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LASER SINTERING FOR TRUE RAPID MANUFACTURING

Creating a prototype is always a challenge. It involves stepping over the limits of knowledge and experience. The Rapid Prototyping (RP, Layer Manufacturing Technique) has always represented the most advanced technique in obtaining, in rapid time, the finished testing model.

CRP Technology's Research & Development area has developed new materials, which, applied to the Selective Laser Sintering, have given life to WINDFORM®, a product which allows the creation of perfectly functional prototypes and production parts for more diverse applications.

The latest one to hit the market is **WINDFORM® XT : the carbon fibre filled PA**, opaque black color with brilliant reflexes.

WINDFORM® XT has been launched 18 months ago on European market with a resounding success, also after having conquered the Japanese market too, and now CRP is ready to try the USA Rapid Manufacturing sector. The product is claimed not only for the Italian Patent Application, but also for the US and European Patent Application, hoping to make the clients satisfied that the hi-tech and exclusive WINDFORM™ Product they have purchased from CRP will be strongly defended from any unlawful counterfeit, if the application will become a patent.

QUALITY AND PERFORMANCE FOR PRODUCTION

High mechanical and thermal properties were developed to allow to shift from simple concept models to high-end prototypes and production parts, while the Quality Politics is applied in order to held the performance closer to production technologies and suppliers: these are the last requirements for end-users and service providers looking for Rapid Manufacturing.

WINDFORM® materials are regulated by the EN 10204: 2005 Type 3.1, that means not having to worry about verifying the information declared by CRP, because the Certification will guarantee it.

The document is validated by the manufacturer's authorized inspection representative, independent of the manufacturing department, and the manufacturer operates traceability procedures, providing the corresponding inspection documents if required.

The Certificate of Conformity attached with each batch of the Windform product, shows the exact data of the 3.1 type Control Certificate and certifies the repeatability of the productive batches, therefore the constancy of the technical characteristics of the powder material. These CoC are now also available online.

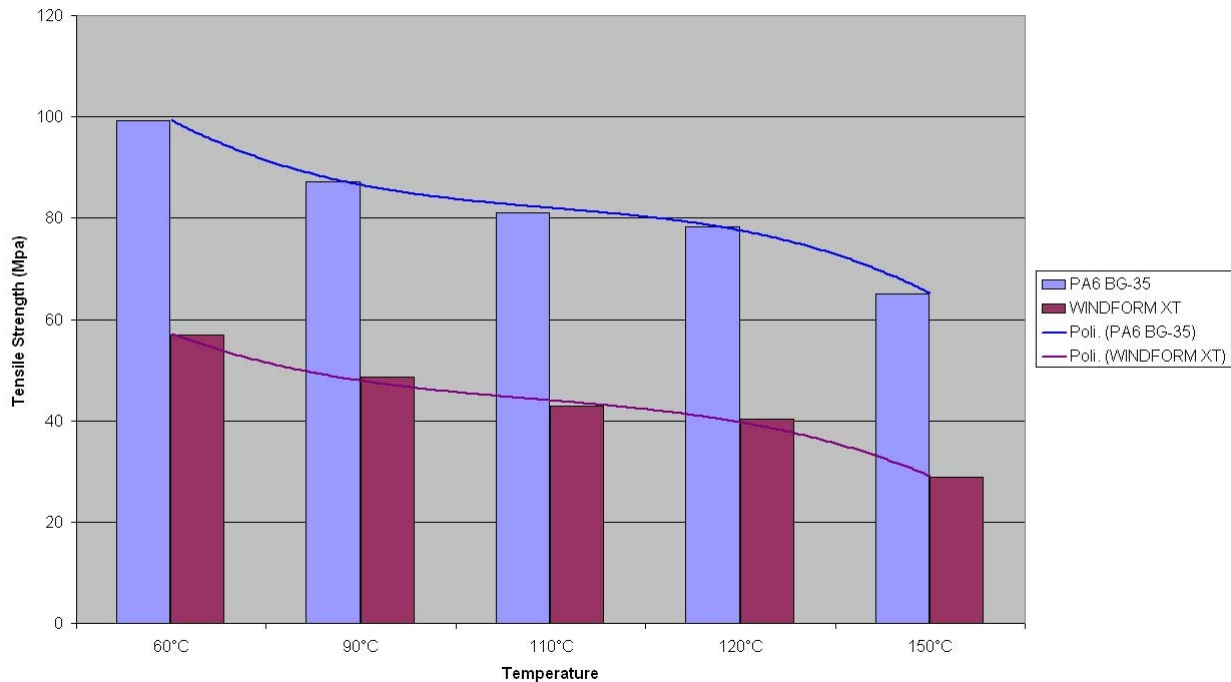
Each batch is consequently characterized by tests on the sintered bars following CRP's indications, which are done by external and certified laboratories, which guarantees the consistency of the technical characteristics of the sintered materials (if sintered in the right way). The results of the tests done on the sintered materials, traceable for each batch of production, are viewable under specific request.

MECHANICAL AND THERMAL PROPERTIES

Technical Data Sheets are available on line, so can be checked and downloaded in every moment, but to demonstrate its' characteristics, an external and independent lab analysed the behavior of WINDFORM® XT in order to prove its' reliability and the good strength even at medium-high temperature was issued. The lab discovered a behavior completely different from all other materials used with Rapid Prototyping techniques. Its behavior is similar to that of the PA6 BG-35, a high performance material for injection moulding, that's used for production of the final parts, for Automotive Industry for example.

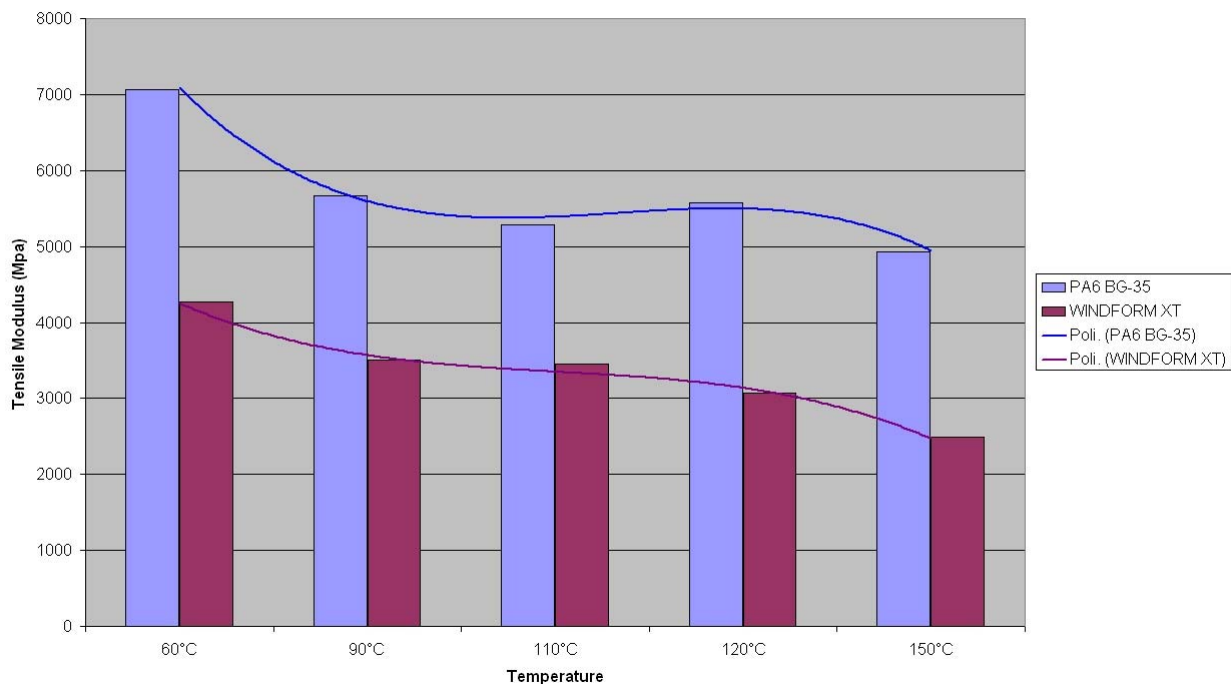
Targeted temperature range, is defined as the top head engine area with value from 176°F to 284°F, **WINDFORM® XT material shows similar handling and property to PA6 BG35: stable evolution and predictable in advance.** For example, between 194°F and 248°F the WINDFORM® XT tensile modulus has almost no decrease and the value underline that WINDFORM® XT at 248°F is almost two times stiffer than standard pure PA12 at 68°F!

Tensile Strength evolution on a function of temperature



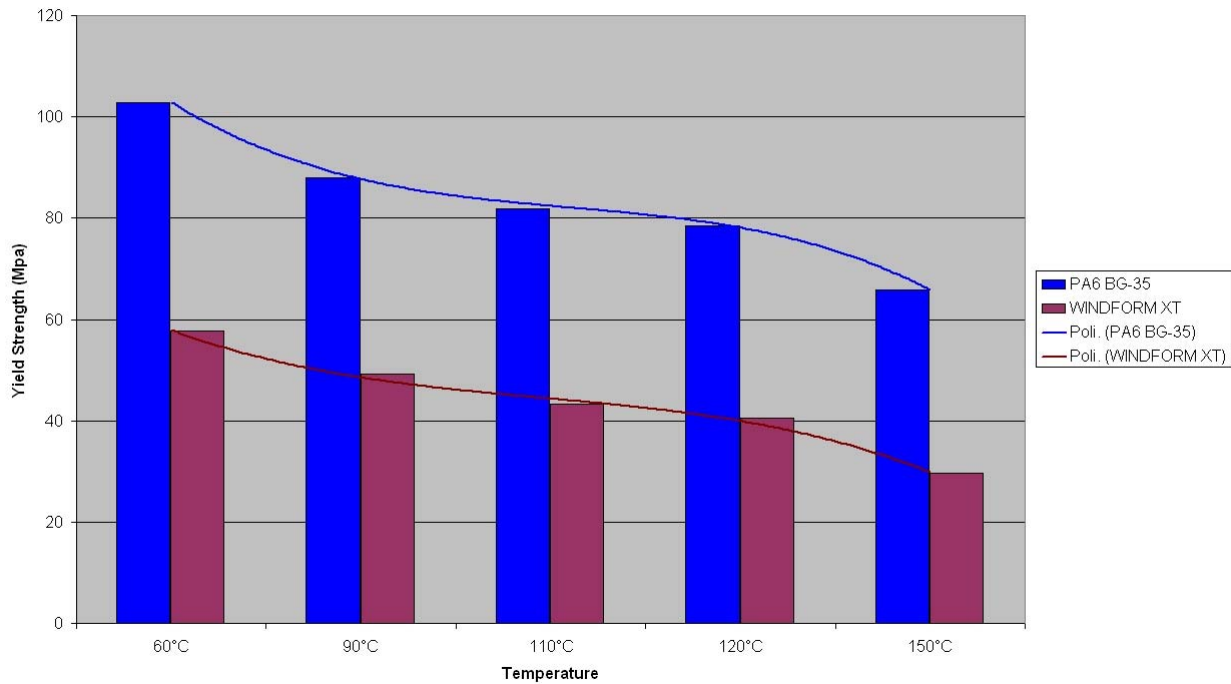
Compared evolution for PA6 BG-35 and WINDFORM® XT in function of temperature : Tensile Strength
 In particular, to be underlined the quite slow decreasing of WINDFORM® XT strength value between 194°F and 248°F, and is also the good value at 248°F, that is almost the value that standard pure PA12 for laser sintering has at 68°F!

Tensile Modulus evolution on a function of temperature



Between 90°C and 120°C the WINDFORM® XT modulus has almost no decrease and the value underline that WINDFORM® XT at 120°C is almost two times stiffer than standard pure PA12 at 20°C!

Yield Strength evolution on a function of temperature



The Yield strength behaviour highlights the incredible reliability of WINDFORM® XT: no unexpected lost of performance or breaks!

Moreover parts made by WINDFORM® XT can be CNC machined, in order to reach stricter tolerances, closer to production needs.

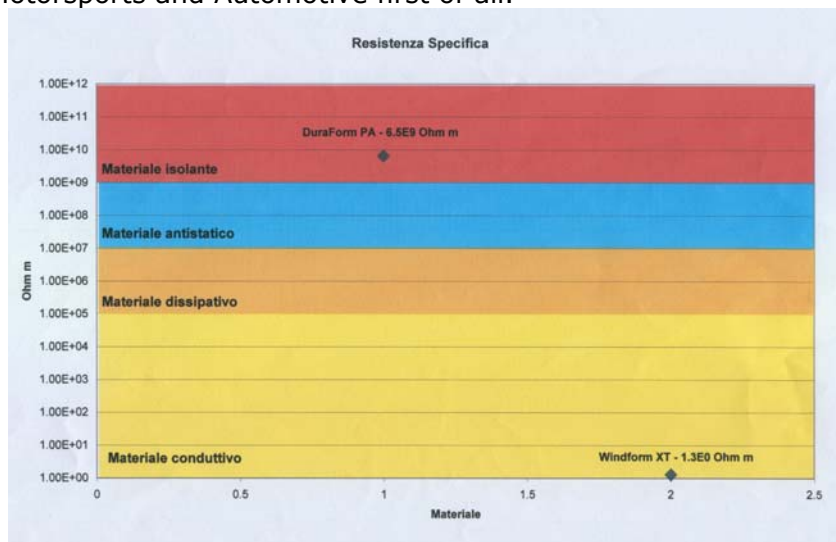
This is the proof that Rapid Manufacturing with WINDFORM® XT has become a fact, no more simple words: extreme reliability and resistance for adaptation testing, aesthetical, immediate ergonomic verification, rapidity of the implementation, which are all fundamental for highlighting designing errors, but also finished and off-the-shelf products, ready to be tested and used.

ELECTRICAL PROPERTIES

In order to test the specific electrical volume resistance according to DIN IEC 60093 of WINDFORM® XT, we have compared it with other antistatic or insulating materials for laser sintering as the Duraform® PA.

While the Duraform has a conductivity equal to $6.5 \times 10^9 \text{ Ohm m}$, WINDFORM® XT is placed as one of the first materials for laser sintering technology in the world that is enough conductive with its $1.3 \times 10^0 \text{ Ohm m}$.

This characteristic is very important because it paves the way for new applications in sectors as the electric one and not only in the other sectors in which the WINDFORM® XT has been used till now as Aerospace, Racing, Motorsports and Automotive first of all.



APPLICATIONS

WINDFORM® XT applications are infinite, and in many different sectors as Aerospace, Racing, Motorsports, Automotive, Design, Packaging, Electronics, Entertainment, Government, Consumer products (household appliances), Industrial, Lighting systems, OEM products, etc.

For example, racing teams make several races with WINDFORM® XT parts on their cars or motorbikes as air/fluid ducts, intakes, flaps, "snail" brake duct, side cover exit, electronics boxes, fuel chambers, fuel ducts, water pump covers, besides using many times the parts in wind-tunnel assemblies as sidepods, air/fluid box for flow tests, all kinds of air intakes and exits, flaps and ducts; but with its' elegant black and brilliant appearance can be applied to design creations too.



F1 Front Nose:

Aerodynamic application for F1 wind tunnel, positioned on the front of a F1 car and supporting the front wing (also known as the "Nose" of a F1 car).

The required base properties are: dimensional accuracy, detail definition, and the best compromise between stiffness and resistance to vibration. The stiffness is the principal property for the wind tunnel models.

Its versatility allows to substitute several different materials: only one material for diverse applications means no loss of time in loading machines with other materials and the highest performance and quality (repeatability and consistence of declared properties) for all kinds of parts and customers.

FAQ (FREQUENTLY ASKED QUESTIONS) ABOUT WINDFORM XT

- which positive characteristics and improvements are reached?

WINDFORM® XT is the original carbon fibre filled PA for laser sintering: its development needed long studies and tests and since it has been launched 2 years ago (December 2004) it has been further improved and optimized.

WINDFORM® XT is completely different from all other materials used with rapid prototyping techniques, and in particular really far away from Nylon and Nylon GF: its behavior is instead similar to PA6 BG-35, a high-performance material for injection moulding, used for production of the final parts, not only for concept models.

In particular the following characteristics have to be underlined:

	Test Method	SI Units	WINDFORM ® XT
General Properties			
Density (20° C)		g/cm3	1,101
Thermal Properties			
Melting Point	ASTM D 3418	°C	179,33
HDT, 1.82 Mpa	ASTM D 648	°C	175,4
Vicat 10N	ASTM D 1252	°C	178,1
Mechanical Properties			
Tensile Strength	UNI EN ISO 527-1(97) UNI EN ISO 527-2(97)	Mpa	77.85
Tensile Modulus	UNI EN ISO 527-1(97) UNI EN ISO 527-2(97)	Mpa	7320.8
Elongation at break	UNI EN ISO 527-1(97) UNI EN ISO 527-2(97)	%	2,6
Flexural Strength	UNI EN ISO 14125:2000	Mpa	131,52
Flexural Modulus	UNI EN ISO 14125:2000	Mpa	6248,5

Properties per density unit			
UTS per density unit		Mpa/g*cm3	70.71
Tensile modulus per density unit		Mpa/g*cm3	6639.4

- which users exploit the new material offer?

With WINDFORM® XT the purpose of reducing time to market is achieved, guaranteeing reliability, quick time of creation, finished and off-the-shelf products, ready to be tested, and high performance. These characteristics are essential in different sectors such as aerospace, racing, motorsports and automotive, or still sectors as design, packaging, electronics, entertainment, government, consumer products (household appliances), industrial, lighting systems, OEM products, etc. Whenever quality, performance e short times are needed WINDFORM® XT is the right product.

- Is it possible to find some metal alloys that can be compared to WINDFORM® XT performance?

Just to have an idea, it is possible to compare specific properties (properties per density unit) at room temperature and check if there is such a great difference between 2 aluminium alloys and WINDFORM® XT, as it is between simple Nylon or Nylon GF and all metal alloys family.

The comparison is with:

A356.0-T6: Sand cast aluminium alloy

(www.matweb.com; <http://www.matweb.com/search/SpecificMaterial.asp?bassnum=MAC3560A6S>).

Typical applications: cast engine crank case or gear box, 2 and 4 strokes.

A5052 H32: Magnesium - Aluminium alloy

(<http://www.aviometal.it/>)

Typical applications: welded structures in aeronautics.

Specific Properties	A356.0-T6	A5052 H32	WINDFORM® XT
UTS Mpa/g*cm3	87.6	78.35	70.7
Elongation at break %	3.5	6-12	2.6

To be noticed that there is not such a great difference among the materials specific properties, considering that WINDFORM® XT is polyamide based.

- Have you ever tested your parts on a real F1 car, for practice tests or a race too? So you can really make final parts and not only prototypes?

Of course! We have done a lot of parts for F1 cars. We began with Windform GF, and now we use Windform XT first of all. We make brake ducts, air intakes, cooling ducts, parts of fuel system, bodywork flapsand so many other parts...I have to underline that usually we prefer to suggest to customers to use Windform XT for parts that require high UTS, high resistance to vibration and high thermal properties, while Windform GF better suits parts that are in touch with water or fuel. By the way, we made a lot of race weekends, from F1, to MotoGP, WRC...and so on. We run an entire Motorbike World Championship with the chain pad, the head cover, the water pump cover, the seat, the mudguards, some windscreens, the ariboxes of the motorbike (250 cc) all made by Windform GF and XT. Oh, and we can make parts for final street cars: we made some parts for last Gallardo Lamborghini bodywork, and they are just....going around with absolutely no problem, they are even better maybe... The real difference in fact is that our parts, made by RP SLS and Windform materials, finished the race...other tried to do the same with other technology and materials and broke the parts at the pit lane end...

R&D AND CUSTOMER CARE

WINDFORM® XT is born from the link between R&D and market needs.

The CRP's service bureau department collects the market requests and problem lists of the past 10 years, and passes them to the R&D department. The cooperation between those two departments are so close and excellent not only for the results recognized all over the world, but above all for the service it give to the customer.

In CRP staff's opinion, it is very important to interact with its' clients: Customer Care is one of the company's top priorities in order to shorten customers implementation times.