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April 11, 2012

THE SPECIALTY GROUP
124-130 Cochranes Rd
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Australia

Attention: Ms. Bernadette Flisak

Reference: File No. TC8575, Project 12CA10619

Subject: Verification Services Test Results On 1055CL Yellow/Silver Fabric

Dear Ms. Flisak:

All testing work associated under File No. TC8575, Project 12CA10619 has been completed. Please see the attached data results.

UL Verification Services did not select the sample(s), determine whether the sample(s) was representative of production samples, witness the production of the test sample(s), nor were we provided with information relative to the formulation or identification of component materials used in the test sample(s). The test results apply only to the actual samples tested.

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Should you have any questions or comments pertaining to the above, please contact the undersigned at our Research Triangle Park office.

Sincerely,

A handwritten signature in black ink, appearing to read 'Stephen Derynck'.

Stephen Derynck
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Reviewed By:

A handwritten signature in black ink, appearing to read 'Joseph M. Waters'.

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GENERAL

Results relate only to the items tested unless otherwise specified.

Tests were conducted per
NFPA 1992, 2012 Edition

SAMPLES:

1055CL Yellow/Silver Fabric

The following tests were conducted:

Chemical Penetration Resistance after flexing and abrasion
Burst Strength
Cold Temperature Performance
Puncture Propagation Tear Resistance

RESULTS:

The fabric complies with the requirements of NFPA 1992-2012

METHOD

Specimens shall be subjected to flexural fatigue in accordance with ASTM F 392, with the following modifications:

- (1) In lieu of Flexing Conditions A, B, C, D, or E, test specimens shall have a flex period of 100 cycles at 45 cycles per minute. A cycle shall be full flex and twisting action.
- (2) Anisotropic materials shall be tested in both machine and transverse directions.

Samples for conditioning shall be 200mm x 280mm rectangles. Samples shall be conditioned by flexing. Following flexing, three samples for abrasion conditioning each measuring 75mm x 230mm shall be cut from the center of the flexed sample. At least one specimen for abrasion conditioning shall be taken from a sample flexed in the cross machine direction for each test chemical.

ABRASION PROCEDURE FOR GARMENT MATERIALS: (NFPA 1992-2012, SECTION 8.1.4)

METHOD

Specimens shall be abraded in accordance with ASTM D 4157, under the following conditions:

- (1) A 2.3 kg (5 lb) tension weight shall be used.
- (2) A 1.6 kg (3.5 lb) head weight shall be used.
- (3) The abradant shall be silicone carbide, ultrafine, 600 grit.
- (4) The specimen shall be abraded for 25 continuous cycles.

After flexing the samples shall be conditioned by abrading. Following abrasion, only one specimen for penetration resistance testing shall be taken from each sample subjected to abrasion. The penetration test specimen shall be taken from the exact center of the abraded sample so that the center of the penetration test and the center of the abraded sample coincide.

CHEMICAL PENETRATION RESISTANCE TEST:

(NFPA 1992-2012, Section 8.4)

CONDITIONING

Samples for conditioning shall be 200 mm x 280 mm rectangles. Samples shall be first conditioned by flexing and then by abrading. Only one specimen for penetration resistance testing shall be taken from each flexed and abraded sample. The penetration test specimen shall be taken from the exact center of the abraded sample so that the center of the penetration test and the center of the abraded sample coincide.

METHOD

Penetration resistance shall be performed in accordance with ASTM F903, Procedure C using the following modifications:

- (a) All tests shall be conducted at 25°C, ± 3°C and 65%, ±5% relative humidity.
- (b) The Plexiglas shield shall be omitted from the test cell.
- (c) Use of blotting paper at the end of the test shall be permitted to assist in the visual observation of liquid penetration. Visual observed chemical on the blotting paper shall constitute failure of the test.
- (d) An observation to determine specimen penetration shall be made at the end of the chemical contact period.

After the specimens are conditioned, each specimen shall be tested against the following liquids, separately:

- (1) Acetone
- (2) Toluene
- (3) Ethyl Acetate
- (4) 50 Percent w/w Sodium Hydroxide
- (5) 93.1 Percent w/w Sulfuric Acid
- (6) Dimethylformamide
- (7) Nitrobenzene

CHEMICAL PENETRATION RESISTANCE TEST (CONT'D): (NFPA 1992-2012, Section 8.4)

The normal outer surface of the material shall be exposed to the liquid as oriented in clothing. The exposure duration is 1 hr., consisting of ambient pressure for 5 minutes, 2 psig for 1 minute and ambient pressure for 54 minutes.

REQUIREMENTS

No penetration of test liquids shall appear for at least one hour. One or more test failures of any specimen against any liquid shall constitute noncompliance of the material.

RESULTS

After Flexing and Abrading

Material: 1055CL Yellow Fabric

Chemical: Acetone

Test Results	Cell 1	Cell 2	Cell 3	
Pass or Fail	PASS	PASS	PASS	Average
Time of Failure	N/A	N/A	N/A	Thickness
Sample Thickness (mm)	0.6	0.6	0.6	0.6

Comments:

Material: 1055CL Yellow Fabric

Chemical: Ethyl Acetate

Test Results	Cell 1	Cell 2	Cell 3	
Pass or Fail	PASS	PASS	PASS	Average
Time of Failure	N/A	N/A	N/A	Thickness
Sample Thickness (mm)	0.6	0.6	0.6	0.6

Comments:

CHEMICAL PENETRATION RESISTANCE TEST (CONT'D): (NFPA 1992-2012, Section 8.4)

RESULTS

After Flexing and Abrading

Material: 1055CL Yellow Fabric

Chemical: 50 Percent W/W Sodium Hydroxide

Test Results	Cell 1	Cell 2	Cell 3	
Pass or Fail	PASS	PASS	PASS	Average
Time of Failure	N/A	N/A	N/A	Thickness
Sample Thickness (mm)	0.6	0.6	0.6	0.6

Comments:

Material: 1055CL Yellow Fabric

Chemical: 93.1 Percent W/W Sulfuric Acid

Test Results	Cell 1	Cell 2	Cell 3	
Pass or Fail	PASS	PASS	PASS	Average
Time of Failure	N/A	N/A	N/A	Thickness
Sample Thickness (mm)	0.6	0.6	0.6	0.6

Comments:

Material: 1055CL Yellow Fabric

Chemical: Toluene

Test Results	Cell 1	Cell 2	Cell 3	
Pass or Fail	PASS	PASS	PASS	Average
Time of Failure	N/A	N/A	N/A	Thickness
Sample Thickness (mm)	0.6	0.6	0.6	0.6

Comments:

CHEMICAL PENETRATION RESISTANCE TEST (CONT'D): (NFPA 1992-2012, Section 8.4)

RESULTS

After Flexing and Abrading

Material: 1055CL Yellow Fabric

Chemical: Dimethylformamide

Test Results	Cell 1	Cell 2	Cell 3	
Pass or Fail	PASS	PASS	PASS	Average
Time of Failure	N/A	N/A	N/A	Thickness
Sample Thickness (mm)	0.6	0.6	0.6	0.6

Comments:

Material: 1055CL Yellow Fabric

Chemical: Nitrobenzene

Test Results	Cell 1	Cell 2	Cell 3	
Pass or Fail	PASS	PASS	PASS	Average
Time of Failure	N/A	N/A	N/A	Thickness
Sample Thickness (mm)	0.6	0.6	0.6	0.6

Comments:

BURST STRENGTH TEST

(NFPA 1992-2012, Section 8.5)

SAMPLES

Ten specimens shall be at least 5 inches (125mm) square, or a circle 5 inches (125mm) in diameter.

METHOD

Ten specimens shall be tested for bursting strength as specified in ASTM D 751.

The tension testing machine shall be equipped with a bursting attachment so that the specimen is held securely by a ring-clamp mechanism that is 44.0 +/- 0.05mm in internal diameter with the center of the specimen pressed against a polished steel ball of 25.00 +/- 0.025mm in diameter. Move the ring clamp at a rate of 5mm/s against the steel ball until rupture occurs. The direction of the motion of the ring clamp shall be at right angles to the initial plane of the specimen.

The burst strength of each specimen shall be reported to the nearest 1 N.

REQUIREMENT

Specimens shall have an average burst strength greater than 134 N (30 lbf).

BURST STRENGTH TEST (CONT'D):

(NFPA 1992-2012, Section 8.5)

RESULTS

Material: 1055CL Yellow Fabric

SPECIMEN NO.	BURST STRENGTH (N)
1	1660.76
2	1598.71
3	1586.40
4	1571.34
5	1549.64
6	1591.44
7	1525.67
8	1615.10
9	1622.84
10	1699.63
AVERAGE	1602.15

OBSERVATIONS

The fabric did have an average burst strength greater than 134 N (30 lbf).

COLD TEMPERATURE PERFORMANCE TEST ONE:

(NFPA 1992-2012, Section 8.7)

METHOD

Five specimens in each of the warp and fill directions shall be tested in accordance with ASTM D 747, Standard Test Method for Bending Modulus of Plastics by Means of a Cantilever Beam, with the following modifications:

- (a) The test temperature shall be -25°C (-13°F).
- (b) The bending moment shall be applied when the specimen is bent to a 60-degree angular deflection and shall be calculated in inch-pounds as follows:

$$\text{Bending Moment} = \frac{\text{Load Scale Reading} \times \text{Moment Weight}}{100}$$

$$\text{Bending Moment (Nm)} = \text{Bending Moment, in-lb} \times 0.113$$

Cold temperature performance results shall be reported as the average for each material in any direction. Failure of the material in any direction shall constitute failing performance.

REQUIREMENT

Specimens shall have an average bending moment of not greater than 0.0057 Nm (0.50 in-lb) at an angular deflection of 60 degrees and -25°C (-13°C)

COLD TEMPERATURE PERFORMANCE TEST ONE (CONT'D): (NFPA 1992-2012, Section 8.7)

RESULTS

Material: 1055CL Yellow Fabric

Sample	Bending Moment (Nm)	
	Warp (Wales)	Fill (Courses)
1	(SR 19-1) 18 =>0.002034	(SR 7-1) 6 =>0.000791
2	(SR 17-1) 16 =>0.001808	(SR 7-1) 6 =>0.000791
3	(SR 19-1) 18 =>0.002034	(SR 7-1) 6 =>0.000791
4	(SR 22-1) 21 =>0.002373	(SR 7-1) 6 =>0.000791
5	(SR 20-1) 19 =>0.002147	(SR 6-1) 5 =>0.000565
Average	18 =>0.002034	6 =>0.000791

OBSERVATIONS

The fabric did not have an average bending moment of greater than 0.057 Nm (0.50 in-lb) at an angular deflection of 60 degrees and -25°C (-13°F).

PUNCTURE PROPAGATION TEAR RESISTANCE TEST: (NFPA 1992-2012, Section 8.6)

SAMPLES

Each garment material shall be tested. If the garment is constructed of several layers, then all layers, assembled in the order in which they appear in the garment, shall be tested as a composite.

Cut 10 specimens measuring 8 by 8 inches and mark the warp (machine) direction on each specimen. Five specimens in each of the warp (machine) and fill (cross machine) directions shall be tested. Multiple cuts can be made on the same specimen if the amount of test material is limited. Each test cut must be at least 1 inch from a previous cut.

CONDITIONING

Specimens for conditioning shall be cut from yardage of material or may be cut from Liquid Splash Protective ensembles. Condition specimens for 24 hrs. at $23 \pm 2^{\circ}\text{C}$ and 65 ± 5 percent relative humidity before testing.

Conduct the test under standard laboratory conditions of $23 \pm 2\text{C}$ and $50 \pm 5\%$ relative humidity.

METHOD

Specimens shall be tested in accordance with ASTM D 2582, Standard Test Method for Puncture Propagation Tear Resistance of Plastic Film and Thin Sheeting.

The puncture propagation tear resistance of each specimen shall be reported to the nearest 0.445 N (0.1 lbf). An average puncture propagation tear resistance shall be calculated for warp and filling directions. Failure of the material in any direction shall constitute failing performance.

Check the probe tip under a magnifying glass for any signs of burrs, nicks or distortions. Also check that the short base end is 0.40 mm in diameter.

Check the probe length by lowering it to the 0 position on the scale. The point of the probe should be just entering the slot in the curved specimen holder. Mark this point on the drop rail.

Measure the vertical drop height from the above mark to the center of the carriage release mechanism. Set the height to $508 \pm 2\text{mm}$.

PUNCTURE PROPAGATION TEAR RESISTANCE TEST
(CONT'D):

(NFPA 1992-2012, Section 8.6)

Check the alignment of the specimen holder receiving slot, up and down the slot length. The probe should be centered, that is, not touching either edge of the slot.

Measure and record the thickness of each specimen tested. Read the thickness to 0.0025 mm or better, except for materials greater than 0.25mm, which shall be measured to a precision of 0.025mm or better.

Secure the specimen in the holder by placing it under the clamps and setting the clamp lever to the down position. The specimen should drape against the holder contour. Stiffer materials should be loosely held adjacent to the holder. Each clamp should apply sufficient pressure to prevent any specimen slippage.

By trial and error select the carriage that produces a minimum tear length of 40mm and does not bottom out against the drop base.

Lower the selected carriage until the probe point touches but does not indent the specimen. Adjust the tear length, indicating rod to "0" on the scale located on the guide channel.

Place the selected carriage in the release mechanism. Cock the release mechanism and release the carriage. Read the tear length to the nearest 0.5mm.

Raise the carriage and reset for another drop. Change or relocate the test specimen. Conduct more drops until five determinations in each direction have been completed.

CALCULATIONS

Drop Height (H) = 508 mm

Calculate the tear resistance N in Newtons as follows:

$$N = \left[\frac{(W \times H)}{L} + W \right] (9.8065)$$

Where

W = weight of carriage, kg

H = height of carriage before release, mm

L = length of tear, mm

9.8065 = conversion factor for Newtons

PUNCTURE PROPAGATION TEAR RESISTANCE TEST
(CONT'D) :

(NFPA 1992-2012, Section 8.6)

Material: 1055CL Yellow Fabric

RESULTS

Specimen	Tear Length (Mm)	Carriage Weight (Kg)	Tear Resistance (N)	Specimen Thickness (Mm)	Type Of Tear
MD1	13	0.4552	178.90	0.6	Slit
MD2	24	0.4552	98.95	0.6	Slit
MD3	19	0.4552	123.81	0.6	Slit
MD4	15	0.4552	155.64	0.6	Slit
MD5	26	0.4552	91.68	0.6	Slit
AVG	19	0.4552	123.81	0.6	Slit

Specimen	Tear Length (Mm)	Carriage Weight (Kg)	Tear Resistance (N)	Thickness (Mm)	Type Of Tear
XM1	10	0.4552	231.23	0.6	Slit
XM2	10	0.4552	231.23	0.6	Slit
XM3	14	0.4552	166.43	0.6	Slit
XM4	8	0.4552	287.92	0.6	Slit
XM5	8	0.4552	287.92	0.6	Slit
AVG	10	0.4552	231.23	0.6	Slit

MD denotes machine direction sample.

XM denotes cross machine direction sample.

PUNCTURE PROPAGATION TEAR RESISTANCE TEST
(CONT'D) :

(NFPA 1992-2012, Section 8.6)

REQUIREMENTS

Specimens shall have an average puncture resistance of not less than 25 N
(5.6 lbf) in either direction.

OBSERVATIONS

Specimens did not have an average puncture resistance of not less than 25 N
(5.6 lbf) in either direction