

**Carolina Performance USA, INC.  
Technical Bulletin HOU-10-10-2013**

**Thermal Resistance of Insulated Fabrics.  
Protect 400 Lining, and Protect 500 Lining Plus.**

**CONTENTS OF THIS BULLETIN**

- I. Overview of Insulated Fabrics
- II. Normal CLO Fabric Values in for Different Weather Conditions
- III. Tested Performance for our Insulated Fabrics

**Introduction**

Carolina Performance U.S.A. dba Carolina Protect, is a Fabric Manufacturer with over 150 years' experience in textiles, and manufactures highly specialized Technical Textiles for personnel protection.

The Insulated Fabric from Carolina Protect is FR Certified under

- **NFPA 2112** *Standard on Flame-Resistant Garments for Protection of Industrial Personnel Against Flash Fire.* The UL Certificate number is 091613-MH47585.
- **ASTM F 1959 / F** *Standard Test Method for Determining the Arc Rating of Materials for Clothing.*

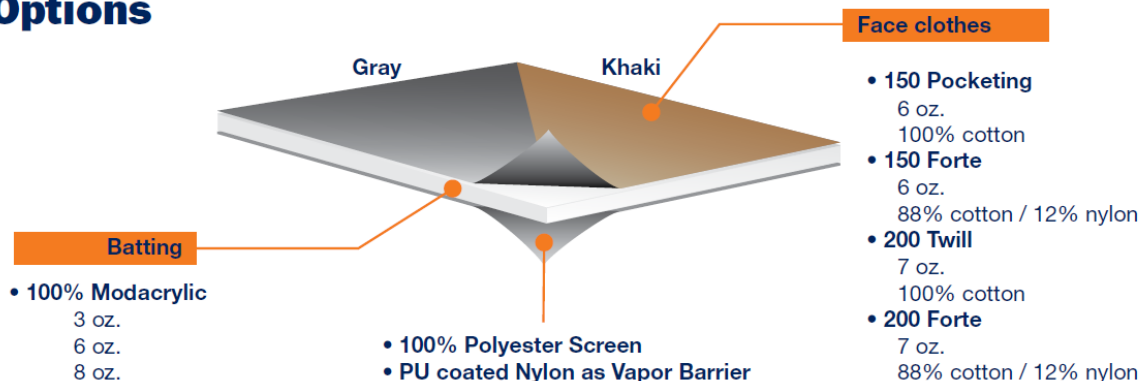
These certificates are available to clients upon request.

This bulletin does not detail the FR Properties of our Insulated Fabric, it refers to the Thermal Resistance Properties of "Protect 400 Lining".

**I. Overview of Insulated Fabrics**

*Protect 400 Lining* is a quilted fabric comprised of three layers: A face cloth, a batting, and an inner screen. These materials are quilted with FR Thread, so the FR properties remain in all options, but the Insulation Values and Arc Rating depend on the materials used.

**Options**



**Carolina Performance USA, INC.  
Technical Bulletin HOU-10-10-2013**

**I. Overview of Insulated Fabrics (Continued)**

*Protect 400 Lining*, as an insulated fabric, was tested and certified by an independent laboratory, using as a testing method ASTM F 1868-02 *Thermal and Evaporative Resistance of Clothing Materials Using a Sweating Hot Plate*.

The results produced by test ASTM F 1868-02 are:

- **Thermal Resistance – Rct (m<sup>2</sup> x K/W)**  
Measurement of the temperature difference by which an object resists heat flowing through it.
- **Thermal Resistance – Rct (CLO)**  
CLO is a measure specific for insulated clothing. Roughly, CLO=1 is the insulating value afforded by a man’s underwear and a lightweight suit. Other conditions, such as wind and humidity can affect the CLO values needed for a garment.

**II. Normal CLO Fabric Values for Different Weather Conditions.**

The following chart lists different CLO Values that , according to the test authors, a person would need in order to stay comfortable under different conditions of weather, and physical activity.

When a CLO value is under 1, the standard of “underwear and lightweight suit” would be too insulating for an adult male to be comfortable.

Environmental temp.	Resting sitting	Slow level walking	Normal level walking	Fast level walking
70°F – Normal outdoors	1.5	0.7	0.4	0.3
50°F – Normal outdoors	3.1	1.5	0.9	0.7
30°F – Normal outdoors	4.7	2.3	1.5	1.1
0°F – Normal outdoors	7.2	3.5	2.3	1.7


*Source: A.Pharo Gagge, A.C. Burton, and H.C. Bazett  
A practical system of units for the description of the heat exchange of man with his environment.  
Science, vol 94, number 2445.*

**Carolina Performance USA, INC.  
Technical Bulletin HOU-10-10-2013**

**III. Tested Performance for our Insulated Fabrics.**

Protect 400 Lining, using a Shell Fabric of Protect 200 Twill, 100% Cotton, 7oz.  
CLO Value= 1.27.

Page 1 of 1

  
**Groupe CTT Group**  
Textiles Division

**ANALYSIS REPORT**  
SCC Accreditation No.: 403

Mr Adolfo Ramirez Alanis Date: September 21, 2011  
Carolina Performance Fabrics Report: 2986-002-52827C

---

**IDENTIFICATION:** Samples: PROTECT 400 LINING + PROTECT 200 TWILL  
Received: August 19, 2011

---

**STANDARD:**

---

**TEST:** Thermal and Evaporative Resistance of Clothing Materials Using a Sweating Hot Plate — Part A ASTM F 1868-02



---

**TEST CONDITIONS:** Part A: Thermal Resistance;  
Apparatus used: Skin model in climatic room; Climatic room conditions: 20°C, 65% R.H.;  
Plate temperature: 35°C; Procedure: Sample in contact with plate;  
Calculation made on last 30 minutes; Test duration: 60 minutes;  
Airflow velocity: 1.0 ± 0.1 m/s.  
Sample weight: 729 g/m<sup>2</sup>  
Sample thickness: 9.37 mm  
Sample construction: PROTECT 400 LINING + PROTECT 200 TWILL  
Side of specimen in contact with the hot plate: Grey side of insulation  
Number of layer(s) tested: 2  
Wrinkle removal method used: Smoothing without compressing  
Date tested: August 24, 2011

---

RESULTS:	Individual Data			Avg.	S.D.	% CV
Thermal Resistance - Ret (m <sup>2</sup> · K/W):	0.2086	0.1925	0.1870	<b>0.1960</b>	0.0112	<b>5.7</b>
Thermal Resistance - Ret (CLO):	1.35	1.24	1.21	<b>1.27</b>	0.07	<b>5.8</b>
Thermal Resistivity - r (m · K/W):	22.24	20.52	19.93	<b>20.90</b>	1.20	<b>5.7</b>

---

Prepared by:  Approved by:   
Dominique Lamoureux, Tech. Martin Filteau, b. eng. Date: September 21, 2011  
Technician First Vice-President

---

**\*\*For any information concerning this report, please contact Martin Filteau.\*\***

The reports are identified by an alphanumeric code, the last character refers to the number of revision(s), this is emitted in ascending order. The samples in relation to this test are retained for a period of 30 days following the expedition day of the written report, unless other instructions are received. The fees for all services after the tests are 125.00 \$ per hour and for appraisal in Court, 195.00\$ per hour. The above reported results refer exclusively to the samples submitted for evaluation. This analysis report cannot be partly used or reproduced, unless in whole, without CTT Group prior written consent. † CTT Group is accredited by the SCC for specific tests as listed on www.scc.ca. For customer's complete address, please refer to the front page.

---

3000, avenue Boulié, Saint-Hyacinthe (Québec) CANADA J2S 1H9  
www.gctg.com 1 877 288-8378 1 450 778-1870 Fax: 1 450 778-3901

**CAROLINA PERFORMANCE USA, INC.**

25511 Budde Road, Suite 1502, The Woodlans, TX. 77380 USA

Phone. +1 (832) 8384710. Toll Free: 1-866-272-6830.

www.carolinaprotect.com

**Carolina Performance USA, INC.  
Technical Bulletin HOU-10-10-2013**

**III. Tested Performance for our Insulated Fabrics.  
(Continued)**

*Protect 400 Lining with Vapor Barrier, using a Shell Fabric of Protect 200 Forte, 88/12,7oz.  
CLO Value= 1.98.*

Page 1 of 1

**GroupeCTTGroup**  
Division Textiles

**ANALYSIS REPORT**  
SCC Accreditation No: 403

Mr Adolfo Ramirez Alanis  
**Carolina Performance Fabrics**

Date: April 16, 2013  
Report: 2986-003-65218A

---

**IDENTIFICATION:** 2 samples: Protect 500 Lining Plus & Protect 200 Forte  
Received: March 25, 2013

---

**STANDARD:**

**TEST:** Thermal and Evaporative Resistance of Clothing Materials Using a Sweating Hot Plate — Part A      ASTM F 1868-12



---

**TEST CONDITIONS:** Part A : Thermal Resistance,  
Airflow velocity: 1.0 ± 0.1 m/s.  
Sample weight (g/m²): 938.0  
Sample thickness (mm): 14.7  
Sample construction: Multi-layers (Quilted fabric + Navy fabric)  
Side of specimen in contact with the hot plate: Brown side of the quilted fabric  
Number of layer(s) tested: 2  
Wrinkle removal method used: Smoothing without compressing  
Date tested: April 15, 2013

---

RESULTS:	Individual Data			Avg.	S.D.	% CV
Thermal Resistance - R <sub>cl</sub> (K · m²/W):	0.3073	0.3062	0.3057	<b>0.3064</b>	0.0008	<b>0.3</b>
Thermal Resistance - R <sub>cl</sub> (CLO):	1.98	1.98	1.97	<b>1.98</b>	0.01	<b>0.3</b>
Thermal Resistivity - r (K · m²/W):	20.88	20.81	20.77	<b>20.82</b>	0.06	<b>0.3</b>

---

Prepared by:  Approved by: 

Dominique Lamoureux, Tech. Technician      For: Martin Phteau, b. eng. First Vice-President      Date: April 16, 2013

---

**\*\*For any information concerning this report, please contact Martin Phteau.\*\***

The reports are identified by an alphanumeric code, the last character refers to the number of revision(s), this is emitted in ascending order. The samples in relation to this test are retained for a period of 30 days following the expedition day of the written report, unless other instructions are received. The fees for all services after the tests are: 125.00 \$ per hour and for appraisal in Court, 195.00\$ per hour. The above reported results refer exclusively to the samples submitted for evaluation. This analysis report cannot be partly used or reproduced, unless in whole, without CTT Group prior written consent. † CTT Group is accredited by the SCC for specific tests as listed on www.scc.ca. For customer's complete address, please refer to the front page.

**CAROLINA PERFORMANCE USA, INC.**

25511 Budde Road, Suite 1502, The Woodlans, TX. 77380 USA

Phone. +1 (832) 8384710. Toll Free: 1-866-272-6830.

www.carolinaprotect.com