	9.06	8.2	48.93	9.22	----------
Mean - 2.00 * Sdv:	.0000	122.1	7.861	49.43	91.3	21.92	29.82	----------
Mean + 2.00 * Sdv:	.0000	172.0	10.980	85.66	124.0	214.00	66.75	----------
Cof of Var:	----------	8.46	8.28	13.41	7.61	40.71	19.12	----------

AMOCO FABRIC AND FIBERS COMPANY
RESEARCH AND DEVELOPMENT CENTER
PHYSICAL TESTING LABORATORY

WIDE WIDTH W LOAD @ 2%, 5%, 10%, 15%, AND 20%
INSTRON MODEL 4505 - TEST METHOD 41
Proprietary - To Be Maintained In Confidence

Test type: Tensile

Instron Corporation
Series IX Automated Materials Testing System 1.34

Operator name: JCR

Test Date: 15 Aug 1995

Sample Identification: 952224W

Sample Type: ASTM

Interface Type: 4500 Series
Machine Parameters of test:
Sample Rate (pts/sec): 25.00
Crosshead Speed (in/min): .400

Humidity (%): 50
Temperature (deg. F): 73

STYLE/EPR NUMBER: 2002 -R14
P T LAB NUMBER: 95222000
DIRECTION: WARP
DESCRIPTION: GEORGIA TECH DURABILITY STUDY

Dimensions:

	Sample
Width (in)	8.0000
Thickness (in)	.10000
Spec gauge len (in)	4.0000
Grip distance (in)	4.0000

Out of 6 specimens. 0 excluded.

Specimen Number	Sample Weight (osy)	Peak Load (lbs/in)	Strain at Peak Load (%)	Load @ 2% Elongation (lbs/in)	Load @ 5% Elongation (lbs/in)	Load @ 10% Elongation (lbs/in)	Load @ 15% Elongation (lbs/in)	Load @ 20% Elongation (lbs/in)
1	.0000	111.60	14.06	26.66	55.71	96.81	103.60	37.78
2	.0000	109.90	12.48	26.10	55.39	95.79	100.20	48.30
3	.0000	119.10	13.22	31.15	60.69	101.40	107.70	36.57
4	.0000	92.65	12.55	18.48	46.55	84.33	45.94	21.04
5	.0000	92.65	10.58	27.02	55.53	89.79	44.02	32.54
6	.0000	113.40	15.65	20.30	49.68	92.16	112.20	30.18
Mean:	.0000	106.50	13.09	24.95	53.92	93.39	85.61	34.41
Standard Deviation:	.0000	11.20	1.71	4.70	5.02	5.98	31.74	9.05
Mean - 2.00 * Sdv:	.0000	84.15	9.68	15.55	43.88	81.43	22.14	16.31
Mean + 2.00 * Sdv:	.0000	128.90	16.50	34.36	63.97	105.30	149.10	52.50
Cof of Var:	----------	10.51	13.02	18.84	9.31	6.40	37.07	26.29

AMOCO FABRIC AND FIBERS COMPANY
RESEARCH AND DEVELOPMENT CENTER
PHYSICAL TESTING LABORATORY

WIDE WIDTH W LOAD @ 2%, 5%, 10%, 15%, AND 20%
INSTRON MODEL 4505 - TEST METHOD 41
Proprietary - To Be Maintained In Confidence

Test type: Tensile

Instron Corporation
Series IX Automated Materials Testing System 1.34

Operator name: JCR

Test Date: 15 Aug 1995

Sample Identification: 952224F

Sample Type: ASTM

Interface Type: 4500 Series
Machine Parameters of test:
Sample Rate (pts/sec): 25.00
Crosshead Speed (in/min): .400

Humidity (%): 50
Temperature (deg. F): 73

STYLE/EPR NUMBER: 2002 -R14
P T LAB NUMBER: 95222000
DIRECTION: FILL
DESCRIPTION: GEORGIA TECH DURABILITY STUDY
COMMENTS:

Dimensions:

	Sample
Width (in)	8.0000
Thickness (in)	.10000
Spec gauge len (in)	4.0000
Grip distance (in)	6.0000

Out of 6 specimens, 0 excluded.

Specimen Number	Sample Weight (osy)	Peak Load (lbs/in)	Strain at Peak Load (%)	Load @ 2% Elongation (lbs/in)	Load @ 5% Elongation (lbs/in)	Load @ 10% Elongation (lbs/in)	Load @ 15% Elongation (lbs/in)	Load @ 20% Elongation (lbs/in)
1	.0000	157.2	12.330	35.81	79.12	141.10	54.85	26.12
2	.0000	149.9	10.500	59.76	101.50	148.50	36.21	13.59
3	.0000	148.7	9.600	65.49	106.10	144.40	32.04	----------
4	.0000	131.6	8.725	55.20	96.00	68.85	41.04	----------
5	.0000	149.6	9.325	62.55	103.80	133.90	45.39	18.07
6	.0000	130.0	9.175	55.65	95.65	125.10	25.00	----------
Mean:	.0000	144.5	9.942	55.74	97.03	127.00	39.09	----------
Standard Deviation:	.0000	11.1	1.306	10.34	9.71	29.66	10.47	----------
Mean - 2.00 * Sdv:	.0000	122.4	7.325	34.67	77.60	67.65	18.14	----------
Mean + 2.00 * Sdv:	.0000	166.6	12.560	76.82	116.50	186.30	60.03	----------
Cof of Var:	----------	7.65	13.16	18.90	10.01	23.36	26.73	----------

AMOCO FABRIC AND FIBERS COMPANY
RESEARCH AND DEVELOPMENT CENTER
PHYSICAL TESTING LABORATORY

WIDE WIDTH W LOAD @ 2%, 5%, 10%, 15%, AND 20%
INSTRON MODEL 4505 - TEST METHOD 41
Proprietary - To Be Maintained In Confidence

Test type: Tensile

Instron Corporation
Series IX Automated Materials Testing System 1.14

Operator name: JCR

Test Date: 15 Aug 1995

Sample Identification: 952226W

Sample Type: ASTM

Interface Type: 4500 Series
Machine Parameters of test:
Sample Rate (pts/sec): 25.00
Crosshead Speed (in/min): .400

Humidity (%): 50
Temperature (deg. F): 73

STYLE/EPR NUMBER: 2002 -R15 RETEST
P T LAB NUMBER: 95222000
DIRECTION: WARP
DESCRIPTION: GEORGIA TECH DURABILITY STUDY

Dimensions:

	Sample
Width (in)	8.0000
Thickness (in)	.10000
Spec gauge len (in)	4.0000
Grip distance (in)	4.0000

Out of 6 specimens. 0 excluded.

Specimen Number	Sample Weight (osy)	Peak Load (lbs/in)	Strain at Peak Load (%)	Load @ 2% Elongation (lbs/in)	Load @ 5% Elongation (lbs/in)	Load @ 10% Elongation (lbs/in)	Load @ 15% Elongation (lbs/in)	Load @ 20% Elongation (lbs/in)
1	.0000	114.3	14.08	24.17	53.72	96.10	108.50	40.17
2	.0000	122.1	14.65	23.46	52.56	94.55	121.20	46.24
3	.0000	119.1	15.00	22.34	51.06	92.78	119.00	55.50
4	.0000	121.6	12.55	34.25	64.52	106.00	86.70	49.27
5	.0000	133.0	16.13	29.15	58.56	100.10	130.30	107.50
6	.0000	132.5	16.80	24.60	53.69	95.94	126.70	76.34
Mean:	.0000	123.8	14.87	26.33	55.68	97.58	115.40	62.50
Standard Deviation:	.0000	7.5	1.51	4.53	5.01	4.79	15.92	25.30
Mean - 2.00 * Sdv:	.0000	108.8	11.85	17.27	45.67	88.00	83.58	11.89
Mean + 2.00 * Sdv:	.0000	138.7	17.88	35.39	65.70	107.20	147.30	113.10
Cof of Var:	----------	6.05	10.15	17.20	8.99	4.91	13.80	40.49

AMOCO FABRIC AND FIBERS COMPANY
RESEARCH AND DEVELOPMENT CENTER
PHYSICAL TESTING LABORATORY

WIDE WIDTH W LOAD @ 2%, 5%, 10%, 15%, AND 20%
INSTRON MODEL 4505 - TEST METHOD 41
Proprietary - To Be Maintained In Confidence

Test type: Tensile

Instron Corporation
Series IX Automated Materials Testing System 1.04

Operator name: JCR

Test Date: 15 Aug 1995

Sample Identification: 952226F

Sample Type: ASTM

Interface Type: 4500 Series
Machine Parameters of test:
Sample Rate (pts/sec): 25.00
Crosshead Speed (in/min): .400

Humidity (%): 50
Temperature (deg. F): 73

STYLE/EPA NUMBER: 2002 -R15 RETEST
P T LAB NUMBER: 95222000
DIRECTION: FILL
DESCRIPTION: GEORGIA TECH DURABILITY STUDY

Dimensions:

	Sample
Width (in)	8.0000
Thickness (in)	.10000
Spec gauge len (in)	4.0000
Grip distance (in)	4.0000

Out of 6 specimens. 0 excluded.

Specimen Number	Sample Weight (osy)	Peak Load (lbs/in)	Strain at Peak Load (%)	Load @ 2% Elongation (lbs/in)	Load @ 5% Elongation (lbs/in)	Load @ 10% Elongation (lbs/in)	Load @ 15% Elongation (lbs/in)	Load @ 20% Elongation (lbs/in)
1	.0000	153.4	10.630	49.07	91.84	148.5	53.38	19.39
2	.0000	153.6	11.300	51.90	94.01	150.0	54.45	20.51
3	.0000	146.2	10.750	45.08	87.38	143.4	64.12	40.03
4	.0000	173.6	11.950	63.94	105.80	161.6	62.80	24.28
5	.0000	155.4	9.825	71.35	112.80	152.1	50.20	11.53
6	.0000	154.6	10.580	59.17	101.00	152.3	61.40	25.07
Mean:	.0000	156.1	10.840	56.80	98.80	151.3	57.73	23.47
Standard Deviation:	.0000	9.2	.721	9.99	9.51	6.0	5.77	9.44
Mean - 2.00 * Sdv:	.0000	137.8	9.396	36.82	79.78	135.3	46.19	4.59
Mean + 2.00 * Sdv:	.0000	174.5	12.280	76.77	117.80	163.3	69.26	42.36
Coef of Var:	----------	5.87	6.65	17.58	9.63	3.97	9.99	40.22

ANDCO FABRIC AND FIBERS COMPANY
RESEARCH AND DEVELOPMENT CENTER
PHYSICAL TESTING LABORATORY

WIDE WIDTH W LOAD @ 2%, 5%, 10%, 15%, AND 20%
INSTRON MODEL 4505 - TEST METHOD 41
Proprietary - To Be Maintained In Confidence

Test type: Tensile

Operator name: JCR

Sample Identification: 952225W
Interface Type: 4500 Series
Machine Parameters of test:
Sample Rate (pts/sec): 25.00
Crosshead Speed (in/min): .400

Instron Corporation
Series IX Automated Materials Testing System 1.04
Test Date: 15 Aug 1995

Sample Type: ASTM

Humidity (%): 50
Temperature (deg. F): 73

STYLE/EPR NUMBER: 2002 -R15
P T LAB NUMBER: 95222000
DIRECTION: WARP
DESCRIPTION: GEORGIA TECH DURABILITY STUDY
COMMENTS:

Dimensions:

	Sample
Width (in)	8.0000
Thickness (in)	.10000
Spec gauge len (in)	4.0000
Grip distance (in)	4.0000

Out of 6 specimens. 0 excluded.

Specimen Number	Sample Weight (osy)	Peak Load (lbs/in)	Strain at Peak Load (%)	Load @ 2% Elongation (lbs/in)	Load @ 5% Elongation (lbs/in)	Load @ 10% Elongation (lbs/in)	Load @ 15% Elongation (lbs/in)	Load @ 20% Elongation (lbs/in)
1	.0000	131.0	17.15	21.300	50.32	92.74	124.4	115.80
2	.0000	122.6	14.55	21.560	50.93	93.98	119.4	82.88
3	.0000	121.6	13.85	32.480	60.90	100.40	119.5	53.94
4	.0000	119.3	16.23	5.209	33.43	79.48	115.6	73.38
5	.0000	132.1	18.32	22.260	50.58	92.04	123.0	128.20
6	.0000	124.0	17.48	14.050	41.80	83.86	115.6	113.50
Mean:	.0000	125.1	16.26	19.470	47.99	90.42	119.6	94.62
Standard Deviation:	.0000	5.2	1.75	9.139	9.36	7.52	3.6	28.91
Mean - 2.00 * Sdv:	.0000	114.6	12.77	1.197	29.28	75.37	112.3	36.80
Mean + 2.00 * Sdv:	.0000	135.6	19.76	37.750	66.71	105.50	126.9	152.40
Cof of Var:	---------	4.18	10.74	46.93	19.50	8.32	3.05	30.55

AMOCO FABRIC AND FIBERS COMPANY
RESEARCH AND DEVELOPMENT CENTER
PHYSICAL TESTING LABORATORY

WIDE WIDTH W LOAD @ 2%, 5%, 10%, 15%, AND 20%
INSTRON MODEL 4505 - TEST METHOD 41
Proprietary - To Be Maintained In Confidence

Test type: Tensile

Instron Corporation
Series IX Automated Materials Testing System 1.04

Operator name: JCR

Test Date: 15 Aug 1995

Sample Identification: 952225F

Sample Type: ASTM

Interface Type: 4500 Series
Machine Parameters of test:
Sample Rate (pts/sec): 25.00
Crosshead Speed (in/min): .400

Humidity (%): 50
Temperature (deg. F): 73

STYLE/EPR NUMBER: 2002 -R15
P T LAB NUMBER: 95222900
DIRECTION: FILL
DESCRIPTION: GEORGIA TECH DURABILITY STUDY
COMMENTS:

Dimensions:

	Sample
Width (in)	8.0000
Thickness (in)	.10000
Spec gauge len (in)	4.0000
Grip distance (in)	4.0000

Out of 6 specimens. 0 excluded.

Specimen Number	Sample Weight (osy)	Peak Load (lbs/in)	Strain at Peak Load (%)	Load @ 2% Elongation (lbs/in)	Load @ 5% Elongation (lbs/in)	Load @ 10% Elongation (lbs/in)	Load @ 15% Elongation (lbs/in)	Load @ 20% Elongation (lbs/in)
1	.0000	176.9	12.43	58.94	101.0	159.4	63.95	31.19
2	.0000	171.1	11.28	63.92	106.6	163.7	48.83	20.99
3	.0000	171.9	11.52	60.01	102.0	160.9	54.79	----------
4	.0000	175.6	12.08	61.90	104.2	163.2	73.21	29.84
5	.0000	176.0	11.93	67.43	109.5	166.2	52.70	10.85
6	.0000	176.1	11.30	67.69	109.3	166.3	59.12	23.58
Mean:	.0000	174.6	11.75	63.32	105.4	163.3	58.77	----------
Standard Deviation:	.0000	2.5	.46	3.70	3.6	2.8	8.80	----------
Mean - 2.00 * Sdv:	.0000	169.7	10.83	55.91	98.2	157.7	41.17	----------
Mean + 2.00 * Sdv:	.0000	179.5	12.66	70.72	112.7	168.8	76.36	----------
Coef of Var:	----------	1.40	3.94	5.85	3.45	1.70	14.97	----------

AMOCO FABRIC AND FIBERS COMPANY
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PHYSICAL TESTING LABORATORY

WIDE WIDTH W LOAD @ 2%, 5%, 10%, 15%, AND 20%
INSTRON MODEL 4505 - TEST METHOD 41
Proprietary - To Be Maintained In Confidence

Test type: Tensile

Instron Corporation
Series IX Automated Materials Testing System 1.04

Operator name: JCR

Test Date: 17 Aug 1995

Sample Identification: 9522277W

Sample Type: ASTM

Interface Type: 4500 Series
Machine Parameters of test:
Sample Rate (pts/sec): 25.00
Crosshead Speed (in/min): .400

Humidity (%): 50
Temperature (deg. F): 73

STYLE/EPR NUMBER: 2006 - R16
P T LAB NUMBER: 95222000
DIRECTION: WARP
DESCRIPTION: GEORGIA TECH DURABILITY STUDY
COMMENTS:

Dimensions:

	Sample
Width (in)	8.0000
Thickness (in)	.10000
Spec gauge len (in)	4.0000
Grip distance (in)	4.0000

Out of 6 specimens, 0 excluded.

Specimen Number	Sample Weight (osy)	Peak Load (lbs/in)	Strain at Peak Load (%)	Load @ 2% Elongation (lbs/in)	Load @ 5% Elongation (lbs/in)	Load @ 10% Elongation (lbs/in)	Load @ 15% Elongation (lbs/in)	Load @ 20% Elongation (lbs/in)
1	.0000	194.4	19.53	7.125	37.60	106.2	165.6	188.20
2	.0000	183.4	15.58	16.670	58.69	128.3	180.4	93.13
3	.0000	185.5	17.30	13.690	51.42	120.5	174.8	78.60
4	.0000	157.4	15.65	12.470	47.78	111.8	154.0	64.88
5	.0000	174.0	18.05	10.900	42.27	106.4	158.1	57.74
6	.0000	195.2	19.98	11.180	44.91	109.2	162.5	195.20
Mean:	.0000	181.6	17.68	12.010	47.11	113.7	165.9	113.00
Standard Deviation:	.0000	14.2	1.87	3.180	7.37	8.9	10.0	62.23
Mean - 2.00 * Sdv:	.0000	153.2	13.94	5.647	32.36	96.0	145.8	-11.50
Mean + 2.00 * Sdv:	.0000	210.1	21.42	18.370	61.86	131.4	186.0	237.40
Cof of Var:	----------	7.83	10.58	26.49	15.65	7.79	6.05	55.09

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RESEARCH AND DEVELOPMENT CENTER
PHYSICAL TESTING LABORATORY

WIDE WIDTH W LOAD @ 2%, 5%, 10%, 15%, AND 20%
INSTRON MODEL 4505 - TEST METHOD 41
Proprietary - To Be Maintained In Confidence

Test type: Tensile

Instron Corporation
Series IX Automated Materials Testing System 1.34

Operator name: JCR

Test Date: 17 Aug 1995

Sample Identification: 952227F

Sample Type: ASTM

Interface Type: 4500 Series
Machine Parameters of test:
Sample Rate (pts/sec): 25.00
Crosshead Speed (in/min): .400

Humidity (%): 50
Temperature (deg. F): 73

STYLE/EPR NUMBER: 2006 - R16
P T LAB NUMBER: 95222000
DIRECTION: FILL
DESCRIPTION: GEORGIA TECH DURABILITY STUDY
COMMENTS:

Dimensions:

	Sample
Width (in)	8.0000
Thickness (in)	.10000
Spec gauge len (in)	4.0000
Grip distance (in)	4.0000

Out of 6 specimens, 0 excluded.

Specimen Number	Sample Weight (osy)	Peak Load (lbs/in)	Strain at Peak Load (%)	Load @ 2% Elongation (lbs/in)	Load @ 5% Elongation (lbs/in)	Load @ 10% Elongation (lbs/in)	Load @ 15% Elongation (lbs/in)	Load @ 20% Elongation (lbs/in)
1	.0000	222.9	20.73	3.690	3.690	39.58	137.20	215.10
2	.0000	249.0	14.02	44.090	107.300	200.00	110.80	66.74
3	.0000	212.4	11.47	46.420	108.800	195.60	95.64	69.01
4	.0000	239.5	11.45	84.160	143.600	226.30	64.29	----------
5	.0000	227.1	11.13	75.470	135.400	218.00	84.14	----------
6	.0000	228.2	12.65	39.860	103.600	194.30	108.80	56.78
Mean:	.0000	229.9	13.58	48.950	100.400	179.00	100.20	----------
Standard Deviation:	.0000	12.8	3.66	28.650	50.140	69.50	24.99	----------
Mean - 2.00 * Sdv:	.0000	204.2	6.25	-8.350	.115	39.98	50.17	----------
Mean + 2.00 * Sdv:	.0000	255.5	20.90	******	200.700	318.00	150.10	----------
Cof of Var:	----------	5.58	26.99	58.53	49.94	38.83	24.96	----------

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PHYSICAL TESTING LABORATORY

WIDE WIDTH W LOAD @ 2%, 5%, 10%, 15%, AND 20%
INSTRON MODEL 4505 - TEST METHOD 41
Proprietary - To Be Maintained In Confidence

Test type: Tensile

Operator name: JCA

Sample Identification: 952228W
Interface Type: 4500 Series
Machine Parameters of test:
Sample Rate (pts/sec): 25.00
Crosshead Speed (in/min): .400

Instron Corporation
Series IX Automated Materials Testing System 1.04
Test Date: 17 Aug 1995

Sample Type: ASTM

Humidity (%): 50
Temperature (deg. F): 73

STYLE/EPR NUMBER: 2006 - R17
P T LAB NUMBER: 95222000
DIRECTION: WARP
DESCRIPTION: GEORGIA TECH DURABILITY STUDY
COMMENTS:

Dimensions:

	Sample
Width (in)	8.0000
Thickness (in)	.10000
Spec gauge len (in)	4.0000
Grip distance (in)	4.0000

Out of 6 specimens. 0 excluded.

Specimen Number	Sample Weight (osy)	Peak Load (lbs/in)	Strain at Peak Load (%)	Load @ 2% Elongation (lbs/in)	Load @ 5% Elongation (lbs/in)	Load @ 10% Elongation (lbs/in)	Load @ 15% Elongation (lbs/in)	Load @ 20% Elongation (lbs/in)
1	.0000	192.5	19.70	14.53	51.19	116.0	168.2	186.50
2	.0000	183.2	18.03	15.57	52.48	116.9	167.4	167.60
3	.0000	168.9	18.17	10.04	41.43	105.5	154.3	85.20
4	.0000	163.9	16.65	15.58	51.42	114.5	157.8	47.09
5	.0000	165.5	17.76	16.31	55.34	119.4	160.5	78.86
6	.0000	169.7	16.38	17.57	56.00	118.3	162.8	75.16
Mean:	.0000	174.0	17.78	14.93	51.31	115.1	161.8	106.70
Standard Deviation:	.0000	11.4	1.20	2.60	5.24	5.0	5.4	56.31
Mean - 2.00 * Sdv:	.0000	151.2	15.39	9.74	40.83	105.1	151.0	-5.90
Mean + 2.00 * Sdv:	.0000	196.7	20.18	20.13	61.79	125.1	172.7	219.40
Cof of Var:	----------	6.54	6.73	17.40	10.21	4.34	3.36	52.76

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PHYSICAL TESTING LABORATORY

WIDE WIDTH W LOAD @ 2%, 5%, 10%, 15%, AND 20%
INSTRON MODEL 4505 - TEST METHOD 41
Proprietary - To Be Maintained In Confidence

Test type: Tensile

Instron Corporation
Series IX Automated Materials Testing System 1.34

Operator name: JCK

Test Date: 17 Aug 1995

Sample Identification: 952228F

Sample Type: ASTM

Interface Type: 4500 Series
Machine Parameters of test:
Sample Rate (pts/sec): 25.00
Crosshead Speed (in/min): .400

Humidity (%): 50
Temperature (deg. F): 73

STYLE/EPR NUMBER: 2006 - R17
P T LAB NUMBER: 95222000
DIRECTION: FILL
DESCRIPTION: GEORGIA TECH DURABILITY STUDY
COMMENTS:

Dimensions:

	Sample
Width (in)	8.0000
Thickness (in)	.10000
Spec gauge len (in)	4.0000
Grip distance (in)	4.0000

Out of 6 specimens, 0 excluded.

Specimen Number	Sample Weight (osy)	Peak Load (lbs/in)	Strain at Peak Load (%)	Load @ 2% Elongation (lbs/in)	Load @ 5% Elongation (lbs/in)	Load @ 10% Elongation (lbs/in)	Load @ 15% Elongation (lbs/in)	Load @ 20% Elongation (lbs/in)
1	.0000	238.2	13.40	56.16	115.6	203.6	72.61	50.09
2	.0000	226.1	11.83	53.06	114.5	205.0	86.25	47.28
3	.0000	238.5	12.60	67.12	127.0	213.6	82.96	40.20
4	.0000	223.1	12.33	47.00	112.2	200.6	87.75	29.61
5	.0000	211.4	12.15	38.00	101.8	190.3	118.50	31.61
6	.0000	226.6	13.05	40.83	105.0	196.6	120.70	71.11
Mean:	.0000	227.3	12.56	50.69	112.7	201.6	94.64	44.98
Standard Deviation:	.0000	10.2	.58	10.68	8.5	7.9	20.05	15.18
Mean - 2.00 * Sdv:	.0000	207.0	11.39	29.41	94.5	185.8	54.55	14.63
Mean + 2.00 * Sdv:	.0000	247.7	13.73	71.98	130.4	217.4	134.70	75.34
Coef of Var:	----------	4.48	4.66	21.06	7.87	3.92	21.18	33.7[illegible]

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RESEARCH AND DEVELOPMENT CENTER
PHYSICAL TESTING LABORATORY

WIDE WIDTH W LOAD @ 2%, 5%, 10%, 15%, AND 20%
INSTRON MODEL 4505 - TEST METHOD 41
Proprietary - To Be Maintained In Confidence

Test type: Tensile

Instron Corporation
Series IX Automated Materials Testing System 1.34

Operator name: JCR

Test Date: 16 Aug 1995

Sample Identification: 952221W

Sample Type: ASTM

Interface Type: 4500 Series
Machine Parameters of test:
Sample Rate (pts/sec): 25.00
Crosshead Speed (in/min): .400

Humidity (%): 50
Temperature (deg. F): 73

STYLE/EPR NUMBER: 2006 - K1
P T LAB NUMBER: 95222000
DIRECTION: WARP
DESCRIPTION: GEORGIA TECH DURABILITY STUDY
COMMENTS:

Dimensions:

	Sample
Width (in)	8.0000
Thickness (in)	.10000
Spec gauge len (in)	4.0000
Grip distance (in)	4.0000

Out of 6 specimens, 0 excluded.

Specimen Number	Sample Weight (osy)	Peak Load (lbs/in)	Strain at Peak Load (%)	Load @ 2% Elongation (lbs/in)	Load @ 5% Elongation (lbs/in)	Load @ 10% Elongation (lbs/in)	Load @ 15% Elongation (lbs/in)	Load @ 20% Elongation (lbs/in)
1	.0000	163.9	16.50	16.46	54.34	119.3	160.5	69.24
2	.0000	155.1	15.83	11.53	46.22	109.7	150.3	104.00
3	.0000	152.4	17.85	13.63	48.18	106.1	146.5	137.80
4	.0000	146.0	13.75	25.12	65.54	121.6	142.7	69.51
5	.0000	154.2	16.00	14.84	50.81	113.6	151.3	73.30
6	.0000	150.4	15.30	16.58	52.85	112.4	148.5	87.81
Mean:	.0000	153.7	15.87	16.36	52.99	114.1	150.0	90.28
Standard Deviation:	.0000	6.0	1.35	4.69	6.83	5.3	6.0	26.88
Mean - 2.00 * Sdv:	.0000	141.7	13.16	6.99	39.34	103.5	138.0	36.51
Mean + 2.00 * Sdv:	.0000	165.6	18.58	25.73	66.65	124.8	161.9	144.00
Coef of Var:	----------	3.88	8.53	28.65	12.88	4.68	3.99	29.78

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PHYSICAL TESTING LABORATORY

WIDE WIDTH W LOAD @ 2%, 5%, 10%, 15%, AND 20%
INSTRON MODEL 4505 - TEST METHOD 41
Proprietary - To Be Maintained In Confidence

Test type: Tensile

Instron Corporation
Series IX Automated Materials Testing System 1.04

Operator name: JCR

Test Date: 16 Aug 1995

Sample Identification: 952221F

Sample Type: ASTM

Interface Type: 4500 Series
Machine Parameters of test:
Sample Rate (pts/sec): 25.00
Crosshead Speed (in/min): .400

Humidity (%): 50
Temperature (deg. F): 73

STYLE/EPR NUMBER: 2006 - K1
P T LAB NUMBER: 95222000
DIRECTION: FILL
DESCRIPTION: GEORGIA TECH DURABILITY STUDY
COMMENTS:

Dimensions:

	Sample
Width (in)	8.0000
Thickness (in)	.10000
Spec gauge len (in)	4.0000
Grip distance (in)	4.0000

Out of 6 specimens, 0 excluded.

Specimen Number	Sample Weight (osy)	Peak Load (lbs/in)	Strain at Peak Load (%)	Load @ 2% Elongation (lbs/in)	Load @ 5% Elongation (lbs/in)	Load @ 10% Elongation (lbs/in)	Load @ 15% Elongation (lbs/in)	Load @ 20% Elongation (lbs/in)
1	.0000	182.7	10.280	34.86	96.46	179.8	104.50	----------
2	.0000	170.6	10.500	28.13	85.77	164.8	112.40	61.13
3	.0000	186.0	10.280	59.41	117.40	185.1	92.83	46.61
4	.0000	160.6	10.180	37.42	94.75	160.0	98.82	36.38
5	.0000	181.2	9.625	72.43	125.80	179.8	65.78	17.39
6	.0000	174.5	11.180	43.53	100.90	166.1	86.23	30.08
Mean:	.0000	176.0	10.340	45.97	103.50	172.6	93.44	----------
Standard Deviation:	.0000	9.4	.584	16.74	15.07	10.2	16.31	----------
Mean - 2.00 * Sdv:	.0000	157.2	9.330	12.48	73.37	152.1	60.82	----------
Mean + 2.00 * Sdv:	.0000	194.7	11.350	79.45	133.70	193.1	126.00	----------
Coef of Var:	----------	5.34	4.57	36.43	14.56	5.93	17.45	----------

AMOCO FABRIC AND FIBERS COMPANY
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PHYSICAL TESTING LABORATORY

WIDE WIDTH W LOAD @ 2%, 5%, 10%, 15%, AND 20%
INSTRON MODEL 4505 - TEST METHOD 41
Proprietary - To Be Maintained In Confidence

Test type: Tensile

Instron Corporation
Series IX Automated Materials Testing System 1.34

Operator name: JCR

Test Date: 17 Aug 1995

Sample Identification: 952222W

Sample Type: ASTM

Interface Type: 4500 Series
Machine Parameters of test:
Sample Rate (pts/sec): 25.00
Crosshead Speed (in/min): .400

Humidity (%): 50
Temperature (deg. F): 73

STYLE/EPR NUMBER: 2044 - K2
P T LAB NUMBER: 95222000
DIRECTION: WARP
DESCRIPTION: GEORGIA TECH DURABILITY STUDY
COMMENTS:

Dimensions:

	Sample
Width (in)	8.0000
Thickness (in)	.10000
Spec gauge len (in)	4.0000
Grip distance (in)	4.0000

Out of 8 specimens. 0 excluded.

Specimen Number	Sample Weight (osy)	Peak Load (lbs/in)	Strain at Peak Load (%)	Load @ 2% Elongation (lbs/in)	Load @ 5% Elongation (lbs/in)	Load @ 10% Elongation (lbs/in)	Load @ 15% Elongation (lbs/in)	Load @ 20% Elongation (lbs/in)
1	.0000	391.4	19.95	23.930	84.61	209.1	318.2	390.5
2	.0000	336.0	20.68	5.236	22.04	125.2	245.4	332.3
3	.0000	430.5	24.53	5.513	39.87	152.0	267.1	363.7
4	.0000	410.0	23.75	5.166	38.43	150.6	269.1	365.7
5	.0000	391.4	23.05	5.456	46.09	160.1	276.2	364.8
6	.0000	395.5	21.22	15.010	63.28	180.9	294.5	383.3
7	.0000	389.7	21.17	13.120	60.26	178.8	294.2	379.5
8	.0000	378.4	20.70	12.980	59.50	177.5	291.2	368.3
Mean:	.0000	390.4	21.88	10.800	51.76	166.8	282.0	368.5
Standard Deviation:	.0000	27.1	1.66	6.755	19.19	25.4	22.3	17.6
Mean - 2.00 * Sdv:	.0000	336.2	18.56	-2.710	13.37	116.0	237.5	333.2
Mean + 2.00 * Sdv:	.0000	444.5	25.21	24.310	90.15	217.5	326.5	403.8

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PHYSICAL TESTING LABORATORY

WIDE WIDTH W LOAD @ 2%, 5%, 10%, 15%, AND 20%
INSTRON MODEL 4505 - TEST METHOD 41
Proprietary - To Be Maintained In Confidence

Test type: Tensile

Instron Corporation
Series IX Automated Materials Testing System 1.04

Operator name: JCR

Test Date: 17 Aug 1995

Sample Identification: 952222F

Sample Type: ASTM

Interface Type: 4500 Series
Machine Parameters of test:
Sample Rate (pts/sec): 25.00
Crosshead Speed (in/min): .400

Humidity (%): 50
Temperature (deg. F): 73

STYLE/EPR NUMBER: 2044 - K2
P T LAB NUMBER: 95222000
DIRECTION: FILL
DESCRIPTION: GEORGIA TECH DURABILITY STUDY
COMMENTS:

Dimensions:

	Sample
Width (in)	8.0000
Thickness (in)	.10000
Spec gauge len (in)	4.0000
Grip distance (in)	4.0000

Out of 8 specimens. 0 excluded.

Specimen Number	Sample Weight (osy)	Peak Load (lbs/in)	Strain at Peak Load (%)	Load @ 2% Elongation (lbs/in)	Load @ 5% Elongation (lbs/in)	Load @ 10% Elongation (lbs/in)	Load @ 15% Elongation (lbs/in)	Load @ 20% Elongation (lbs/in)
1	.0000	394.2	17.23	23.49	99.35	247.2	363.5	247.5
2	.0000	420.9	18.85	28.40	114.00	258.1	372.2	193.1
3	.0000	433.7	17.65	49.58	150.50	295.5	407.5	212.6
4	.0000	388.0	14.95	71.28	169.30	305.7	387.5	203.0
5	.0000	454.0	17.46	79.04	178.40	320.2	429.2	165.6
6	.0000	437.0	16.85	81.35	178.90	318.5	420.1	158.7
7	.0000	353.4	16.25	25.05	95.37	242.6	341.9	207.7
8	.0000	373.5	16.28	35.56	120.20	262.4	363.5	251.6
Mean:	.0000	406.8	16.94	49.22	138.30	281.3	385.7	205.0
Standard Deviation:	.0000	34.9	1.16	24.71	35.13	32.2	30.8	33.6
Mean - 2.00 * Sdv:	.0000	337.0	14.62	-.21	67.99	216.9	324.0	137.8
Mean + 2.00 * Sdv:	.0000	476.7	19.26	98.64	208.50	345.6	447.3	272.1
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	25.41	[illegible]	[illegible]	[illegible]

ABDCO FABRICS AND FIBERS COMPANY
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PHYSICAL TESTING LABORATORY

Grab Tensile Test - Strength Not Normalized
ASTM Method D4632

Test type: Tensile

Instron Corporation
Series IX Automated Materials Testing System 1.34

Operator name: JCR

Test Date: 21 Aug 1995

Sample Identification: 9522263W

Sample Type: ASTM

Interface Type: 4500 Series
Machine Parameters of test:
Sample Rate (pts/sec): 25.00
Crosshead Speed (in/min): 12.000

Humidity (%): 55
Temperature (deg. F): 75

P.T. LAB #: 95222000
SAMPLE ID: STYLE 2902, SAMPLE R1I
DESCRIPTION: GEORGIA TECH DURABILITY STUDY
TEST DIRECTION: WARP
COMMENTS: GRAB TENSILE TEST

Dimensions:

	Sample
Width (in)	4.0000
Thickness (in)	.10000
Spec gauge len (in)	3.0000
Grip distance (in)	3.0000

Out of 6 specimens. 0 excluded.

Specimen Number	Actual Weight oz/sq.yd	Ultimate Strength (lbs)	% Elong. at Max.Load (%)
1	.0000	187.9	17.37
2	.0000	187.7	18.07
3	.0000	182.1	17.40
4	.0000	188.2	17.50
5	.0000	173.1	19.17
6	.0000	177.8	18.00
Mean:	.0000	182.8	17.92
Standard Deviation:	.0000	6.3	.68
Cof of Var:	----------	3.45	3.81

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PHYSICAL TESTING LABORATORY

Grab Tensile Test - Strength Not Normalized
ASTM Method D4632

Test type: Tensile

Instron Corporation
Series IX Automated Materials Testing System 1.34

Operator name: JCR

Test Date: 21 Aug 1995

Sample Identification: 95222B3F

Sample Type: ASTM

Interface Type: 4500 Series
Machine Parameters of test:
Sample Rate (pts/sec): 25.00
Crosshead Speed (in/min): 12.000

Humidity (%): 55
Temperature (deg. F): 75

P.T. LAB #: 95222000
SAMPLE ID: STYLE 2002. SAMPLE R1C
DESCRIPTION: GEORGIA TECH DURABILITY STUDY
TEST DIRECTION: FILL
COMMENTS: GRAB TENSILE TEST

Dimensions:

	Sample
Width (in)	4.0000
Thickness (in)	.10000
Spec gauge len (in)	3.0000
Grip distance (in)	3.0000

Out of 6 specimens, 0 excluded.

Specimen Number	Actual Weight oz/sq.yd	Ultimate Strength (lbs)	% Elong. at Max.Load (%)
1	.0000	221.2	13.83
2	.0000	213.2	14.23
3	.0000	160.8	11.97
4	.0000	188.0	13.37
5	.0000	212.3	13.77
6	.0000	207.2	14.07
Mean:	.0000	200.5	13.54
Standard Deviation:	.0000	22.4	.82
Cof of Var:	----------	11.19	6.09

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Grab Tensile Test - Strength Not Normalized
ASTM Method D4632

Test type: Tensile

Instron Corporation
Series IX Automated Materials Testing System 1.34

Operator name: JCR

Test Date: 21 Aug 1995

Sample Identification: 95222G4W

Sample Type: ASTM

Interface Type: 4500 Series
Machine Parameters of test:
Sample Rate (pts/sec): 25.00
Crosshead Speed (in/min): 12.000

Humidity (%): 55
Temperature (deg. F): 75

P.T. LAB #: 95222000
SAMPLE ID: STYLE 2002. SAMPLE E14
DESCRIPTION: GEORGIA TECH DURABILITY STUDY
TEST DIRECTION: WARP
COMMENTS: GRAB TENSILE TEST

Dimensions:

	Sample
Width (in)	4.0000
Thickness (in)	.10000
Spec gauge len (in)	3.0000
Grip distance (in)	3.0000

Out of 7 specimens. 1 excluded.

Specimen Number	Actual Weight oz/sq.yd	Ultimate Strength (lbs)	% Elong. at Max.Load (%)
1	.0000	175.5000	16.600
2	.0000	171.6000	18.030
3	.0000	188.7000	17.630
4	.0000	168.3000	15.400
5	.0000	167.4000	17.470
6	.0000	169.3000	17.330
Excluded	.0000	.2790	6.800
Mean:	.0000	173.5000	17.080
Standard Deviation:	.0000	8.0060	.947
Coef of Var:	----------	4.62	5.54

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PHYSICAL TESTING LABORATORY

Grab Tensile Test - Strength Not Normalized
ASTM Method D4632

Test type: Tensile

Instron Corporation
Series IX Automated Materials Testing System 1.04

Operator name: JCR

Test Date: 21 Aug 1995

Sample Identification: 95222B4F

Sample Type: ASTM

Interface Type: 4500 Series
Machine Parameters of test:
Sample Rate (pts/sec): 25.00
Crosshead Speed (in/min): 12.000

Humidity (%): 55
Temperature (deg. F): 75

P.T. LAB #: 95222000
SAMPLE ID: STYLE 2002, SAMPLE R14
DESCRIPTION: GEORGIA TECH DURABILITY STUDY
TEST DIRECTION: FILL
COMMENTS: GRAB TENSILE TEST

Dimensions:

	Sample
Width (in)	4.0000
Thickness (in)	.10000
Spec gauge len (in)	3.0000
Grip distance (in)	3.0000

Out of 6 specimens. 0 excluded.

Specimen Number	Actual Weight oz/sq.yd	Ultimate Strength (lbs)	% Elong. at Max.Load (%)
1	.0000	222.3	14.43
2	.0000	164.4	11.80
3	.0000	195.9	13.40
4	.0000	173.1	12.16
5	.0000	183.4	11.93
6	.0000	185.3	12.83
Mean:	.0000	187.4	12.75
Standard Deviation:	.0000	20.2	1.03
Cof of Var:	----------	10.79	8.04

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Grab Tensile Test - Strength Not Normalized
ASTM Method D4632

Test type: Tensile

Instron Corporation
Series IX Automated Materials Testing System 1.04

Operator name: JCR

Test Date: 21 Aug 1995

Sample Identification: 95222B6W

Sample Type: ASTM

Interface Type: 4500 Series
Machine Parameters of test:
Sample Rate (pts/sec): 25.00
Crosshead Speed (in/min): 12.000

Humidity (%): 55
Temperature (deg. F): 75

P.T. LAB #: 95222000
SAMPLE ID: STYLE 2002, SAMPLE R15 (RE-TEST)
DESCRIPTION: GEORGIA TECH DURABILITY STUDY
TEST DIRECTION: WARP
COMMENTS: GRAB TENSILE TEST

Dimensions:

	Sample
Width (in)	4.0000
Thickness (in)	.10000
Spec gauge len (in)	3.0000
Grip distance (in)	3.0000

Out of 6 specimens. 0 excluded.

Specimen Number	Actual Weight oz/sq.yd	Ultimate Strength (lbs)	% Elong. at Max.Load (%)
1	.0000	189.3	18.27
2	.0000	155.6	15.97
3	.0000	183.5	20.00
4	.0000	185.1	17.70
5	.0000	214.1	19.23
6	.0000	199.4	18.63
Mean:	.0000	187.8	18.30
Standard Deviation:	.0000	19.4	1.39
Cof of Var:	----------	10.35	7.60

AMOCO FABRICS AND FIBERS COMPANY
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PHYSICAL TESTING LABORATORY

Grab Tensile Test - Strength Not Normalized
ASTM Method D4632

Test type: Tensile

Operator name: JCR

Sample Identification: 95222G6F
Interface Type: 4500 Series
Machine Parameters of test:
Sample Rate (pts/sec): 25.00
Crosshead Speed (in/min): 12.000

Instron Corporation
Series IX Automated Materials Testing System 1.34
Test Date: 21 Aug 1995

Sample Type: ASTM

Humidity (%): 55
Temperature (deg. F): 75

P.T. LAB #: 95222000
SAMPLE ID: STYLE 2002, SAMPLE R15 (RE-TEST)
DESCRIPTION: GEORGIA TECH DURABILITY STUDY
TEST DIRECTION: FILL
COMMENTS: GRAB TENSILE TEST

Dimensions:

	Sample
Width (in)	4.0000
Thickness (in)	.10000
Spec gauge len (in)	3.0000
Grip distance (in)	3.0000

Out of 6 specimens, 0 excluded.

Specimen Number	Actual Weight oz/sq.yd	Ultimate Strength (lbs)	% Elong. at Max.Load (%)
1	.0000	213.1	13.20
2	.0000	197.3	13.00
3	.0000	214.4	13.00
4	.0000	204.1	13.30
5	.0000	219.1	13.27
6	.0000	219.0	13.33
Mean:	.0000	211.2	13.22
Standard Deviation:	.0000	8.7	.20
Cof of Var:	----------	4.13	1.48

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PHYSICAL TESTING LABORATORY

Grab Tensile Test - Strength Not Normalized
ASTM Method D4632

Test type: Tensile

Instron Corporation
Series IX Automated Materials Testing System 1.34

Operator Name: JCR

Test Date: 21 Aug 1995

Sample Identification: 95222650

Sample Type: ASTM

Interface Type: 4500 Series
Machine Parameters of test:
Sample Rate (pts/sec): 25.00
Crosshead Speed (in/min): 12.000

Humidity (%): 55
Temperature (deg. F): 75

P.T. LAB #: 95222000
SAMPLE ID: STYLE 3002, SAMPLE R15
DESCRIPTION: GEORGIA TECH DURABILITY STUDY
TEST DIRECTION: WARP
COMMENTS: GRAB TENSILE TEST

Dimensions:

	Sample
Width (in)	4.0000
Thickness (in)	.10000
Spec gauge len (in)	3.0000
Grip distance (in)	3.0000

Out of 6 specimens, 0 excluded.

Specimen Number	Actual Weight oz/sq.yd	Ultimate Strength (lbs)	% Elong. at Max.Load (%)
1	.0000	195.4	20.60
2	.0000	222.0	14.50
3	.0000	208.5	19.87
4	.0000	199.9	18.40
5	.0000	213.4	21.17
6	.0000	200.4	19.60
Mean:	.0000	206.6	19.92
Standard Deviation:	.0000	10.0	2.41
Cof of Var:	----------	4.82	12.09

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Grab Tensile Test - Strength Not Normalized
ASTM Method D4632

Test type: Tensile

Operator name: JCR

Sample Identification: 95222B5F
Interface Type: 4500 Series
Machine Parameters of test:
Sample Rate (pts/sec): 25.00
Crosshead Speed (in/min): 12.000

Instron Corporation
Series IX Automated Materials Testing System 1.04
Test Date: 21 Aug 1995

Sample Type: ASTM

Humidity (%): 55
Temperature (deg. F): 75

P.T. LAB #: 95222000
SAMPLE ID: STYLE 2002. SAMPLE R15
DESCRIPTION: GEORGIA TECH DURABILITY STUDY
TEST DIRECTION: FILL
COMMENTS: GRAB TENSILE TEST

Dimensions:

	Sample
Width (in)	4.0000
Thickness (in)	.10000
Spec gauge len (in)	3.0000
Grip distance (in)	3.0000

Out of 6 specimens. 0 excluded.

Specimen Number	Actual Weight oz/sq.yd	Ultimate Strength (lbs)	% Elong. at Max.Load (%)
1	.0000	230.9	14.10
2	.0000	209.9	12.97
3	.0000	212.2	13.13
4	.0000	217.2	13.30
5	.0000	231.4	14.03
6	.0000	220.6	13.47
Mean:	.0000	220.4	13.50
Standard Deviation:	.0000	9.2	.47
Cof of Var:	----------	4.15	3.48

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Grab Tensile Test - Strength Not Normalized
ASTM Method D4632

Test type: Tensile

Instron Corporation
Series IX Automated Materials Testing System 1.04

Operator name: JCR

Test Date: 21 Aug 1995

Sample Identification: 9522267W

Sample Type: ASTM

Interface Type: 4500 Series
Machine Parameters of test:
Sample Rate (pts/sec): 25.00
Crosshead Speed (in/min): 12.000

Humidity (%): 55
Temperature (deg. F): 75

P.T. LAB #: 95222000
SAMPLE ID: STYLE 2006, SAMPLE #16
DESCRIPTION: GEORGIA TECH DURABILITY STUDY
TEST DIRECTION: WARP
COMMENTS: GRAB TENSILE TEST

Dimensions:

	Sample
Width (in)	4.0000
Thickness (in)	.10000
Spec gauge len (in)	3.0000
Grip distance (in)	3.0000

Out of 6 specimens, 0 excluded.

Specimen Number	Actual Weight oz/sq.yd	Ultimate Strength (lbs)	% Elong. at Max.load (%)
1	.0000	293.2	19.67
2	.0000	275.4	17.97
3	.0000	270.8	17.97
4	.0000	268.2	19.77
5	.0000	234.8	18.97
6	.0000	233.6	19.50
Mean:	.0000	262.7	18.97
Standard Deviation:	.0000	23.7	.83
Cof of Var:	----------	9.03	4.36

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PHYSICAL TESTING LABORATORY

Grab Tensile Test - Strength Not Normalized
ASTM Method D4632

Test type: Tensile

Instron Corporation
Series IX Automated Materials Testing System 1.04

Operator name: JCR

Test Date: 21 Aug 1995

Sample Identification: 95222807F

Sample Type: ASTM

Interface Type: 4500 Series
Machine Parameters of test:
Sample Rate (pts/sec): 25.00
Crosshead Speed (in/min): 12.000

Humidity (%): 55
Temperature (deg. F): 75

P.T. LAB #: 95222000
SAMPLE ID: STYLE 2906. SAMPLE R16
DESCRIPTION: GEORGIA TECH DURABILITY STUDY
TEST DIRECTION: FILL
COMMENTS: GRAB TENSILE TEST

Dimensions:

	Sample
Width (in)	4.0000
Thickness (in)	.10000
Spec gauge len (in)	3.0000
Grip distance (in)	3.0000

Out of 6 specimens. 0 excluded.

Specimen Number	Actual Weight oz/sq.yd	Ultimate Strength (lbs)	% Elong. at Max.Load (%)
1	.0000	311.3	13.13
2	.0000	319.5	13.40
3	.0000	297.8	13.37
4	.0000	340.4	13.67
5	.0000	271.8	12.67
6	.0000	287.8	12.93
Mean:	.0000	304.8	13.13
Standard Deviation:	.0000	24.3	.44
Cof of Var:	--------	7.97	3.39

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PHYSICAL TESTING LABORATORY

Grab Tensile Test - Strength Not Normalized
ASTM Method D4632

Test type: Tensile

Operator name: JCR

Sample Identification: 95222G8W
Interface Type: 4500 Series
Machine Parameters of test:
Sample Rate (pts/sec): 25.00
Crosshead Speed (in/min): 12.000

Instron Corporation
Series IX Automated Materials Testing System 1.04
Test Date: 21 Aug 1995

Sample Type: ASTM

Humidity (%): 55
Temperature (deg. F): 75

P.T. LAB #: 95222000
SAMPLE ID: STYLE 2006. SAMPLE 217
DESCRIPTION: GEORGIA TECH DURABILITY STUDY
TEST DIRECTION: WARP
COMMENTS: GRAB TENSILE TEST

Dimensions:

	Sample
Width (in)	4.0000
Thickness (in)	.10000
Spec gauge len (in)	3.0000
Grip distance (in)	3.0000

Out of 6 specimens. 0 excluded.

Specimen Number	Actual Weight oz/sq.yd	Ultimate Strength (lbs)	% Elong. at Max.Load (%)
1	.0000	264.1	21.55
2	.0000	289.1	22.27
3	.0000	311.3	22.13
4	.0000	286.9	20.50
5	.0000	321.6	21.70
6	.0000	238.7	17.20
Mean:	.0000	285.3	20.89
Standard Deviation:	.0000	30.4	1.91
Cof of Var:	----------	10.67	9.15

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PHYSICAL TESTING LABORATORY

Grab Tensile Test - Strength Not Normalized
ASTM Method D4632

Test type: Tensile

Instron Corporation
Series IX Automated Materials Testing System 1.34

Operator name: JCR

Test Date: 21 Aug 1995

Sample Identification: 95222868F

Sample Type: ASTM

Interface Type: 4500 Series
Machine Parameters of test:
Sample Rate (pts/sec): 25.00
Crosshead Speed (in/min): 12.000

Humidity (%): 55
Temperature (deg. F): 75

P.I. LAB #: 95222000
SAMPLE ID: STYLE 2006. SAMPLE R17
DESCRIPTION: GEORGIA TECH DURABILITY STUDY
TEST DIRECTION: FILL
COMMENTS: GRAB TENSILE TEST

Dimensions:

	Sample
Width (in)	4.0000
Thickness (in)	.10000
Spec gauge len (in)	3.0000
Grip distance (in)	3.0000

Out of 6 specimens, 0 excluded.

Specimen Number	Actual Weight oz/sq.yd	Ultimate Strength (lbs)	% Elong. at Max.Load (%)
1	.0000	295.7	12.47
2	.0000	298.5	12.37
3	.0000	284.6	12.20
4	.0000	284.4	12.63
5	.0000	272.0	12.27
6	.0000	314.5	13.13
Mean:	.0000	291.6	12.51
Standard Deviation:	.0000	14.8	.34
Coef of Var:	----------	5.03	2.73

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PHYSICAL TESTING LABORATORY

Grab Tensile Test - Strength Not Normalized
ASTM Method D4632

Test type: Tensile

Operator name: JCR

Sample Identification: 9522261N

Interface Type: 4500 Series

Machine Parameters of test:

Sample Rate (pts/sec): 25.00

Crosshead Speed (in/min): 12.000

Instron Corporation
Series IX Automated Materials Testing System 1.34
Test Date: 21 Aug 1995

Sample Type: ASTM

Humidity (%): 55

Temperature (deg. F): 75

P.T. LAB #: 95222000
SAMPLE ID: STYLE 2006, SAMPLE #1
DESCRIPTION: GEORGIA TECH DURABILITY STUDY
TEST DIRECTION: WARP
COMMENTS: GRAB TENSILE TEST

Dimensions:

	Sample
Width (in)	4.0000
Thickness (in)	.10000
Spec gauge len (in)	3.0000
Grip distance (in)	3.0000

Out of 6 specimens, 0 excluded.

Specimen Number	Actual Weight oz/sq.yd	Ultimate Strength (lbs)	% Elong. at Max.Load (%)
1	.0000	279.8	20.90
2	.0000	276.0	18.77
3	.0000	227.6	17.17
4	.0000	258.3	20.13
5	.0000	238.9	22.67
6	.0000	203.4	23.77
Mean:	.0000	247.3	20.57
Standard Deviation:	.0000	29.6	2.44
Coef of Var:	----------	11.96	11.86

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Grab Tensile Test - Strength Not Normalized
ASTM Method D4632

Test type: Tensile

Operator name: JCR

Sample Identification: 95222G1F
Interface Type: 4500 Series
Machine Parameters of test:
Sample Rate (pts/sec): 25.00
Crosshead Speed (in/min): 12.000

Instron Corporation
Series IX Automated Materials Testing System 1.04
Test Date: 21 Aug 1995

Sample Type: ASTM

Humidity (%): 55
Temperature (deg. F): 75

P.T. LAB #: 95222000
SAMPLE ID: STYLE 2006, SAMPLE X1
DESCRIPTION: GEORGIA TECH DURABILITY STUDY
TEST DIRECTION: FILL
COMMENTS: GRAB TENSILE TEST

Dimensions:

	Sample
Width (in)	4.0000
Thickness (in)	.10000
Spec gauge len (in)	3.0000
Grip distance (in)	3.0000

Out of 6 specimens. 0 excluded.

Specimen Number	Actual Weight oz/sq.yd	Ultimate Strength (lbs)	% Elong. at Max.Load (%)
1	.0000	285.3	14.87
2	.0000	225.1	13.90
3	.0000	264.0	12.90
4	.0000	252.5	13.97
5	.0000	280.6	13.47
6	.0000	212.5	12.37
Mean:	.0000	253.3	13.58
Standard Deviation:	.0000	29.5	.88
Coef of Var:	----------	11.64	6.47

55