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FEATURE

A new innovative SLS front air inlet is born

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New materials enable engineers to create tougher, stronger, lighter, higher-performing components. This can be seen with materials such as composites for Selective Laser Sintering (SLS) technique: driven by demands from high performing sectors such as motorsports and automotive, the frontiers of material development will be pushed to even more extreme levels in order to reach even more successful results.

SLS composite materials must be suited to the application. The properties of any material become increasingly important as a product progresses from concept and functional prototyping to end use. CRP Technology's R&D department tackled the development of a new front air inlet for a Moto3 racing customer to solve space issues in the front fork area. It has been manufactured in WINDFORM® composite 3D printing materials by using the SLS Additive Manufacturing technique. Testing had shown that increasing air flow to the air-box improved the performance of the engine at every RPM range. This led the team as well as the engineers to conclude that they need to design a new track ready inlet. This design would make the air inlet longer, and bring the opening up to the front side of the fairing, in order to have a direct air flow with less turbulence.

Among the goals to be achieved was the need to avoid modifying the existing frame and the existing triple clamps. The design would have to fit the existing platform in order to test the on-track advantages and disadvantages of using this solution, and to make a direct comparison with the current standard inlet. The final decision to use the new inlet came from its behavior on-track with the key points being its performance and reliability. Engineers kept the current airbox with the aim to mount the traditional air inlet as well as the new one and to acquire data of the airbox pressure on track.

Through the use of reverse engineering, the original airbox was scanned and virtually assembled with the CAD system. This allowed the engineers to be able to create a new model of the air inlet by taking into account the amount of available space, and the constraints of the assembly of the current airbox and frame.

The reverse engineering technology represents a fundamental tool to recreate, design samples that are no more at disposal from the point of view of the industrial production, or to create pieces that are unique in the world. Reverse engineering represents a considerable advantage in the reduction of engineering timing in order to obtain high-quality products. Reverse engineering is also connected to product engineering because it can be used as the starting point for development of a product.

Once a first draft of the air inlet was developed, a prototype in WINDFORM® GF 2.0 (Composite polyamide based material reinforced with glass and aluminum) and SLS technique was created (Fig. 1).

The first air inlet prototype allowed engineers to see if the design fitment was correct and suitable for assembly. It was revealed by

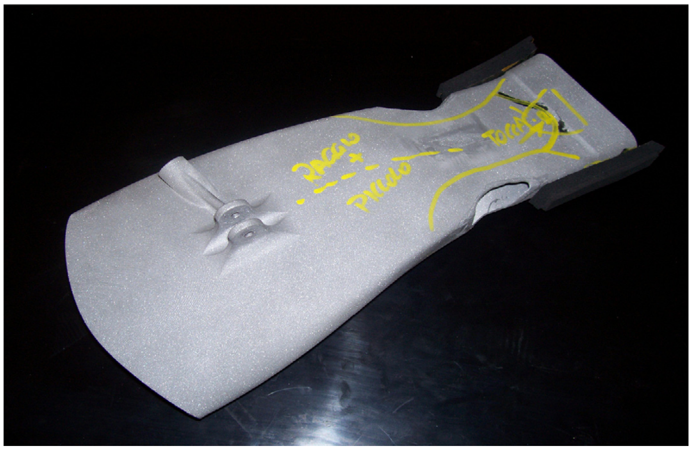

FIG. 1

First prototype: the duct was mounted and required changes were marked. The flexible areas were adjusted to guarantee the minimum steering angle.

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the first design that some sections needed to be changed due to the lack of space available under the lower triple clamp. This problem is further complicated when the bike is cornering and under braking conditions.

To optimize the volume of the inlet duct under the lower triple clamp, the engineers adopted a creative approach and decided to use a portion of the duct in WINDFORM® RL, rubber-like composite material. This would be bonded to the main structure that was made out of WINDFORM® XT 2.0 (ground breaking carbon fiber reinforced composite 3D printing material) for evaluation in racing conditions. To facilitate this they also carried out a bonding test to study the characteristics of the final assembly.

The concept was to make the bottom part of the duct with WINDFORM® RL in the fork and triple clamp area, and then assemble this into the top part produced in WINDFORM® XT 2.0. This approach would allow good clear airflow on the straightaway sections of the course, and thus an excellent flow to the airbox. Under breaking, the front fender could move up and collapse the inlet duct without any damages, due to the flexible material.

In addition, it was decided after examining the part that making the ducting flexible in the same area next to the front forks would off an additional benefit. The engineers were able to maximize the duct volume because the maximum steering actions are only reached when the bike is pushed into the paddock by the technical staff. In this situation, the front fork can tough the inlet duct deforming it without any damages (Fig. 2).

Before proceeding with the construction of the airbox in WINDFORM® RL and WINDFORM® XT 2.0, a second prototype was made in WINDFORM® GF 2.0. Once the second prototype was mounded the engineers noticed some changes to be made, especially in the front fork area.

The soft section was too short and the forks could touch the area of the duct near the bonding overlap when steering travel was checked from lock to lock position. It was also seen that toward the back of the flexible area, near the airbox, that the duct was very close to the front wheel in the maximum braking position.

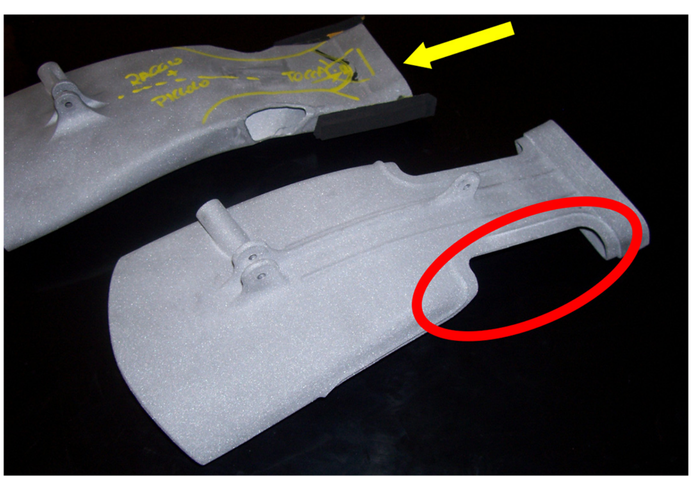

FIG. 2
Comparison between the two prototypes. First prototype: outlined in yellow changes to be made. Second prototype: the flexible area has been redesigned (outlined in red) in order to ensure the mobility of the steering.

During testing it was determined that when the motorcycle was under severe braking, the front fender contact area on the duct in the soft part was too large. This situation, from the rider's point of view, was not good because during hard braking, the steering must be free from movements, as the rider might need to correct the trajectory quickly. The amount of input from the rider may be small, but it must occur very smoothly and too much contact of the front wheel assembly gave the impression of drag on steering. This affected the way the rider felt on the bike. The team and engineers decided to change the inlet by reducing the portion that would make contact with the fender to reduce drag perceived by the rider. The part made in WINDFORM® RL was enlarged according to the second test, and engineers and the rest of the team could get the correct fit for performance.

SLS technology uses a laser to harden and bond small grains of composite materials into layers in a 3D dimensional structure. The laser traces the pattern of each cross section of the 3D design onto a bed of powder. After one layer is built, the bed lowers and another layer is built on top of the existing layers. The bed then continues to lower until every layer is built and the part is complete. One of the major benefits of SLS is that it doesn't require the support structures that many other AM technologies use to prevent the part from collapsing during production (Figs. 3 and 4).

In the final test version, WINDFORM® XT 2.0 was utilized in order to reduce the weight of the front and central part of the inlet, while the WINDFORM® RL material was used for the flexible part of the inlet. The two parts were bonded together after being produced (Fig. 5).

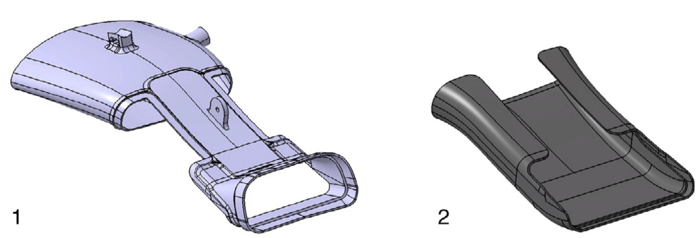

FIG. 3
From left: (1) Front air inlet – top part in WINDFORM® XT 2.0. (2) Front air inlet – bottom part in WINDFORM® RL.

FIG. 4
Front air inlet (final version) after testing. Outlined in red the zone where the front fork touched the inlet duct.

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