

PRECONSTRAINT

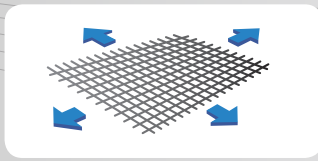
LONGEVITY & SUSTAINABILITY



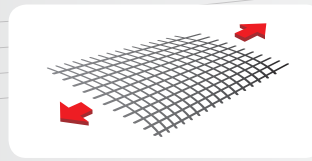
Serge Ferrari

Exclusive advantages of Précontraint Serge Ferrari® technology

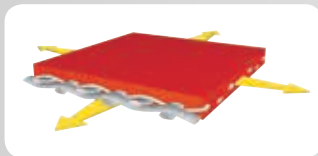
The worldwide patented Précontraint Serge Ferrari® technology confers unique properties to the Précontraint® composite materials compared to conventional coated fabrics.



Précontraint composite materials are tensioned in both directions during the coating process.
 > More consistent from batch to batch.



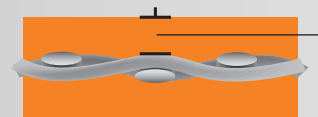
Conventional coated fabrics are tensioned only in warp direction.
 > Less consistent from batch to batch.



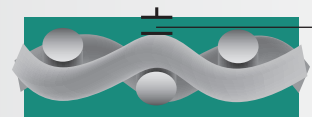
Balanced in both directions:
 > Straight yarns
 > Low crimp
 > Low elongation
 > Far smoother surface



Non balanced, in weft:
 > Non straight yarns
 > Higher crimp
 > Higher elongation
 > Uneven surface



240 microns Top coat
 > Better protection of the yarn against UV, weathering and abrasion



80 microns Top coat
 > Less protection of the yarn against UV, weathering and abrasion

Proven consistency

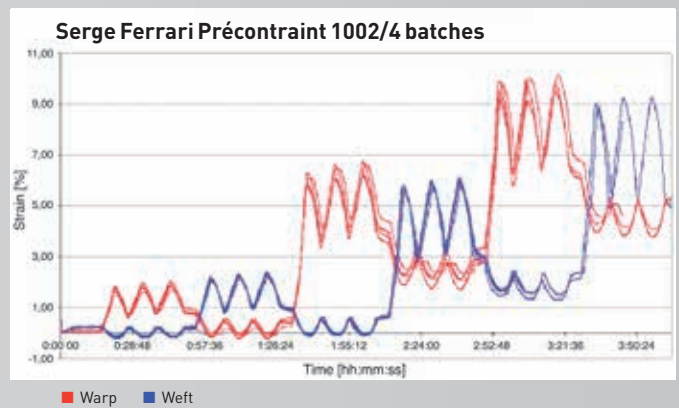
Comparative bi axial testing of 4 different batches demonstrates:

- A balanced elongation between warp and weft,
- An homogenous elongation under load of 4 different batches.

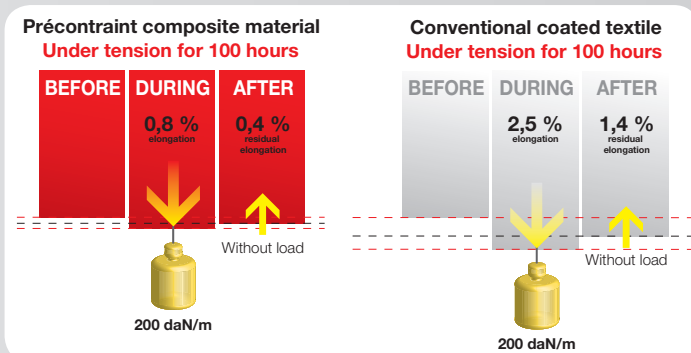
This allows reasonable and **consistent compensation levels** from one batch to another, and a better control of the installation.

"Results are virtually 100% the same for the different batches. We therefore conclude that this material is very uniform".

Blum Laboratory



Limited creep

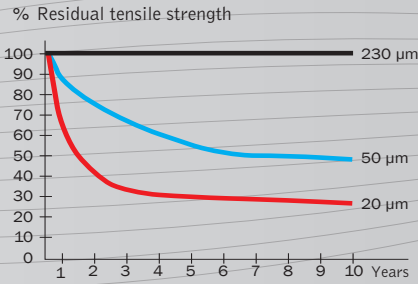


Précontraint Serge Ferrari® technology enables a limited creep, balanced between warp and weft. For conventional textiles, the weft creep is 3 to 4 times higher than the warp creep.

Elongation in the weft direction under a 200 daN/m load over a period of 100 hours. Then residual elongation without load.

Mechanical longevity

The thicker surface coating of Serge Ferrari Précontraint composite materials provides greater protection to the base cloth and much higher mechanical resistance characteristics over time - critical to the lifespan of your installations.



An independent **ENKA study** was conducted on 3 fabrics with different thicknesses. The tensile strength was measured annually over **10 years**, in Florida USA. **The graph dramatically demonstrates the benefits of thicker coatings on the residual strength of the fabric.**

> **High residual strength on long term exposed buildings:** The following results, measured on actual material sampled from the building, under different worldwide climate, reveal very high residual strengths values. It confirms the durability of Précontraint composite based on technical advances in polymer formulation, thread and surface treatments.



Airbus hangar - 1982
Bremen - Germany
Précontraint 1302

Tensile resistance after **22 years:**
Warp **97%** - Weft **84%**



Warehouse - 1989
La Tour-du-Pin - France
Précontraint 832

Tensile resistance after **20 years:**
Warp **91%** - Weft **86%**



Exhibition hall - 1982
Port-Gentil - Gabon
Précontraint 1302

Tensile resistance after **18 years:**
Warp **86%** - Weft **76%**



Airport terminal - 1989
Lyon - France
Précontraint 1202

Tensile resistance after **16 years:**
Warp **78%** - Weft **98%**



School covered playground - 1994
Kerikeri - New Zealand
Précontraint 702

Tensile resistance after **14 years:**
Warp **96%** - Weft **98%**



Les Halles Carpark Facade - 1994
Avignon - France
Précontraint 392

Tensile resistance after **12 years:**
Warp **90%** - Weft **80%**



Car dealership - 2000
Johannesburg - South Africa
Précontraint 1002

Tensile resistance after **12 years:**
Warp **80%** - Weft **85%**



Walkway Cover - 1989
Paris - France
Précontraint 1002

Tensile resistance after **11 years:**
Warp **97%** - Weft **86%**



Ladies Pavilion - 1996
Abu Dhabi - U.A.E
Précontraint 1202 Fluotop

Tensile resistance after **10 years:**
Warp **89%** - Weft **98%**



Radisson Hotel - 1996
Cape Town - South Africa
Précontraint 1002


Tensile resistance after **10 years:**
Warp **99%** - Weft **100%**

Aesthetic longevity

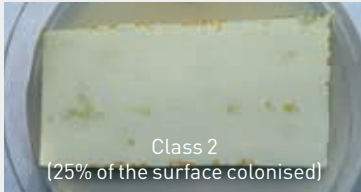
Resistance to microbial attacks of Fluotop treatment

Resistance to micro-organisms development is tested in compliance with **ISO 846** Method A. The material is exposed for 4 weeks at 29°C in a solution containing various micro-organisms. The material is classified on a scale from 0 (inert: no micro-organisms development) up to 5 (100% of the material surface colonised by micro-organisms).

Resistance to micro-organisms Précontraint 1202 Fluotop T	ISO 846 Method A
• Brand New	Classe 0 (inert)
• After 10 years (Abu Dhabi)	Classe 0 (inert)
• After 13 years (Malaysia)	Classe 0 (inert)



Class 0
inert



Class 2
[25% of the surface colonised]



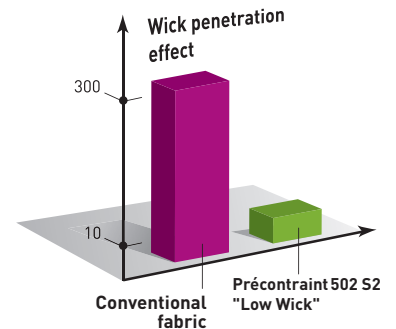
Ladies Pavilion - Abu Dhabi, UAE
Précontraint 1202 Fluotop T - Installation: 1996 - Sampling: 2006
Average relative humidity: 65%



Sukan Negara Train Station - Kuala Lumpur, Malaysia
Précontraint 1202 Fluotop T - Installation: 1997 - Sampling: December 2010
Average relative humidity: 80%

“Low Wick” thread treatment

The high-tenacity polyester threads are protected with “Low Wick” (anti-capillarity treatment) at the Serge Ferrari Group’s spinning facility. This treatment prevents moisture rising up the threads, mainly from the exposed edge of the weld. This results in a far better membrane appearance due to uniform translucency.



Effective and durable surface treatments

A 4 000h exposure to an accelerated weathering test, in compliance with EN ISO 4892-3, simulates approximately a 3 year-ageing through outdoor exposure to UV, heat and humidity in Florida.



Fluotop T2 and S2 surface treatments behave very well in front of combined action of UV, heat and humidity. The Fluotop T2 formula, with high PVDF concentration, remains white for a longer period of time. This is proven in its 15 years of experience in applications around the world.

	Précontraint 1002 S2	Précontraint 1002 Fluotop T2	Standard
White colour evolution after 4 000h UV/Humidity/Heat*	$\Delta E = 5.5$	$\Delta E = 3.5$	CIE Lab
Surface treatment adhesion after 4 000h UV/Humidity/Heat	No peeling	No peeling	Scotch tape test

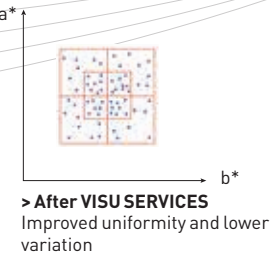
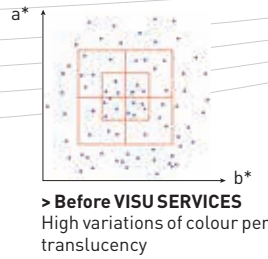
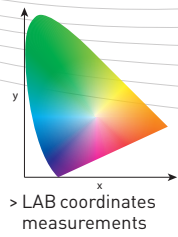
* These values are obtained after tests on at least 20 batches.
 ΔE : In colorimetric space, a colour is expressed as $l^*a^*b^*$ along 3 axes: l^* = clarity; a^* = red/green axis; b^* = yellow/blue axis
 A colour change is expressed by a variation of $l^*a^*b^*$ values (coordinates)
 ΔE is the colorimetric distance between a sample and a reference: the higher its value, the more distant the compared colours are.

Uniformity of colour per translucency

The Serge Ferrari Group has designed innovative tools for accurately measuring and controlling the color translucency (**VISU SERVICES**); where in the past the standard practice was to measure only the reflection.

Thanks to this tool, Serge Ferrari improves uniformity of color per translucency within batch and from batch to batch.

VISU SERVICES is a daily help to choose the most ideal production mix for a given project.



Thermal performance: Textherm exclusive tool

Textherm is a preliminary calculation software for an air-conditioning unit (AC unit):

It calculates the required electrical power of the AC, depending on the nature of the envelope in a given context. Thereby allowing the simulation of various material options prior to construction - including translucent, opaque, LowE membranes as well as single and double layer skins.

Preliminary calculation for AC units
TexTherm VE2

Situation: Cooling

Air conditioning unit (kW): 203

kWh cost: 0.10

Hour cost: 20,3

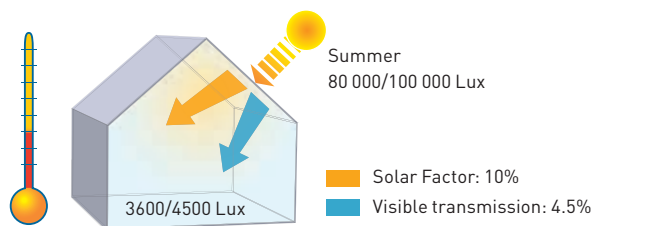
Heat sources breakdown (kW):
Fabric conduction: 146
Fabric radiation: 209
Human activity: 10
Wall conduction: 59

Help and recommendations | Membranes

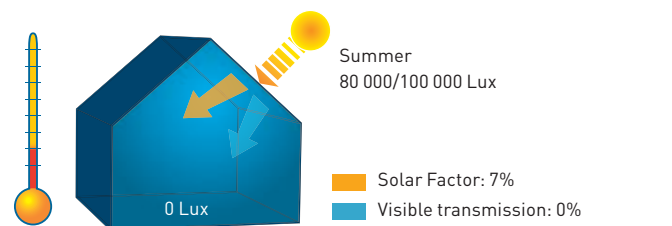
> Textherm is downloadable on sergeferrari.com

Case Study

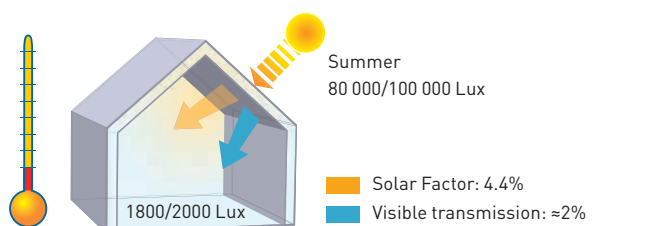
Location	Abu Dhabi	Indoor activity	Sports	Membrane surface	2 000 m ²
Outside temperature	40°C	Number of people	45	Wall surface	720 m ²
Inside target temperature	22°C				



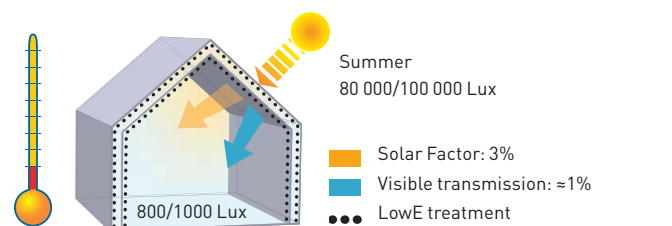
Single membrane translucent **Précontraint 1002 Fluotop T2**
Required electric power = 245 kW



Single membrane **Précontraint 1002 Opaque**
Required electric power = 215 kW **-12%**



Double membrane translucent **Précontraint 402 highly translucent (int.) + Précontraint 1002 T2 (ext.)**
Required electric power = 131 kW **-46%**



Double membrane **LowE Précontraint 702 LowE (int.) + Précontraint 1002 LowE (ext.)**
Required electric power = 109 kW **-55%**

Serge Ferrari sustainability policy

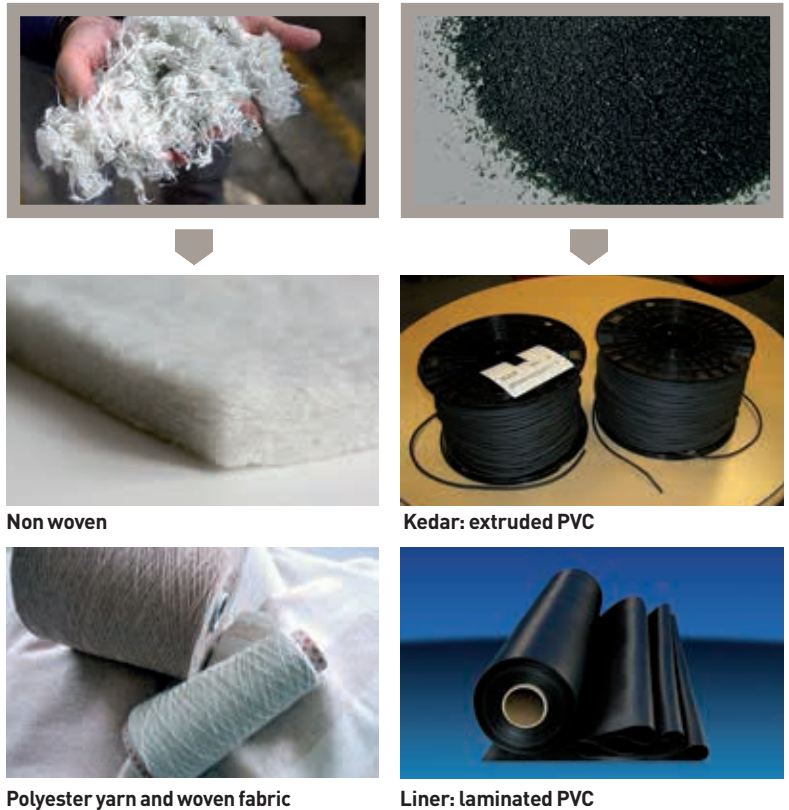
Texyloop®: unique and operational recycling process

Thanks to an organised collection network, end-of-life materials are recycled at Texyloop® facility at Ferrara, Italy since 2008.

Overall process

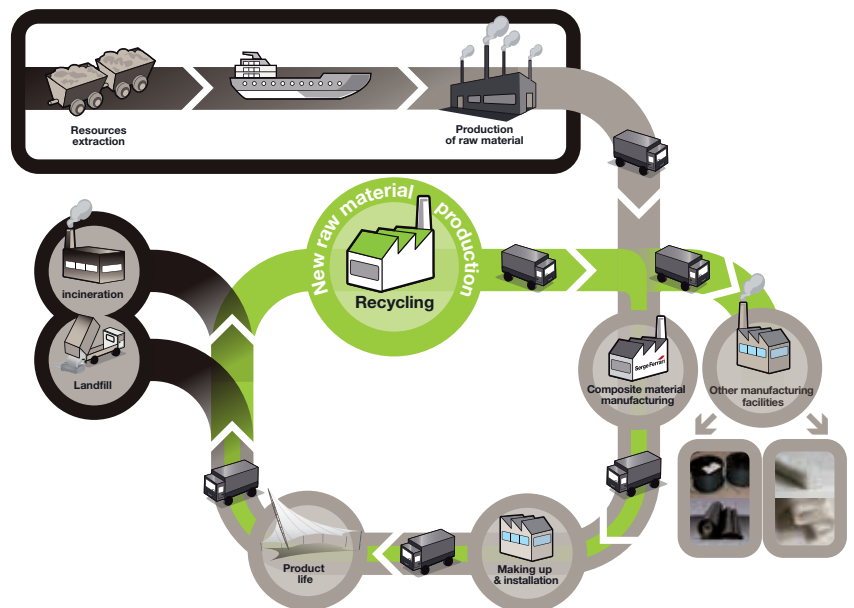
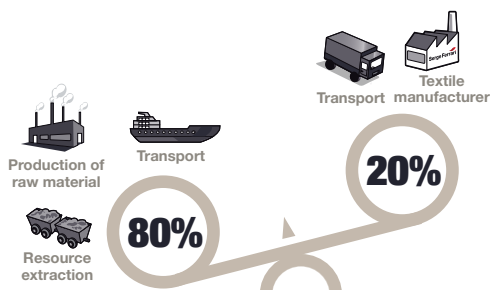


2nd generation raw materials for multi-applications



Why is recycling so efficient?

- The Life Cycle Assessment shows that the greatest environmental impacts in our industry (80% on average) are generated by raw material extraction and production.
- The Texyloop® recycling process avoids incineration and landfill disposal.
- By creating second generation raw materials, Texyloop® avoids further extraction of resources from the earth.



The second generation raw materials of high intrinsic value are used by Serge Ferrari Group's or other industries' production chains.

Life Cycle Assessment (LCA)








The Life Cycle Assessment (LCA) is measuring the environmental impacts of any product from raw material extraction to the end of the life cycle. Our Life Cycle Assessment has been conducted on the whole Précontraint range by an external environmental consultant, EVEA France, in conformity with ISO 14040 series and submitted to a peer review made by CIRAIG (Canada).

Impact measurements are converted into common denominator equivalent, chosen among well-known substances and standard units (kg Antimony eq, kg CO2 eq, ...).

The overall impacts of Serge Ferrari Précontraint composite materials are significantly reduced when recycled by means of Taxyloop®.

Comparative analysis depending on end-of-life scenarios

Functional unit: 1 sqm Précontraint 1002 S2

Type of impacts	Taxyloop® recycling	Landfill	Incineration
 Resource depletion Kg Antimony equivalent	0.024	0.151	0.151
 Global warming kg CO2 equivalent	2.572	4.104	4.757
 Human toxicity Kg 1,4-dichlorobenzene equivalent	0.679	1.326	1.414
 Water consumption litres	139.6	339.6	341.3
 Energy Consumption Mega Joule equivalent	59.7	103.3	103.3
 Bulk waste kg	0.081	1.358	0.252
 Hazardous waste kg	0.0011	0.0029	0.0029

Complete LCA reports, including other types of impacts, are available on request.

LEED certification

Heat Island Effect

The LEED credits requires a Solar Reflectance Index (SRI) >78 for flat roofs and >29 for sloped roofs.

Précontraint membranes help fighting the Heat Island effect, and therefore provide 1 full point under the credit SSc7.2/GIB C9 (roof) and 2 full points under the credit SSc7.1 (non roof).

Additional contributions

Précontraint composite materials can also contribute to the following credits:

- Credit SSc8 - Light pollution reduction
- Credit IEQ 8.1 - Daylight
- IDc1 - Innovation and design

Detailed LEED reports are available on request.

Solar reflectance index (SRI) Précontraint 1002 Fluotop T2 & S2	ASTM 1980
White	> 95%
Ref 8341: Champagne Ref 1076: Beige	> 80%
Ref 2152: Red Ref 2158: Green	> 30%

Environmental communication in conformity with ISO 14021

In september 1999, the ISO published the ISO 14021 standard concerning self-declaration on environmental issues, also called Type II declarations.

The main objective of this standard is to clarify the environmental communication, where the best can be found next to the worst.

ISO 14021 requires the environmental communication to be : exact, precise, verifiable, pertinent and not misleading.

Sustainability case studies

Lord's Cricket Club – London – UK

- Architect: Michael HOPKINS
- Engineer: OVE ARUP
- Serge Ferrari composite material: Précontraint 1002 T2
- Material area: 1200 sqm

Membrane changed after 19 years in service

- > Dismantled in December 2005 in 1 Day
 - > Re-installed in December 2005 in 7 Days
- The original membrane was recycled with Taxyloop®.



German Pavilion – Shanghai 2010 Universal Exhibition

- Architect: Schmidhuber + Kaindl (Munich)
- Serge Ferrari composite material: Stamisol FT 371
- Material area: 21 000 sqm

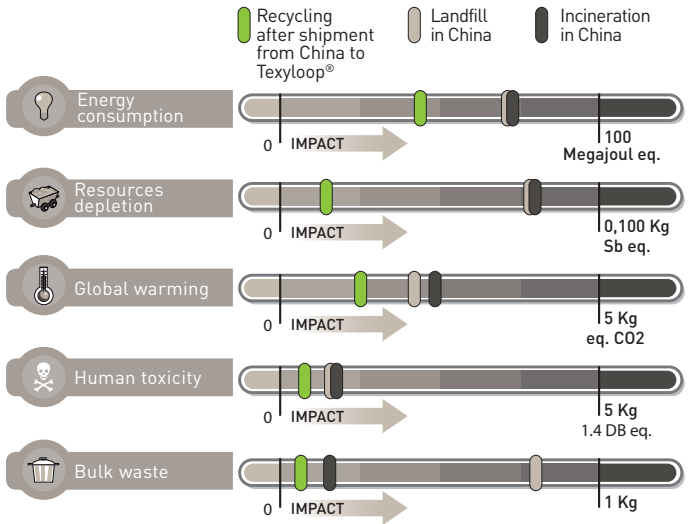
Building dismantled after exhibition

- > Recycling via Taxyloop® offers a viable end of life solution for temporary buildings and reducing the impact on the environment.



Comparative LCA depending on end-of-life scenarios

Functional unit: 1 sqm Stamisol FT 381



→ Contact

- Headquarters:
+ 33 (0)4 74 97 41 33
- Your local representative:
www.sergeferrari.com

→ Taxyloop®

- The Serge Ferrari operational recycling chain
- Secondary raw materials of high intrinsic value compatible with multiple processes
- A quantified response to combat depletion of natural resources

www.taxyloop.com