metelli s.p.a.

New techno-polymer impellers for water pumps: quality and technology for maximum reliability

Water pump impellers

Water pump impellers have always been the key component that make water pumps do their job: circulating water throughout the entire engine cooling circuit.
In fact, the water pump's role is to rotate the impeller which provides the coolant with enough pressure to circulate it with an adequate flow rate throughout the cooling system, overcoming resistance within the circuit

First and foremost, therefore, the impeller must be reliable, but this is not enough: it must also be designed and constructed to ensure the flow rate and pressure needed for proper cooling of the engine with which the water pump is intended to be used.
Metelli always designs its own impellers in-house, not just optimizing the flow behavior, but also by choosing the materials and production process that best fit the specific needs of each component.
Metelli is always alert to innovations in materials and manufacturing technologies, yet very careful to validate new solutions properly before releasing them onto the market; accordingly, the materials now used to make the impellers can also include techno-polymers, which have now reached an high level of technical maturity.

Materials chosen

Polymeric materials, which can now be found in practically all everyday objects, are not all the same!
Today there are perhaps hundreds of different polymers, each with its own particular characteristics; these polymers may in turn be strengthened by mixing different types of reinforcing materials that, in technical terms, are called "fillers": this combination of polymer and filler produces what is known as a *composite material*.

The use of a huge number of different polymers with a range of filling materials creates a virtually unlimited combination of composite materials, each with its own properties, for the designer to choose from.

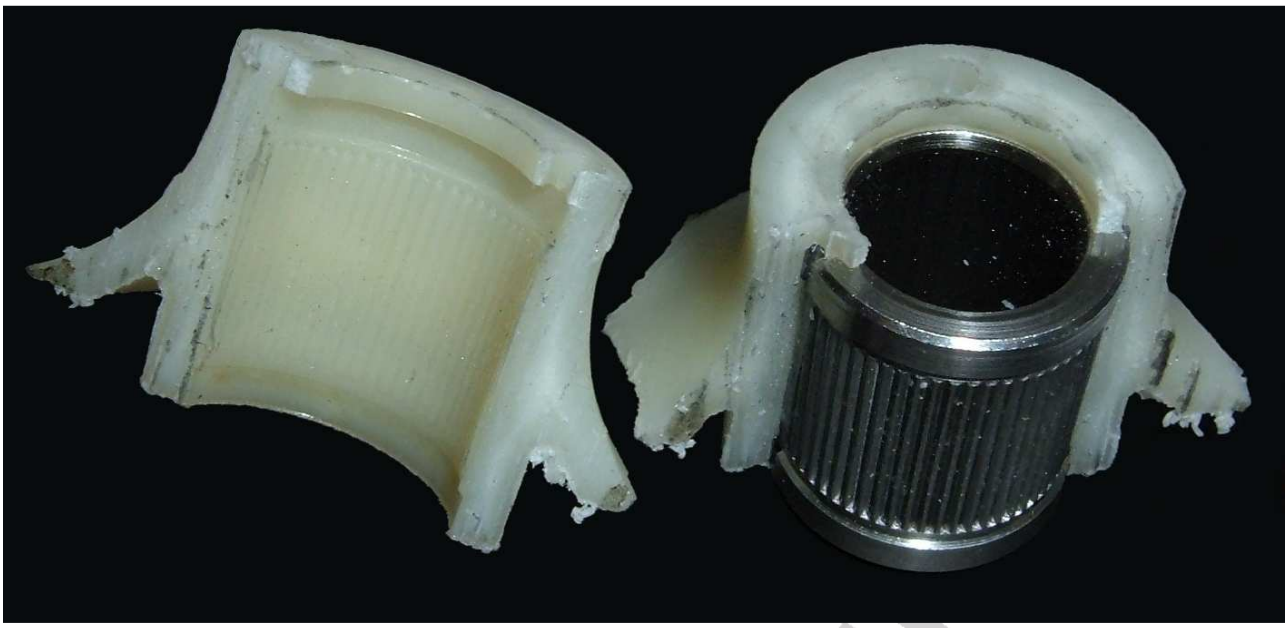
Metelli's designers have chosen their polymers with a key objective in mind: providing a reliable solution. The criteria for selecting polymers include not only purely industrial factors, such as the systematic capability to make a proper molding, but also the strength properties of the materials when exposed to operating conditions.
Metelli's aim is to provide its customers with a component that was free of the problems found in some OE references.
The polymers tested, validated and accepted by Metelli are all materials produced by the world's leading polymer producers.
All our suppliers of these materials have large production capacities, detailed knowledge of the process and chemistry of the material itself, which all goes to ensure that the materials supplied are always of the impeccable quality that allows us consistently to produce top quality impellers.

The “colors of the impellers”

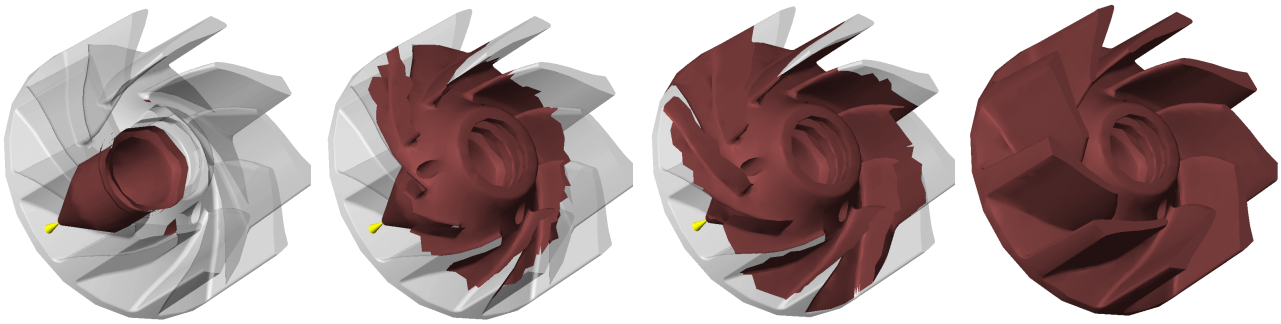
In addressing the potential use of polymers in water pump impellers, studies have been carried out by technicians, and therefore the purely technical aspects relating to the characteristics of the materials have been given considerable importance among the various factors that have been taken into account in making the choice.
This approach has resulted in the identification of a set of polymers found to be suitable for their performance, as opposed to their appearance.
All the materials selected are "neutral" in color, which means they all have the color that is naturally given by the production process; the pigments used to give polymers fanciful colors do not make the slightest contribution to the polymer’s structure, but their particles are real foreign bodies within the material.
So what does this mean? It’s simple: “naturally colored” polymers have the best mechanical properties, providing further assurance that every design choice has been made for maximum reliability.

The metal insert

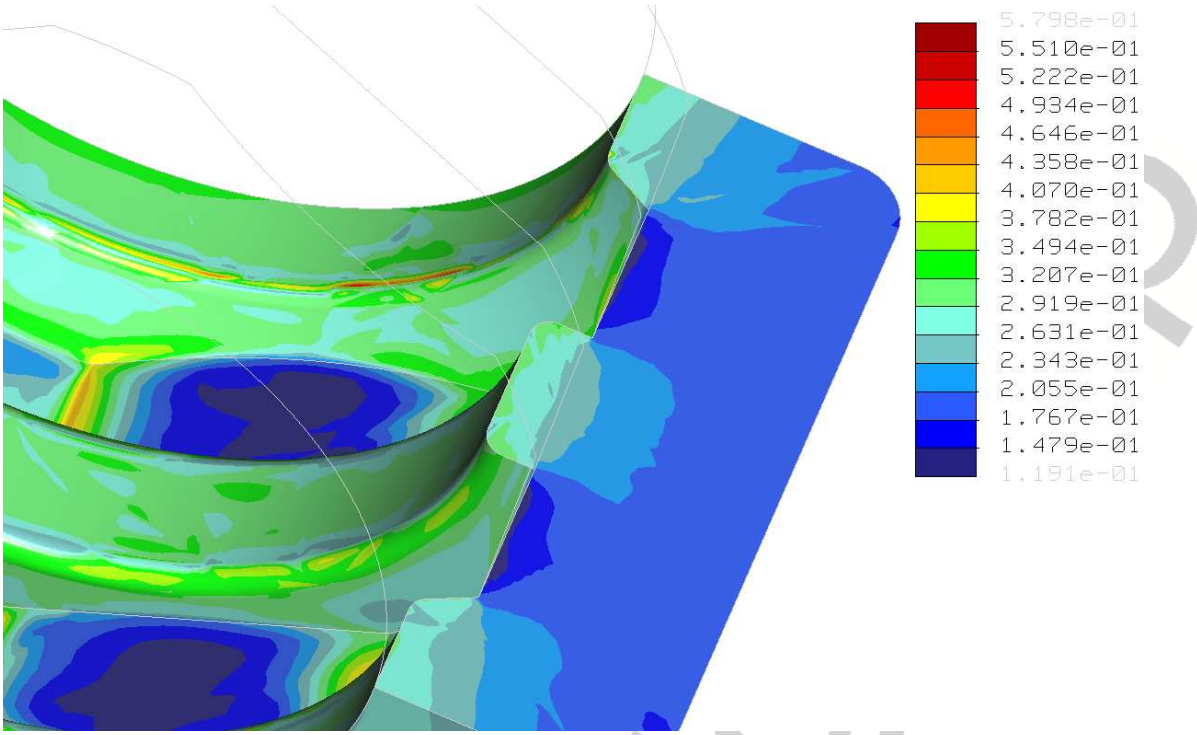
The metal insert, although seemingly insignificant, is really the key to achieving proper drive for the entire impeller.
This insert is assembled with sufficient interference on the bearing’s shaft to ensure correct impeller positioning even in the harshest working conditions.
This assembly causes considerable mechanical stress on the insert itself, but the characteristics of the steel used and the dimensions of the insert ensure that nothing but a virtually negligible percentage of these stresses is transmitted to the polymer surrounding it.



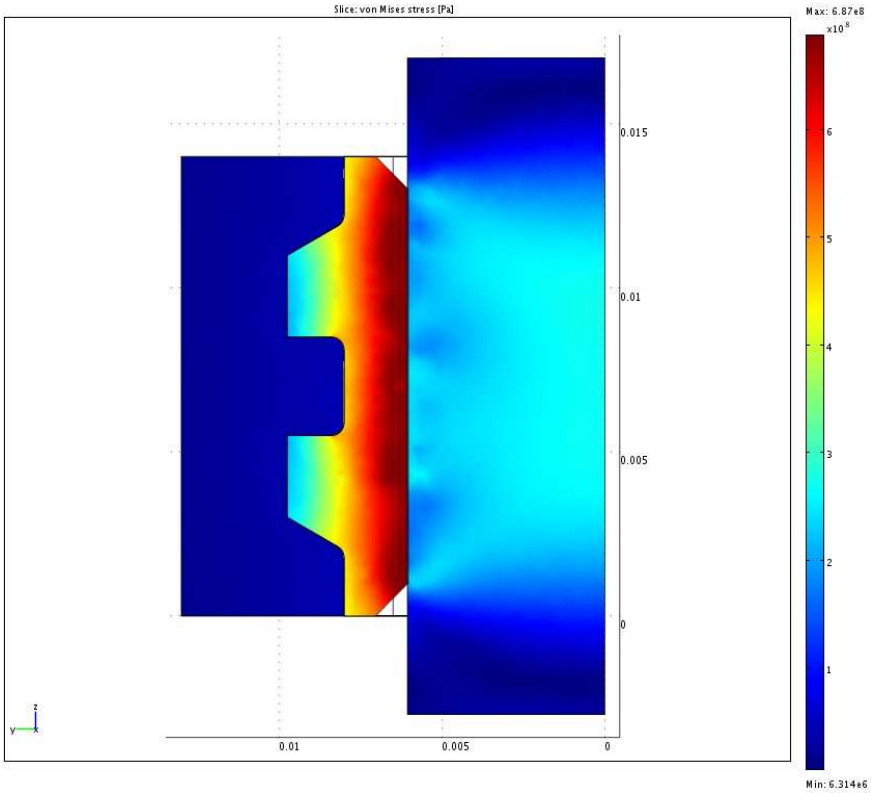
Unlike almost all inserts, with simple vertical ribbing that can be found on the market, Metelli conducted specific studies that have finally enabled completely new geometries to be defined. We did not confine ourselves by adopting the same solution, since this geometry is not without problems, as we ourselves have been able to verify.



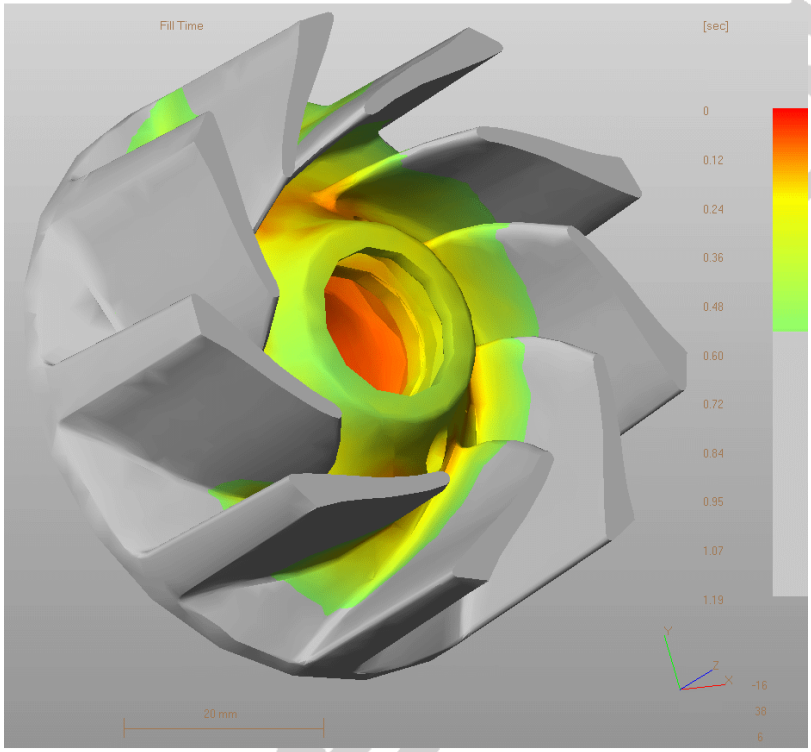
The geometry of the surface in contact with the polymer is key to correct overall functioning, and it was not the result of mere testing, but has been the subject of extensive analysis and a number of specific studies.



Before we even built the first prototypes, Metelli research and development engineers have made several computerized FEM simulations; the appearance and characteristics of the surface devised have been carefully evaluated from all points of view.
No aspect has been overlooked and in performing these studies the best simulation software on the market today was used.



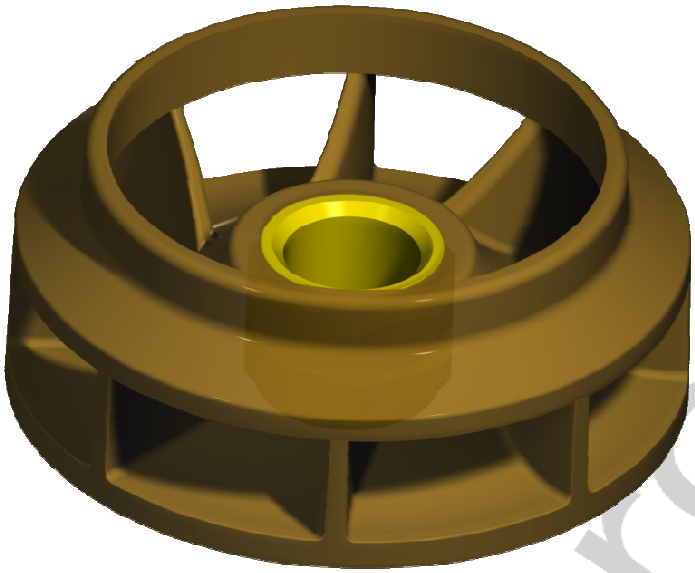
The geometry of the insert was validated with the computer, by considering how well the surface of the insert, which must be in contact with the polymer, can be successfully incorporated during the molding stage of the impeller.
Indeed, it is fundamental that the insert is incorporated without residual air bubbles inside the impeller, as only then can all the design assumptions find effective and reliable expression in the actual component.



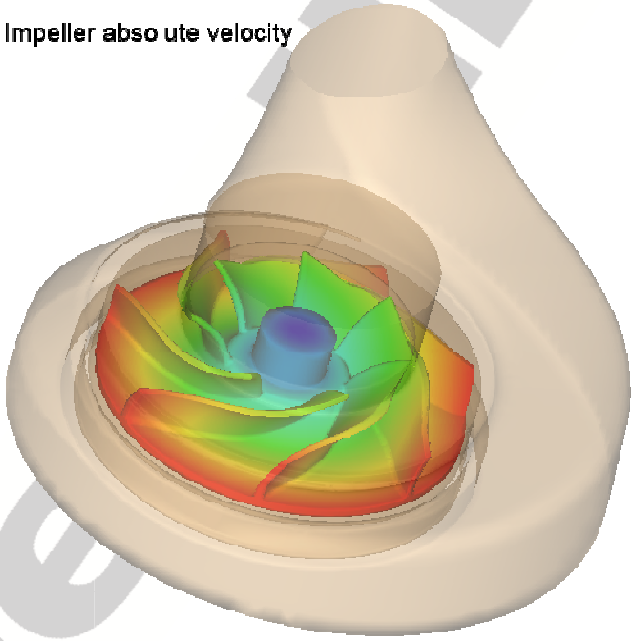
The result of all these studies is a unique insert which is unique of its kind, offering an excellent combination of high torque transmission capacity to the polymer with high resistance to mounting stresses without putting the impeller itself under stress.

The performance of techno-polymer impellers

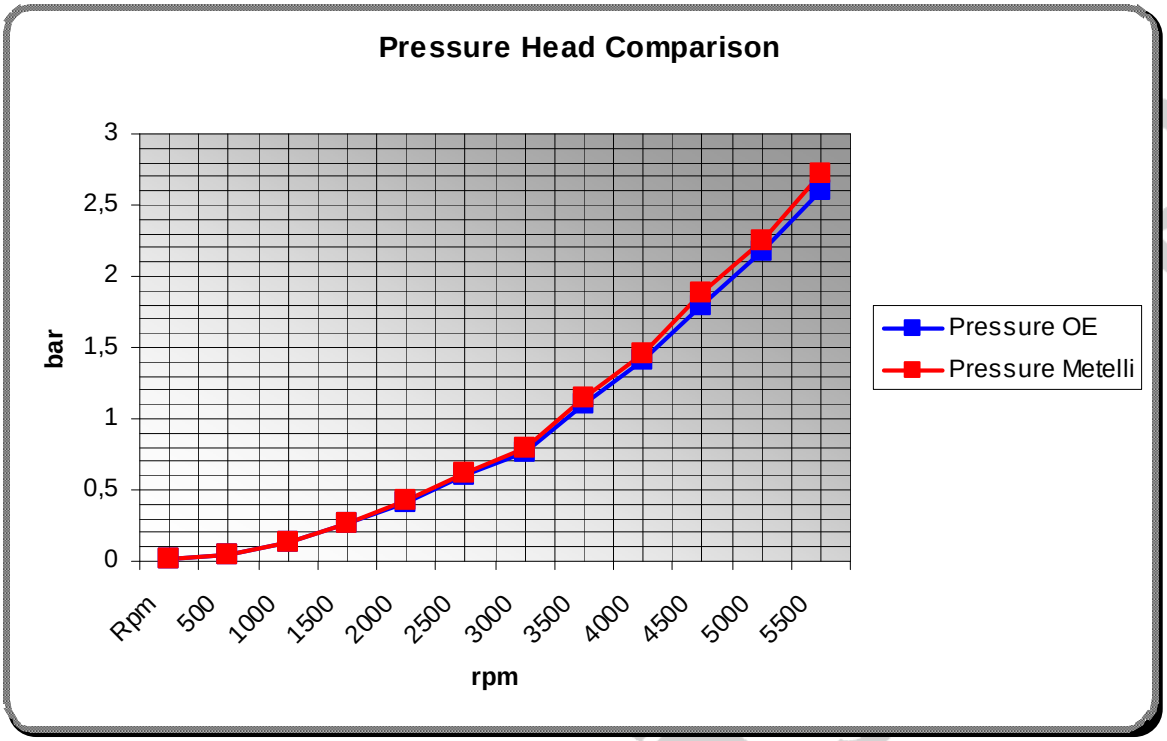
Water pump performance is always an important consideration for Metelli's engineers.
Our impellers must meet ever greater performance requirements, which is why over many years our engineers have worked with established technologies like injection molding, and innovative materials such as latest-generation polymers which are capable of failure-free operation even at the high temperatures found in the cooling circuit.

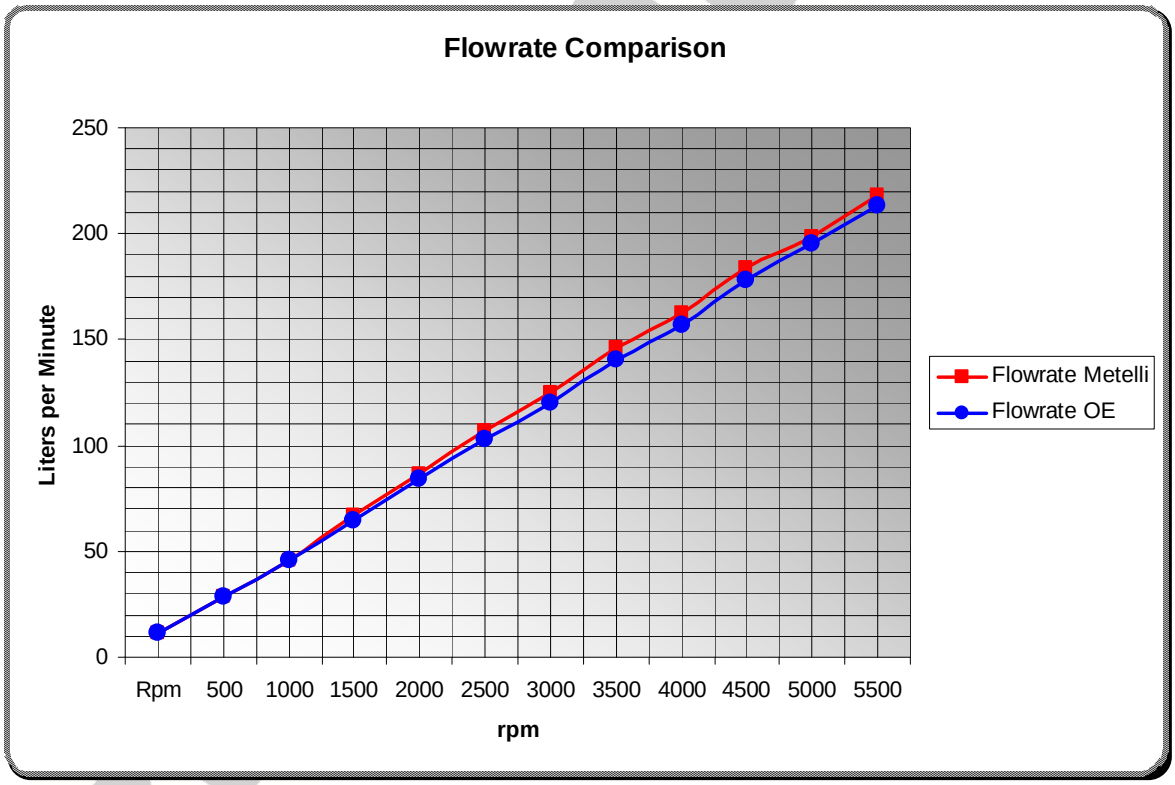


It is precisely through the pursuit of our corporate philosophy, to achieve the right performance for our water pumps every time, but not at the expense of reliability to customers, that we have developed this solution.



Without compromising on product reliability, we have devised a solution that offers further improvements to the performance of our water pumps, creating shapes and surface finishes which are unachievable with other production processes.





As a result of this approach, our impellers have performance that were first simulated using the best CFD software on the market today, and then measured and verified at the test bench. This performance is therefore absolutely compatible with the components they replace, whilst ensuring optimum behavior under operating conditions.

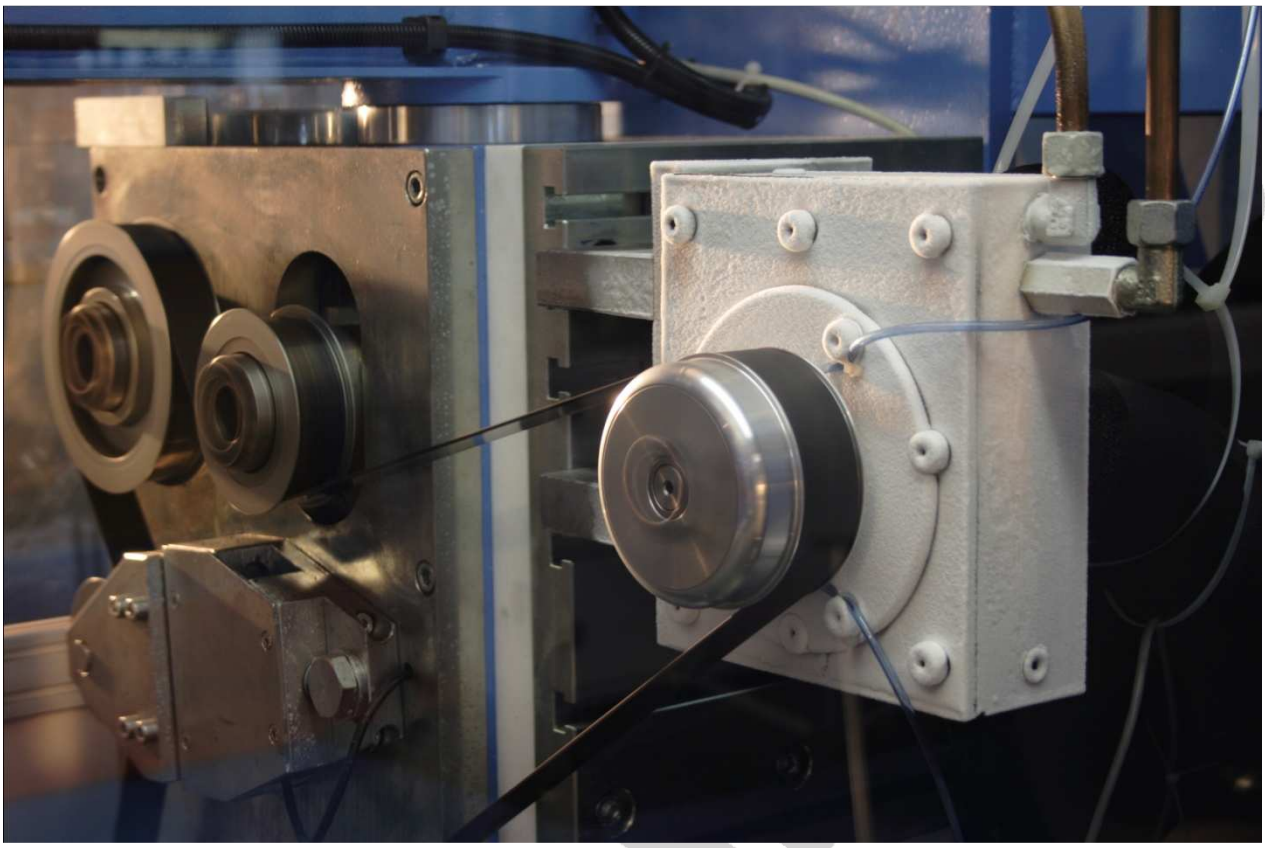
The reliability of the solution

Metelli has always offered its customers highly reliable products. When designing and producing techno-polymer impellers too, reliability has been a essential objective in order to deliver the products to the market.
Thousands of hours of testing have been carried out at our test benches; each aspect has been taken into account, first at the design stage, then with individual tests on real components.
Today we are proud to have sold tens of thousands of techno-polymer impellers without any problem of returns.

The stringent testing

Solutions have been designed, planned and simulated on computers, and intensively tested by our test engineers.

Due to the need to verify different technical aspects from those affecting impellers made from "traditional" materials (such as cast iron, brass, steel, etc.), Metelli has designed and built a special test bench to its own specifications dedicated to testing the reliability of techno-polymer impellers.
The use of this test bench, along with other existing ones, has enabled us to develop extremely heavy duty test cycles, which put the entire impeller under extreme thermal and mechanical stress.



The final solution adopted successfully passed all the tests devised for these components, and prototypes that failed just a single test were deemed unsuitable for release to market.