A YARN WITH HIGH TECHNOLOGICAL CONTENT.

Resistex® Carbon was created in the research laboratories of Tecnofilati, a textile firm specialising in the production of yarns with high technological content for sportswear, protective clothing and leisure wear. This is a yarn with unique technical features, composed of a continuous filament of conductive material based on active carbon and textile fibres.

Using **Resistex® Carbon**, a normal garment can be transformed into an ally, capable of improving any performance.

FEATURES

The use of electronic equipment, plastic furnishings and garments made of synthetic fabrics hides a phenomenon that shall be taken into account with great attention: static electricity.

Men undergo the phenomenon of triboelectricity without realising it. They annoyingly become aware of it when - opening the car door, for instance on a dry and windy day, they perceive an irritating shock in their hand. The wind action - replacing the one of a “piece of wool” is intended to electrify men who have discharged their electrostatic potential on the car. The discharge has been produced because wind has created the so-called potential difference between man and car by activating the electrification process.

The man of the third millennium lives immersed in an ensemble of electric and electromagnetic fields produced by industrial and non-industrial equipment that can fulfil his/her need for assets and services (TV-sets, computers, radio, Wi-Fi networks, mobile phones, etc.). In the presence of these electric and electromagnetic fields, the individual accumulates an amount of electricity intended to increase the electric and electrostatic potential on his/her body. As a matter of fact, the permanent modification of the human potential caused by the exposure to electric fields may cause the onset of transient disorders or real diseases.
The biologic effects of such exposures are being studied by the most advanced occupational medicine institutes, according to which the most frequent diseases are those affecting the visual, nervous and circulatory system.

Parameters influencing the generation of static electricity and variable electric fields

1) RELATIVE HUMIDITY
- the generation of static electricity in clothes is minimum when relative humidity is equal to or higher than 65%; when the humidity percentage decreases (e.g. 20-30%), the generation of static electricity and electric fields considerably increases (even 10 - 20 times higher).

2) THE HUMAN BODY
the electric charge acquired by a body may be produced by:
- triboelectric effect (electrostatic charge)
- sources of variable electric fields (home appliances, Wi-Fi networks, computers, mobile phones...)

Its potential may reach values from 1,500 to 35,000 volts; this depends upon the capacitive reactance (build-up) of the human body, which may range between 100 and 100,000 ohms, but is typically varying between 1,000 and 5,000 ohms in some individuals. It is therefore necessary to avoid such a build-up on the human body through dissipative antistatic garments that can avoid the generation of static charges and the radiation of the electric fields present in the environment, which might cause some disorders to the visual, nervous and cardiocirculatory system.

Bioelectricity is used by biological cells to store energy

We can raise a finger thanks to **bioelectricity** and we can see thanks to it. Almost every single action is carried out thanks to the presence of bioelectricity. We are talking about the electric signals that are generated and detected by our organs, muscles, brain and glands. These signals are transmitted by our nerves.
Our body is made up of biologic tissue. The tissue that can generate or detect bioelectric signals is referred to as excitable tissue. Some examples of this tissue (and its cells) are neurons and the **muscular tissue**. Neurons shall transmit the excitatory bioelectric signal to another neuron (forming the nerves), to a muscular tissue or to a brain gland, **whereas muscular cells are responsible for muscular contraction and distension**. Some specialised cells generate bioelectric signals: optical receptors (eyes), **muscular cells conveying the pain sensation**, etc.

Electric potentials and EMG signal

Skeletal muscles are functionally organised on the basis of motor units (MU).
The cross section of a muscle shows how the fibres belonging to a MU are placed in-between those of other MU's. As a consequence, the muscular fibres of one single MU represent a bioelectric source distributed in a conductive medium, of which all the other muscular fibres, both active and inactive, are an integral part.
The electric signal generated by the active fibres of a MU is referred to as extra-cellular potential or motor unit potential (MUP), it has a three-phase morphology (i.e. consisting of three peaks with an alternate sign), a duration from 3 to 15 ms, a variable amplitude from 20 to 2000 V, according to the MU features and a discharge frequency from 6 to 30 Hz.

SEMG (Surface Electromyography) measures the electric field potential arising out of the overlap of the action potentials of every single active muscular fibre.
It is important to point out that every single electric contribution generated by MU's or MUP's give rise to an electric signal by overlapping in the muscular volume in terms of space and time. Apparently irregular, it is referred to as an interference pattern typically non-periodical and variable all over the time; for these reasons, to be able to interpret the signal, it is necessary to process it by using proper statistic and electric parameters, also varying all over the time.

A particular technique, used in studying muscular fatigue, consists in artificially inducing contraction through the electric stimulation of the muscle, thus resulting into contraction levels and, therefore, electromyographic measurements that are more repeatable than those obtained from voluntary contraction.

Resistex® Carbon has a dissipative antistatic effect and it ensures protection against electric disturbances. Thorough studies in the field of ESD (Electro Static Discharge) protection have pointed out that the control of static electricity and variable electric fields **concerns any kind of environment**. The human body suffers - sometimes imperceptibly and sometimes considerably - from the presence of these natural phenomena: both the electrostatic discharge (ESD) and the electric over-stress discharge (EOS) clearly affect its well-being. As a matter of fact, it is important to know that the electric charges settling on our body may cause several disorders, such as for instance the overheating of some parts of our body due to a triboelectric effect during sports activity and not only. This overheating may alter normal blood microcirculation and cause annoying itching, tingling and fatigue sensation.

The SEMG (Surface Electromyography) lab tests on garments made of **Resistex® Carbon** have shown that they are not only comfortable, but they also prevent electric charges from settling on the body, thus avoiding a negative reaction on muscular contractility.

Thanks to its excellent conductive features, **Resistex® Carbon** can accelerate the movement of humidity through evaporation, thus increasing the sensation of well-being and decreasing humidity in case of skin contact.

USES

For work

Static electricity is a natural phenomenon or better it is the “shape” ‘electricity assumes in the nature.
It is defined “static” when it fails to flow down to the ground (e.g. in very insulating synthetic fibres) and “mobile” when it flows down to the ground (e.g. when conductive wires allowing for the flow-down to the ground are inserted into the fibres of fabrics).

How static electricity is produced.

Static electricity is produced thanks to a transfer of electrons from the body of an object to another one by rubbing two materials of synthetic fibres.
Static electricity can be easily produced as soon as humidity decreases in windy days and in heated industrial or civil rooms and wherever there may be an air flow.

What a triboelectric charge is.

“Static electricity” is also referred to as “triboelectric electricity” (or triboelectric charge) in the technical language.
The triboelectric charge is produced by synthetic materials of different charge (positive [+] or negative [-] established by their position in the Triboelectric Series) when they come into contact with each other.
The “Triboelectric Charge” is the list of the various materials in order and according to the type of charge, positive [+] or negative [-], which they assume when they come into contact with each other.
The list supplied here below shows that:
• the materials on the top have a positive charge [+]
• the materials at the bottom have a negative charge [-]
E.g.: cotton [+] - acrylic [-]
cotton [-] - wool [+]

Static electricity.

Static electricity reveals itself through electrostatic discharge. Its most common signs are:
• lightning
• the spark produced when a person touches a surface, another person or an object with a potential different from its own.
The electrostatic discharge is the phenomenon, according to which the electrostatic charge held by a body is neutralised.
The electrostatic discharge is produced when an electrified body is in the presence of another body with an electric potential different from its own.

Table 1: the generation of an electrostatic charge due to a triboelectric effect in a work environment

HOW THE CHARGE IS PRODUCED	RELATIVE HUMIDITY	
	10 - 20%	65 - 75%
A person walking on a moquette floor	**35.000 Volts**	**6.000 Volts**
A person walking on a ceramic floor	**12.000 Volts**	**5.000 Volts**

Table 2: the generation of an electrostatic charge due to a triboelectric effect in a living environment

HOW THE CHARGE IS PRODUCED	RELATIVE HUMIDITY	
	10 - 20%	65 - 75%
A person triboelectrically charged by the use of synthetic clothes and touching a door handle	**20.000 Volts**	**6.000 Volts**
A person triboelectrically charged by the use of synthetic clothes and touching the door while getting off a car	**18.000 Volts**	**8.000 Volts**

The damage caused by static or triboelectric electricity.

In electronic industry and in communications:
- electronic components are sensitive to electrostatic discharges;
- electrostatic discharges may damage or definitively spoil electronic components;
- every kind of component has a susceptibility threshold. In general, the higher the integration degree of the component, the higher the sensitivity to electrostatic discharges.

In the sanitary field: the electronic equipment used in this field are particularly sensitive to the effects of the electrostatic discharges that may cause their bad operation through the output of false data or even through data loss.
- dentist's surgeries;
- analysis laboratories;
- radiology;
- cardiology;
- hyperbaric chambers;
- operating theatres, etc.

In chemical industry and in the industry of explosives: in labs, in storage warehouses and in all the other environments where there may be the presence of volatile gases, the generation of a spark, even a very small one, may cause explosions or fires.

What are electromagnetic radiofrequency fields and microwaves.

Electromagnetic radiofrequency fields and microwaves are electromagnetic waves emitted by electric equipment of an industrial and civil type.
Unlike static electricity, manifesting as a spark or as a shock, they can not be perceived, but they are equally, if not more, harmful.
If the emission of electromagnetic radiofrequency and microwave fields is nearby, propagation can be transmitted by contact or by inductance.
If the emission of electromagnetic radiofrequency and microwave fields is far-off, propagation can be transmitted by inductance with many network and data frequency couplings from the electric sources encountered along its path.

Scope of application of electromagnetic and microwave fields. The problems.

There are many fields in which the technology of electromagnetic radiofrequency and microwave fields is applied:
in case of nearby emission
- in the sanitary field;
- in the chemical industry;
- in the industry of plastic materials;
- in the car industry;
- in the furniture industry;
- in the paper industry;
- in the hotel and catering industry (microwave ovens)

in case of far-off emission
- radio-TV broadcasting stations
- radar stations (civil or military)
- mobile and fixed telephony (by land - air - sea)

Even if it has become absolutely necessary by now, the use of this technology may cause serious electromagnetic incompatibility problems between man/machine and man/environment, thus compromising the good operation of the equipment and the intactness of man's health.

Electric features required by antistatic - dissipating - screening fabrics.

The fabrics to be used as a protection against Static Electricity, Electromagnetic Radiofrequency and Microwave Fields must necessarily have the following electric features:

	Antistatic protection	Man's protection against Electromagnetic field - RF - MO
Electric resistivity Rs - Rv	**> 7,5 x 10^3 - < 10^9 W**	**0 - < 10^2 W**
Triboelectric compatibility or generation of the electrostatic charge	**0 - < 100 Volt**	**0 - < 10 Volt**
Decay time of the charge	**0 - < 3 sec.**	**0 - < 1 sec.**
Attenuation of the electrostatic field or variable electric field 2.500 Volt 60pF - 20.000 Volt, 120 pF	**32 - 65 %**	**65 - 96%**
Attenuation of the electrostatic field MHz 200 - 299 1.000 - 1.800 = 1,8 GHz		**35 - 50 dB%** **40 - 65 dB%**

By applying these standards, it is possible to offer consumers protective textile materials that can contribute to the users' well-being.

Static electricity - The solutions.

To safeguard man's health, first of all, and the good operation of the equipment, protective fabrics have been conceived and certified for clothing and furniture by using **Resistex® Carbon** yarns, which can fully observe the EN 1149/1-2-3-5 standard in force.

FOR SPORT

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A particular technique, used in studying muscular fatigue, consists in artificially inducing contraction through the electric stimulation of the muscle, thus resulting into contraction levels and, therefore, electromyographic measurements that are more repeatable than those obtained from voluntary contraction.
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Moreover, the clothes made of **Resistex® Carbon** have proved to positively influence muscular performance, above all in the disciplines requiring efforts for a long time and/or in environmental conditions characterised by **high temperatures**, e.g. during aerobics.

Behavioural thermodynamics due to the use of clothes made of Resistex® Carbon.

The thermoregulation mechanism triggered by our body is mainly based on three factors:
- Perspiration and dispersion phase
- Muscular contraction and peripheral vascularisation (hands and feet)
- Endogenous heat production

We are already considering from now on that the last two aspects are decisive factors for the variation of the physiologic parameters determining the correct state of health of an individual and that they are of fundamental importance if analysed at the time of an agonistic effort. The increase in the contraction and endogenous thermal values causes a decrease in performance.
The three points described above show a considerable degree of improvement if analysed in conditions where the individual is wearing the garments made of **Resistex® Carbon** .

The Thermal Gradient (point 1) generated by **Resistex® Carbon** determines - in primis - a global control phase of the endogenous heat production and that the body temperature is kept constant even in case of hyper-effort. This results into a cardiac frequency decrease that is no longer set to well-defined out-of-threshold parameters, thus increasing the effort extent. As a consequence, the body fails to overheat and it must not necessarily make use of hyper-perspiration to restore control parameters. **Resistex® Carbon** therefore involves a considerable improvement of the thermodynamic capacity of our receptors by stressing them less and providing for a long effort without increasing energy dispersion.

Resistex® Carbon also decreases the values of lactic acid (point 2). The negative muscular contraction decreases and, therefore, the muscle may continue to work on medium-high frequency for more time. Substantially, **Resistex® Carbon** enables the muscle to get less tired. It reduces the lactate component that is responsible for a decrease in performance at the time of muscular fatigue, thus enabling the muscle to increase its strength capacity (data obtained from the SEMG tests). It guarantees better peripheral circulation since it enables blood to reach even peripheral areas without any obstacle, i.e. without obstructing the passage through them by way of micro-contractures, by reducing negative concentration (muscles are more tonic and relaxed).

Another interesting data item comes from the evaluation of the body regulation mechanism, underlying the endogenous heat production, through specific chemical exothermal reactions, i.e. reactions that can produce energy in form of heat. This system is autonomous and involuntary and it employs a large amount of reserves from our body.

Resistex® Carbon determines a correct balance of these parameters while always keeping the endogenous central unit of our body under control, by interfacing with it and by limiting the overheating of all our internal organs. This means that the action potential of our body is kept continuous and that it is never drastically used up to a very low level.

When we consider the data relative to performance, understood as the metabolic energy percentage the muscular system can change into mechanical energy, it shall be pointed out that the trend is up during the first thirty minutes of effort with **Resistex® Carbon** clothing (24.68% at the 15th minute vs. 24.93% at the end of the test) whereas the performance tends to decrease with the passing of minutes if you wear a normal clothing 100% made of polyester. In the latter case, fatigue is perceived earlier, as it is shown by higher cardiac frequency and the transformation of energy is more difficult.

FOR FREE TIME

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