SKAPS INDUSTRIES

WOVEN AND
NONWOVEN DIVISION

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QUALITY CONTROL

PROGRAM OUTLINE

SKAPS Industries
Nonwoven
QUALITY CONTROL PROGRAM OUTLINE

RAW MATERIAL QUALITY CONTROL

All raw materials used in the manufacturing of SKAPS Nonwoven products are certified by the supplier to meet the most stringent production standards in the industry. Each truckload of fiber received by SKAPS Nonwovens is certified by the resin supplier's Quality Control Manager to meet specifications as set by SKAPS Industries. All fiber released to production can be tracked by supplier and individual bale number for up to one year after the fiber is processed.

DEFINITION OF 'LOT'

A Lot is a planned production quantity satisfying all of the following:

- **Manufactured under the same material specification.**
- **Identified as the same style (fabric designation).**
- **When tested, having physical characteristics consistent with published values.**

QUALITY CONTROL CONFORMANCE SAMPLING OF EACH LOT

As a minimum, a number of production units shall be selected at random from each lot in accordance with TABLE 1.

TABLE 1
Number of Units Selected as Lot Samples
Specification Conformance

Number of Units in Lot	Number of Units Selected
1 to 2	1
3 to 8	2
9 to 27	3
28 to 64	4
65 to 125	5
126 to 216	6
217 to 343	7
344 to 512	8
513 to 729	9
730 to 1000	10
1001 or more	11

Note: A production unit is considered to be a shipment roll.

Typically, the first shipment roll from each line will be sampled. It will be necessary to consider the minimum planned production quantity to determine if more frequent sampling and testing is required.

Quality Control Testing of Each Sample:

Each quality control sample shall be sent to the quality control lab before the end of the shift during which the sample was taken. Full identification of the sampled roll will be provided with the sample.

The following tests are performed on each sample:

TEST PROPERTY	TEST METHOD
Weight	ASTM D 5261
Thickness	ASTM D 5199
Grab Tensile	ASTM D 4632
Grab Elongation	ASTM D 4632
Trapezoid Tear Strength	ASTM D 4533
Puncture Resistance	ASTM D 4833
Mullen Burst Strength	ASTM D 3786
Water Flow Rate	ASTM D 4491
Permeability	ASTM D 4491
Permittivity	ASTM D 4491
U.V. Resistance	ASTM D 4355
Apparent Opening Size (AOS)	ASTM D 4751

Quality Control Test Results:

All quality control test results will be maintained by the Quality Control Manager along with the corresponding shipment roll identification.

The Quality Control Manager will make lot testing summaries available upon request detailing the individual test results and aggregate mean, minimum and standard deviations of each test property for the shipment rolls under consideration.

SKAPS NONWOVENS
QUALITY CONTROL PLAN

The Quality Control Department tests nonwoven fabrics at the following frequencies. The tests for these properties are routine with test results reported representing each roll of fabric produced.

MINIMUM TESTING FREQUENCY IN SQUARE YARDS

PROPERTY	UNITS	TEST METHOD	MINIMUM FREQUENCY SQUARE YARDS
Mass/Unit Area	oz/yd	ASTM D 5261	10,000
Thickness	mils	ASTM D 5199	10,000
Grab Tensile Strength	lbs	ASTM D 4632	10,000
Grab Elongation	%	ASTM D 4632	10,000
Trapezoidal Tear Strength	lbs	ASTM D 4533	15,000
Puncture Strength	lbs	ASTM D 4833	15,000
Mullen Burst	psi	ASTM D 3786	15,000
Apparent Opening Size	U.S. Sieve	ASTM D 4751	65,000
Permittivity	sec^{-1}	ASTM D 4491	65,000
Permeability	cm/sec	ASTM D 4491	65,000
Water Flow	gpm/ft^2	ASTM D 4491	65,000

Additional testing is conducted on non-routine properties in the SKAPS Quality Control Lab or at a reputable independent test lab. Examples of non-routine tests include:

PROPERTY	UNITS	TEST METHOD
Abrasion-Sliding Block	% strength retention	ASTM D 4886
Abrasion-Rotary Platform	lbs	ASTM D 3884
U.V. Resistance-Fluorescent Type	% strength retention	ASTM G 53
U.V. Resistance-Xenon Type	% strength retention	ASTM D 4355
Wide Width	lbs/in	ASTM D 4595

SKAPS conforms and adheres to the following additional ASTM Test Methods relating to fabric identification, sampling and specification conformance:

ASTM D 4873 Identification, Storage and Handling of Geotextiles
ASTM D 4354 Sampling of Geosynthetics for Testing
ASTM D 4759 Determining Specification Conformance of Geosynthetics

CIVIL PRODUCTS

Product	GT131	GT135	GT140	GT142	GT160	GT170	GT180	GT110	GT112	GT116
Square Yard	500/600	500/600	500/600	500/600	500	500	500	500	500	250
Testing Frequency, Number of Rolls										
Mass/Unit Area	20/15	20/15	20/15	20/15	20	20	20	20	20	40
Thickness	20/15	20/15	20/15	20/15	20	20	20	20	20	40
Grab Tensile Strength	20/15	20/15	20/15	20/15	20	20	20	20	20	40
Grab Elongation	20/15	20/15	20/15	20/15	20	20	20	20	20	40
Trapezoidal Tear Strength	30/25	30/25	30/25	30/25	30	30	30	30	30	60
Puncture Strength	30/25	30/25	30/25	30/25	30	30	30	30	30	60
Mullen Burst	30/25	30/25	30/25	30/25	30	30	30	30	30	60
AOS	130	130	130	130	130	130	130	130	130	260
Permittivity	130	130	130	130	130	130	130	130	130	260
Permeability	130	130	130	130	130	130	130	130	130	260
Water Flow	130	130	130	130	130	130	130	130	130	260

ENVIRONMENTAL PRODUCTS

Product	GE140	GE160	GE170	GE180	GE110	GE112	GE114	GE116
Square Yard	2250	1500	1300	1150	950	800	650	600
Testing Frequency, Number of Rolls								
Mass/Unit Area	4	6	7	8	10	12	15	16
Thickness	4	6	7	8	10	12	15	16
Grab Tensile Strength	4	6	7	8	10	12	15	16
Grab Elongation	4	6	7	8	10	12	15	16
Trapezoidal Tear Strength	6	10	11	13	15	18	23	25
Puncture Strength	6	10	11	13	15	18	23	25
Mullen Burst	6	10	11	13	15	18	23	25
AOS	28	43	50	56	68	80	100	108
Permittivity	28	43	50	56	68	80	100	108
Permeability	28	43	50	56	68	80	100	108
Water Flow	28	43	50	56	68	80	100	108

ROUTINE CHECKS

The following checks of SKAPS nonwoven fabrics are routine during manufacturing:

1. **Visual inspection – Line Inspector inspects fabric for good selvages, weight verification, correct take-up and needle streaks.**

2. **Metal Detection - Three metal detectors are positioned on the production line to detect needles or other contaminates. If needles are detected, the line automatically shuts down and needles are located and removed.**

Certifications are required on all fiber purchases to control raw material properties. SPC data is required for each shipment.

In SKAPS' SPC system of quality reporting, a request for corrective action is issued resulting from any property failing to meet specification for three sequential occurrences.

This system has been implemented to correct all non-conforming material. It is SKAPS Industries' policy to ship only fabric meeting or exceeding specification. A Quality Report is issued daily summarizing manufacturing production.

SAMPLING FREQUENCY OF WOVEN GEOTEXTILES

The sampling frequency of woven geotextiles exceeds the requirements of ASTM D-4354. ASTM D-4354 requires that the cubed root of the number of rolls in a lot be tested. Following is a table outlining the number of samples to be tested per lot size.

Number of Units in Lot	Number of Units Selected
1 to 2	1
3 to 8	2
9 to 27	3
28 to 64	4
65 to 125	5
126 to 216	6
217 to 343	7

For the purposes of defining a lot to determine sample frequency a truckload quantity will be used. Using style W300 150" X 360', it takes 220 rolls to fill a truck. According to ASTM D-3454, the number of rolls that should be tested is seven.

Product	Rolls/truck	Yds/truck	Yds/beam	Samples/truck	Samples needed
W200 150"X 432'	241	34,704	6,000	10	7
W200 210" X 309'	176	18,128	6,000	6	6
W300 150" X 360'	220	26,400	6,000	8	7
W300 210" X 258'	144	12,384	6,000	6	6
W200 150" X 432'	Sample 1st and 4th master roll off loom for each loom beam				
W200 210" X 309'	Sample 1st and 4th master roll off loom for each loom beam				
W300 150" X 360'	Sample 1st and 4th master roll off loom for each loom beam				
W300 210" X 258'	Sample 1st, 3rd and 5th master roll off loom for each loom beam				

Consider the weave room running style W300 150" X 360' with 6,000 linear yards on yarn on a loom beam. Put-up of master rolls from the loom beam will be approximately 1,000 yards per roll. Six master rolls will be produced from the loom beam. Two samples should be taken from the loom beam. The first sample should be taken from the first master roll off the loom. The second sample should be taken from the fourth master roll doffed from the loom beam.

In the example of using a truckload lot of W300 150" X 360' with 220 rolls on a truck, there will be 26,400 linear yards of fabric in the lot. This translates to approximately 4.4 loom beams of warp yarn per truck for a total of eight samples tested. Since the number of samples tested meets the ASTM method, the requirements of ASTM D-4354 are met.

WOVENS SAMPLING PROCEDURE

W200 150" X 432'	**Sample 1st and 4th master roll off loom for each loom beam**
W200 210" X 309'	**Sample 1st and 4th master roll off loom for each loom beam**
W300 150" X 360'	**Sample 1st and 4th master roll off loom for each loom beam**
W300 210" X 258'	**Sample 1st, 3rd and 5th master roll off loom for each loom beam**

This test frequency exceeds the requirements in ASTM D-4354.

LAB PROCEDURES

Grab Tensile	**ASTM D-4632**
Grab Elongation	**ASTM D-4632**
Trap Tear	**ASTM D-4533**
Burst	**ASTM D-3786**
AOS	**ASTM D-4751**
Permittivity	**ASTM D-4491**
Puncture	**ASTM D-4833**

SKAPS INDUSTRIES

GEOTEXTILE INSTALLATION INSTRUCTIONS

SEWING / INSTALLATION GUIDE

NONWOVEN GEOTEXTILES

SKAPS INDUSTRIES
Nonwoven Division

Installation Procedure
Geotextile Fabrics

I. Geotextile Unloading & Storage:

A. The geotextile shall be labeled, stored, and handled in accordance with ASTM D 4873, "Guide for Identification, Storage and Handling of Geotextiles".

B. Geotextile rolls are to be unloaded under supervision of the geotextile installer using straps or other devices that will prevent damage to the geotextile material.

C. The geotextile shall be kept dry and wrapped in a waterproof wrapping so that it is protected from UV light and the elements during shipping and storage. Torn wrapping shall be repaired as quickly as possible using an approved protective covering.

D. Rolls should be stored on supports that will not damage the material. The material must be elevated at least 2 inches above the sub grade.

E. If any material is found to be damaged during unloading, a notation should be made as to the roll number, location of damage and type. This information should be given to the Project Manager.

II. Material Deployment

A. No material is to be deployed until the Project Inspector has inspected and approved installation of the geotextile.

B. Material will not be deployed when moisture, high winds, or other adverse weather conditions are expected. This determination will be made by the Field Installation Superintendent (FIS).

C. Geotextile materials are to be deployed using methods that will not damage the material. The material will be visually inspected during deployment and any faulty or unsatisfactory areas will be marked for corrective action.

D. If necessary, temporary sand bags may to be used to prevent material uplift and movement from winds during geotextile installation. The number and location of sand bags will be determined by the FIS.

E. All folds and excessive wrinkles are to be removed prior to sewing adjacent panels together.

F. On slopes, the geotextile shall be anchored at the top and unrolled down the slopes.

III. Material Seaming

A. Field seams are to be made by using sewing machines and thread specifically adapted for this purpose.

B. Adjacent panels are to be overlapped a minimum of six inches and sewn together. A sewing crew is to consist of a sewing machine operator and at least one assistant to help align the materials. The machine operator and assistant are to inspect opposite sides of the seam for dropped or incorrect stitches.

C. Seams shall be sewn utilizing one or two rows of stitching. Each row shall consist of 4 to 7 stitches per inch.

D. Damaged areas of geotextile are to be patched with an additional layer of geotextile material. The patch is to overlap the damaged area by a minimum of six inches on each side and is to be heat bonded to the main layer of geotextile.

E. Thread should be of contrasting color to the fabric to facilitate seam inspection.

F. The installer shall ensure that no soil materials are present within seams or overlaps.

IV. Project Documentation

A. The FIS will maintain the following documentation on a daily basis:

1. Log of job activities, including number of personnel, weather conditions, and quantity of geotextile deployed.

2. Listing of material placed, including panel size and location, and a cross reference of panel numbers.

3. Listing of patches and repairs, including location and reason.

B. Upon completion of the project, the following documentation is to be provided to the owner or inspector:

1. Copies of Items 1, 2, and 3 above.

2. Copies of Material Certifications from the Geotextile Manufacturer, *if* required by the project specifications.

THREAD SPECIFICATION

Threads used to sew geotextiles should be:

- **Polyester, Polypropylene, or Nylon**
- **Bonded and Thermally Set**
- **1800 Denier Minimum**

SKAPS Nonwovens recommends the use of BT207 - nylon sewing thread which meets or exceeds all these criteria.

Unless otherwise specified, the thread should be of contrasting color to the fabric to facilitate seam inspections.

Thread weight is typically expressed as "denier" or "tex". Denier is the weight in grams of 9000 linear meters of thread. Tex is the weight in grams of one kilometer of thread.

2000 denier = .222 g/m

230 tex = .230 g/m

For example, one pound of 2000 denier thread contains approximately 6,700 feet (2045 m) of thread.

THREAD CONSUMPTION

Thread consumption is the length of thread required to sew a linear seam, i.e., seven feet of thread is required to sew one foot of seam. Thread consumption rates for the two-thread and single-thread machines are as follows:

Machine	Length Ratio Thread:Stitch
Two-Thread, Double-Locked Stitch	7:1
Single Thread, Chain Stitch	4:1

NEEDLES

Needle size is critical to the efficiency of the sewing operation. Needles should be compatible with machine and sewing thread. Needles are available through sewing machine manufacturer representatives.

SEWING MACHINES

MODELS

Field seaming of geotextiles can be accomplished with the following types of sewing machines:

Single Thread, Chain Stitch
Union Special, American Newlong, or equal
(Federal Class 101)

(Refer to the Federal Standard on stitches, seams and stitching).

SEAMS AND STITCHES

SEAMS

Three seams that will provide optimum strength for geotextile sewing are the Flat (Prayer) seam, the "J" seam, and the Butterfly-folded seam.

When sewing a flat seam, the stitching should be approximately 1.5 inches from the outside edge of the fabric (not in the selvage or at the selvage edge). The "J" fold and Butterfly fold seams require a fold of 1.25 inches to 2 inches from the fabric edge with the stitching approximately 1 inch from the folded edge.

Care should be taken with either seam to assure that the two fabric edges are even during seaming.

Folders can be attached to the sewing machine to fold and guide the edges of the two fabric layers into the sewing head.

STITCHES

Seams should contain between four and seven stitches per inch to assure adequate strength.

SKAPS Nonwovens

HEAT SEAMING
of GE-Series
Nonwoven Geotextiles

HEAT SEAMING INSTALLATION

On geotextiles seven (7) ounces per yard or heavier, fusion seaming with a heat gun may be used. The minimum overlap for this type of welding is four (4) inches. Prior to fusion seaming the geotextile together, the installer must demonstrate to the Field Engineer the ability to perform this type of installation. Areas burned through by fusion welding shall be properly repaired. Care should be taken during installation to prevent damage to the geotextile. Torn or punctured material shall be patched with sufficient overlap to prevent separation.

SKAPS Nonwovens

SEWING PROCEDURE

Fabric layers should be placed on the ground (preferably firm ground) so that the edges to be sewn are parallel and overlapping. This can be accomplished by a variety of placement techniques. The sewing operation typically requires three men; a machine operator and a man on each side of the machine to aid in fabric throughout. The lead man should hold the fabric edges evenly together and feed the fabric into the sewing machine head or folder. The man behind the machine should hold tension on the fabric so the machine operator has a taut and straight edge to sew across. All three men advance at the machine sewing speed.

If the machine misses a stitch or runs off the fabric, terminate the seam by cutting and tying the thread. Begin a new seam approximately one foot behind the broken seam.

CHEMICAL RESISTANCE OF POLYPROPYLENE GEOTEXTILES

SKAPS Industries nonwoven geotextiles are manufactured from polypropylene with ultraviolet stabilizing additives. The excellent chemical resistance of SKAPS Industries polypropylene geotextiles is one of the qualities which has established SKAPS Industries as a leading producer of geotextiles for use in the waste containment industry. This technical note addresses the chemical resistance of polypropylene with a focus on recent testing programs which have clearly demonstrated the durability of SKAPS Nonwovens fabrics in a variety of chemical environments.

Of the polymers used to manufacture geotextiles, polypropylene exhibits the greatest resistance to chemical attack. In fact, polypropylene is the polymer of choice for such commonly used products as synthetic grass for athletic fields, outdoor carpeting, battery cases, bleach bottles, antifreeze jugs, washing machine agitators, and thousands of other commonly used items that are routinely exposed to chemical environments. Polypropylene is stable within a pH range of 2 to 13, making it one of the most stable polymers available for manufacturing geotextiles. Polypropylene geotextiles have been found to be durable in a wide range of chemical environments, (Bell, et. al., 1980; Haxo, 1978, 1983; Pucetas, et. al., 1991; Tisinger, et. al., 1989). Research has found both woven and nonwoven polypropylene geotextiles to be nonbiodegradable and resistant to commonly encountered soil-bound chemicals, landfill leachates, mildew, and insects.

Numerous laboratory test programs have subjected polypropylene to severe chemical environments such as solutions of organic solvents, oils, organic acids and inorganic acids. The laboratory tests are generally performed in accordance with ASTM D 543. "Standard Test Method for Resistance of Plastics to Chemical Reagents". These test programs have found polypropylene to exhibit superb chemical resistance.

In the ASTM D 543 procedure, specimens are immersed in a concentrated chemical solution at a specified temperature for a specified exposure period. This test method exposes the polypropylene to extremely harsh conditions which are considerably more severe than those encountered in most civil engineering applications.

The chemical compatibility of geotextiles with leachates is determined by EPA Test Method 9090 (EPA 9090), "Compatibility Test for Wastes and Membrane Liners". This is the laboratory method used in the geotextile test programs. Geotextile samples are immersed in a constant temperature leachate bath for four months. At the end of each month, samples of the fabric are removed and subjected to physical testing. Changes in properties may indicate chemically imposed degradation.

In all testing programs there was no indication of geotextile degradation due to exposure to landfill leachates. These results demonstrate the excellent chemical resistance of polypropylene geotextiles and their suitability for use in waste containment applications.

HAZARDOUS WASTE LEACHATE

A laboratory testing program was performed to evaluate the chemical compatibility of polypropylene geotextiles with a hazardous waste leachate. The program included EPA 9090 testing of nonwoven specimens. The testing exposed the geotextile to leachate in both the laboratory and in a leachate collection sump at a hazardous waste landfill.

Test evaluation incorporated detailed microstructural analyses which are not typically incorporated into chemical resistance testing programs. Methods included differential scanning calorimetry, thermal gravimetric analysis, and infrared spectro-photometry. These analyses were performed to isolate any changes in the microstructure of the geotextile due to immersion in the leachate.

The results of this testing program found the geotextile microstructure remained intact, stable, and unchanged. These results demonstrate the superior chemical resistance of polypropylene geotextiles in hazardous waste applications.

MUNICIPAL WASTE LEACHATE

The chemical resistance of polypropylene geotextiles to municipal solid waste leachate was evaluated in laboratory testing programs. The testing programs evaluated changes in physical properties of the specimens, including dimension, thickness, grab tensile strength and elongation, puncture resistance, burst strength, and tear strength. In all cases there were no measurable changes in physical properties of the specimens after exposure to leachate.

All SKAPS Nonwovens geotextiles are equally resistant to chemical degradation because all are manufactured using the same polymer and additives. This conclusion is supported by the test results which demonstrated no difference in chemical resistance for different types of SKAPS Nonwovens geotextiles. This technical note is considered to be applicable to all SKAPS Nonwovens geotextiles regardless of weight, thickness, or strength.

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MATERIAL SAFETY DATA SHEET (MSDS)
SKAPS WOVEN/NONWOVEN GEOTEXTILES

Section 1 - Product Identification:

Manufacturer's Name:

SKAPS Industries (Nonwoven Division)
335 Athena Drive
Athens, GA 30601 (U.S.A.)

Emergency Phone: (706) 354-3700
Fax: (706) 354-3737

Date Prepared: June 2, 2006

Section 2 - Hazardous Ingredients:

No hazardous components in geotextile fabrics at or above threshold limit values.

Section 3 - Physical/Chemical Characteristics

Boiling Point:	Not Applicable
Vapor Pressure:	Not Applicable
Specific Gravity:	0.9-0.905
Melting Point:	120-170 Degrees (C)
Vapor Density:	Not Applicable
Evaporation Rate:	Not Applicable
Solubility in Water:	Not Applicable
Appearance and Odor:	Essentially odorless

Section 4 - Fire and Explosion Hazard Data

Flash Point:	> 600 degrees (F)
Extinguishing Media:	Dry Chemical, CO_2, Foam, Water, Halon

Special Fire Fighting Procedure:

- Avoid Inhalation of vapors.
- Use self contained breathing apparatus when fire fighting in confined areas.

Unusual Fire and Explosion Hazards:

- Treat as a solid that can burn. Generally burns slowly with low smoke density and flaming drips. Burns with high smoke density under certain conditions.

Section 5 - Reactivity Data

Material is stable. Hazardous polymerization will not occur.

Section 6 - Health Hazard Data

Primary Routes of Entry:

- Inhalation: Negligible
- Skin Contact: Negligible
- Indigestion: Not Applicable

Carcinogen: Not a carcinogen

Emergency and First Aid Procedure:

- Eye Contact: Flush with Water
- Skin Contact: Treat as thermal burn if contact with molten

Section 7 - Precaution for Handling and Use

Practice reasonable care and caution in handling.

Waste Disposal: Place in appropriate disposal facility in compliance with local regulation.

Storage: In cool, dry locations away from oxidizing materials.

Section 8 - Control Measures

Use NIQSH respirators when hot/molten product.

Protective Gloves: Required when handling molten product.

Practice general hygiene by washing hands and clothes after handling.