

# shape

*Gurit*

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## Dear Reader

September draws to a close and it has been another busy nine months for Gurit. We have made further progress in developing our core businesses, strengthening our product offering and adapting our organizational footprint to customer and market needs.

At product level, the launch of Gurit Kerdyn™ Green PET and the new Balsaflex™ Lite as the future wind core material solution was a major step forward. Please see page 32. We believe that both products create strong customer value. This will support our business partners in achieving the necessary cost savings for wind energy to reach unsubsidized cost parity with non-renewable forms of energy.

Better user health and safety has been the driver for our Formulated Products development activities. Ampreg™ 30 and Ampreg™ 30 LRT (see page 33) are the first additions to the product range that have been launched this year and further products will be introduced in the coming months.

The appointment of Dr. Emiliano Frulloni as Group CTO and member of the Executive Committee as of November 1st, 2018, will strengthen our innovative capability and we look forward to having him add a new perspective to the experience and know-how that our teams have built up over the course of the years.

At organizational level, transfer of our prepreg production activities from the UK to Spain made further progress and is expected to be completed within the coming weeks. Moreover, aerospace has been established as an independent business unit in order to bundle resources and strengthen focus. Recruitment of Michael Muser as Head of Business Unit Aerospace and member of the Executive Committee as of January 1st, 2019, supports our target to further enhance customer value and growth.

We are also very pleased that the marine market has returned to a healthy growth rate and there is a large number of projects that we want to share with our readers. Therefore, we have launched a dedicated quarterly marine newsletter. Please feel free to subscribe to stay up to date.

We hope you enjoy the selection of projects and updates in the current issue of Shape – The Gurit Magazine. Happy reading!

Yours sincerely,  
Rudolf Hadorn CEO

# Pink Gin VI –

## Opening the doors to innovation

Baltic Yachts and Gurit have enjoyed a long and productive relationship, collaborating closely for 30 years to produce an impressive portfolio of Baltic superyachts that in recent years have included award winning yachts like Nilaya, Visione, WinWin and Hetairos, all of which are all-carbon with an accompanying high level of performance and technology. Their latest superyacht, Pink Gin VI is no exception and has recently been named by Boat International as, the Sailing Yacht of the Year and taken out the Sailing Yachts 50m and Above class in the World Superyacht Awards 2018.



With naval architecture by Judel/Vrolijk, Pink Gin VI stands out, not only by the fact that it is the largest carbon fibre sloop in the world, but also by the presence of a unique design feature. Cut into the topsides of the yacht are a pair of large balcony doors; one forward, acting as a balcony for the master cabin and one amidships serving as a tender dock and main sea entrance.

Until now these features have been limited to motoryachts where global loads are of lesser consideration. However with designers increasingly looking to incorporate mega yacht features into sailing yachts it falls to structural designers to turn these ideas into reality.

The viability of the project was not only dependent on whether the doors could be successfully incorporated into the design, but also on the yacht's ability to gain class approval; the boat would not have gone ahead had this not been possible. To this end Gurit worked closely with Germanischer Lloyd (now DNV-GL) in the early stages of the programme to agree an analysis philosophy and design concept that could evolve into an acceptable end solution. The productive collaboration continued through the life of the project to ensure class compliance for the entire structure.

Crucial to the success of the doors was achieving a high level of global stiffness, as well as producing tight, even shut lines. To achieve this it was clear that such large topside doors would need to be structural, in other words, rigidly connected to the surrounding

topsides and contributing to the structures overall strength when underway. At the same time however, the behaviour of the vessel with the doors open was also critical since not only must the vessel retain a level of residual strength in the event of a system or hardware failure, but also the doors' operation must not be impinged by deformation of the frame. With so many considerations and challenges, and with mechanical systems becoming an integral part of the structure, Gurit not only took responsibility for the composite design but also the concept and preliminary design of the door mechanism itself.

A global finite element model of the yacht was created to assist in the design by evaluating the vessels deflections and laminate strains with the doors open and closed, combined with multiple loadcases to reflect sail configurations, sea states and static rig loads. This testing provided an accurate estimate of maximum loads imparted on the door hinge and

locking mechanisms for Gurit engineers to find a suitable system capable of handling these loads.

Using the finite element model, a solution was found that incorporated structural hinges at the bottom corners, and lateral pins in the upper corners. These four components have the effect of holding the four corners of the door and transferring the in-plane



global loads in a way comparable to a diagonal truss, while minimising the number of moving parts. Additional side-locking pins were incorporated to the sides of the door to assist with water tightness but do not play a structural role so were designed to be comparatively small.



**“The viability of the project was not only dependent on whether the doors could be successfully incorporated into the design, but also on the yachts ability to gain class approval; the boat would not have gone ahead had this not been possible”**

Designing the door and hinge system wasn't the only challenge Gurit engineers faced, the design and engineering of the carbon fibre trunk that houses the 71 tonne lifting keel, capable of being locked into one of three vertical positions between 4.5m and 7.5m was also undertaken within this project.

The size of the keel fabrication and enormity of the loads meant that a close collaboration between Gurit and keel suppliers, APM was essential to establish a keel head and fin geometry that would load the internal surface of the composite trunk and the hull shell in a manner that could be accommodated. Once more, with such large loads being applied, it was critical that the full thickness of the keel trunk laminate was built up in such a way to avoid any laminate imbalance, which could see laminates failing in through-thickness shear or out-of-plane bending when loaded in tension. All of these global and local considerations were investigated using solid and shell finite element models to verify the very detailed laminate specification.

Gurit engineers designed a machined sacrificial Super Duplex stainless steel grounding block at the trailing edge of the fin. The grounding block was designed to

transfer the grounding loads (over 1,300 tonnes) from the keel fin into the heavily reinforced lower perimeter of the keel trunk, such that loads can then be dissipated evenly into the hull shell and surrounding structure.

Similar to the door and hinge system, this area was designed and extensively optimised for weight saving using finite element analysis while applying geometry constraints to ensure the finished geometry could be practically machined.

The weight optimisation is continued in the materials with Gurit supplying composite and class approved materials with comprehensive technical support and mechanical testing. Pink Gin VI is predominantly constructed using Gurit Corecell™ M structural foam, SE 84 carbon prepreg, SPRINT™ ST 94, Ampreg 22 laminating epoxy, high modulus carbon unidirectional tapes for global stiffness and Gurit's SF 96 surface film to provide a fantastic paint ready surface straight from the mould.

We at Gurit are incredibly proud to have been involved with this innovative project, which replaces Pink Gin V, a 152ft yacht launched in 2006, also a Baltic Yachts/Gurit collaboration. Since launching Pink Gin VI in June 2017

the Baltic Yachts team is now well on their way to completing construction of a full carbon prepreg and SPRINT™ Baltic 142 Custom with a Dynamic Stability System, a Baltic 112 Custom and a Baltic 85 Custom.

Pink Gin VI is an excellent example of how mega yacht features such as the novel balcony doors are possible if the right approach is employed. These design and engineering challenges were noted by the judges of the World Superyacht Awards 2018 who state “Pink Gin's hull and rig were considered to be a triumph of structural engineering in that her fore and aft deflection is a mere 76mm, despite a 300-tonne rig loading imposed by her 68-metre high carbon mast. While contributing enormously to the practicality and functionality of the yacht, the two large hull openings – a guest's boarding platform to port and a balcony in the master cabin forward – further added to the complexity of this engineering.”

The team at Gurit look forward to continuing our collaborative relationship with Baltic Yachts and following the progress of the Baltic Custom yachts expected in 2019.





# Supporting Growing Wind Turbine Blade Lengths with Automation and Service

The global wind energy industry has made rapid progress on the path to becoming a fully competitive, unsubsidized constant in the global energy mix over the past years. One of the key factors contributing to this success is the growing wind turbine blade length that helps to better utilize wind conditions. While the average wind turbine blade length was at around 40 meters in 2008, it has grown to an average length of 67.4 meters in 2018. This trend, however, presents challenges for the manufacture, transport and installation of wind turbine blades. Automation of processes and additional services, e.g. for the safe and damage-free transportation of wind turbine blades, play an increasingly important role for OEMs, manufacturers and operators.

## **Production Records at Highest Quality**

To support this development, Gurit has constantly invested in its Tooling production facilities, while expanding its overall Tooling offering and increasing its service network. The production facility

in Taicang, China was steadily expanded over the years; it now has a total area of some 45 000 square meters. The premises offer a climate-controlled production environment equipped with the latest technologies as well as multiple bridge cranes for efficient and safe

mould and material handling. The manufacturing set-up has already enabled construction of wind turbine blade moulds of lengths close to 90 meters. The most recently added new production bay now provides the space to manufacture moulds of up to 150 meters – ensuring the parameters are set for whatever comes next in the industry.

The Gurit Tooling premises in Taicang, China, some 40 km from central Shanghai



About 500 employees deliver an annual production capacity of over 70 mould sets per year. “It is the combination of a state-of-the-art production environment and a highly skilled team which guarantees the fast, reliable and flexible completion of customer orders to specification and at highest quality standards,” explains Kelvin Yao, Operations Manager at Gurit Tooling.





Installation of a mould heating system at the Gurit Tooling premises.

### Complete Suite of Automation Tools

Gurit Tooling offers a complete suite of automation tools, designed to address every aspect of the wind turbine blade manufacturing process. This additional offering comprises mould heating systems customised per the size of the mould with dedicated heating zones and featuring powerful, in-house developed software for full control and easy supervision of the curing process, as well as data logging for quality control tracking. The mould heating systems are available in two types: electric heating systems, including the Gurit PH Automation PowerHeater system, as well as Gurit's patented liquid heating and cooling system which facilitates controlling of the laminate temperature during exothermic reactions.

To safely and precisely close the two halves of a mould, Gurit Tooling offers a range of mould turning systems. The different

hinge models suit various mould shapes and sizes with the largest able to safely open and close mould halves weighing up to 165 tonnes. Available models include the Gurit 160, 200 and 258 hinges as well as the Gurit PH V45, V57 and V67 Powerhinges. All hinge models are aimed at retaining a small footprint and low pivotal height and seamlessly integrate with further automation equipment – such as the mould align-



Gurit PH Automation V57 modular hinge

ing and clamping system (MAC). The MAC ensures a repeatable bond gap and overbite alignment between upper and lower mould half. It provides even clamping pressure and is much safer and quicker than manual clamps. It is available as part of the mould package or as a stand-alone product and can also be complemented by the shear-web aligning and clamping system (SWAC), which assures repeatable and precise alignment between the shear web and the mould half.

Additional services include engineering, tune-up of moulds and automation systems as well as operator and maintenance training. Blade dollies, blade transportation and blade lifting devices are targeted at supporting customers to safely transport and install the finished blades. With service centres in China, India, Europe and North America, Gurit Tooling is also able to support installation and maintenance of wind blade moulds and related automation equipment to make sure customers benefit from fast production readiness, minimised downtime, and quick maintenance on site.

### For further information, please contact:

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# Bringing Niche Medical Supplies into the 21st Century

**Benefitting from the award-winning design and manufacturing expertise brought by its parent company Adept Ltd, Adept Medical has quickly become recognised as New Zealand's leading specialist plastics manufacturer to the medical market.**

Operating from central Auckland for over 40 years, Adept have developed a reputation as leaders in the product development and manufacturing industry. The subsidiary, Adept Medical specializes in providing innovative new products in partnership with medical professionals to fulfill niche market needs within the medical industry internationally.

With the addition of composite capabilities to the factory, Adept Medical have designed and developed a range of products utilising Gurit's B<sup>3</sup> SmartPac construction solution with Corecell™ M foam and carbon fibre reinforcement. Gurit's ability to supply both CNC cut foam and carbon cloth to Adept Medical's design has allowed the team to focus exclusively on the lay-up and moulding process and significantly increased the speed of their manufacturing procedure as a result.

The benefits of Adept Medical's composite capabilities are evidenced through the success of the STARSsystem range, which encom-



passes the STARBoard, STARTable and STARSsupport. The system has been designed to provide a complete, clinically engineered solution for radial access procedures. Manufactured using Gurit Corecell™ M as the sandwich panel, the complete system achieves a lightweight 3.3kg or 7.3lb assembled, allowing for medical staff to easily transport and assemble the pieces. Corecell™ M was also selected due to

its radiolucent nature; allowing clinicians unimpeded X-ray scanning without removing the unit. Carbon fibre is used as reinforcement throughout the STARSsystem to provide sufficient strength, an aesthetically pleasing appearance and to maintain the light weight advantages provided through the use of composites. The STARTable however, has 0.5mm thick lead added to the carbon fibre in order to minimise the issue of radiation scatter, providing up to 80% protection for the operator.



Adept Medical's latest innovations to join the STARSsystem are the Femoral Table and the IR Platform which have been similarly created using Corecell™ M and carbon fibre. Designed in conjunction with a neuroradiologist, the tables are an effective solution for all femoral access procedures and have been shown to offer clinical benefits to the current practice of laying procedural equipment over the draped patient's legs. The Corecell™ M provides a lightweight, radiolucent work surface that has been designed to facilitate stable catheter or guide wire manipulation and to provide a surface for syringes, towels and other equipment. Like the STARSsystem, the Femoral Table and IR Platform are also reinforced with carbon fibre to complement the composite sandwich core and to provide additional strength, bringing medical supplies a step towards the future.

# Getting to the Core

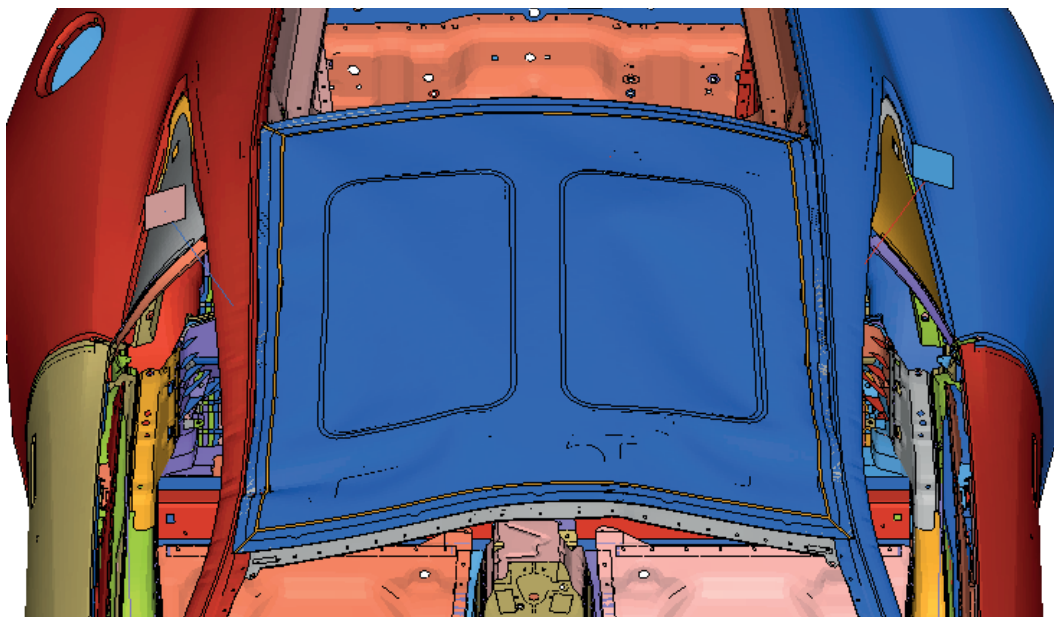
The forty strong Gurit engineering team has demonstrated a strong track record since the 1980s, providing independent composite engineering services. Since then, the team has optimised everything that floats, from racing yachts to production boats, super yachts to workboats. Today, their capabilities stretch further with expertise in the automotive sector, civil and architectural structures, renewables and capabilities to provide support with any FRP project.

Crucial to the design and engineering in all industries is understanding how the material behaves and performs. To facilitate this, Gurit runs an internationally accredited mechanical testing laboratory at the site in Auckland, New Zealand, which specialises in the mechanical testing of FRP composites. With this testing facility, composite engineers are able to design and carry out testing on sample objects, interpreting and reporting on the results to apply improvements to the end design or process.

Besides static material testing at the Gurit in-house lab, activities recently also involved dynamic core material testing at the Uni-

versity of Auckland Centre for Advanced Composite Materials using their drop tower and high speed camera. The goal of these tests was to prove that energy absorption rather than shear elongation is the most suitable measure to determine a core material's ability to absorb impact.

This is crucial for the longevity of racing and endurance yachts, such as the Volvo Ocean Race yachts which during Leg 7 pass Point Nemo, an imaginary place that marks the farthest distance from land. At this point, the closest humans will be the astronauts on the International Space Station, so outside help is a long way away!



Roof crush FEA

Results have been presented at the 12th International Conference on Sandwich Structures in Lausanne, Switzerland in August this year. Findings will also be shared with classification societies such as DNV GL to conclusively prove that energy absorption rather than shear elongation should be the measure when evaluating core selection in hull slamming areas. This will enable classification societies to adjust their recognised design approach accordingly and will ensure future projects built according to the classification societies guidelines will be safer and better suited for their intended purpose.

In the marine industry, Gurit Composite Engineering has been working alongside the world's top boat designers and builders since the 1980s and has been involved

in the construction and design of a huge range of vessels. Engineers provide each project with an appropriate level of involvement to suit the project's needs and budget, ranging from basic advice and design sketches through to concept studies to full engineering design, 3D CAD, Finite Element Analysis and construction drawings. In addition to the main structural design, Gurit engineers also design masts and spars, bowsprits and features, such as retractable propulsion systems, all tailored to ensure the highest performance from each vessel.

Similar to marine applications, Gurit engineers are using advanced analysis tools such as Finite Element Analysis in the automotive sector to optimise the designs of cars, buses, trains and other high capacity vehicles to allow for great-

er payloads, better emissions and lower weight. Gurit engineers have furthermore developed technology to simulate a crash test in order to improve the vehicle design through simulation ahead of crash tests such as Euro NCAP which are costly to undertake. Shape spoke with Principal Engineer, Luke McEwen

Interior Head Impact FEA





who advised that “big improvements can sometimes be made by small changes to the stiffness or strength of components so that they fail in a safe way during a crash.” The crash simulation enables these small changes to be identified prior to an actual crash test, making it easier for manufacturers to prioritise safety.

Crash testing was undertaken on the Jaguar F-TYPE Coupe carbon fibre roof where Gurit engineers produced a FEA model of the carbon fibre roof and virtually joined it to Jaguar’s FEA model of the aluminium car body. Thanks to extensive testing on smaller samples of carbon fibre used in the roof, Gurit engineers were able to simulate dynamic impacts and capture the way the material bends, yields or crushes in a crash test.

The first simulation indicated how the roof would behave in the actual crash test. With this knowledge, the

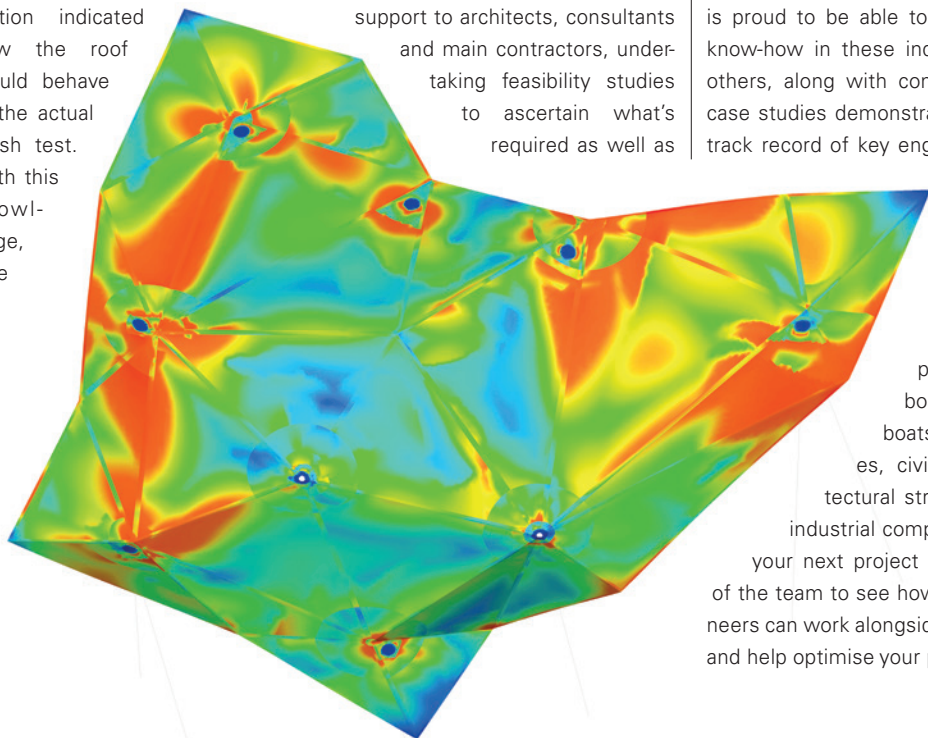
design of the laminates were optimised to make the carbon fibre stronger in some areas or in other areas weaker to ensure it failed in a controlled way. Prototype roofs with the chosen laminate design were then manufactured by Gurit and bonded by Jaguar to the test cars for the physical testing to be undertaken. Lastly, the results of the testing were fed back into the FEA model allowing the material to be fine-tuned for future simulations.

Architectural and civil structures are also benefitting from the design and light weight advantages composites provide the automotive sector. In addition, modular installation efficiencies, low maintenance, corrosion resistance and good thermal and acoustic properties provide architectural and civil structures real benefits over traditional materials. Gurit engineers provide support to architects, consultants and main contractors, undertaking feasibility studies to ascertain what’s required as well as

working with composite fabricators for detailed design and analysis to optimise any structure.

Recent examples include the development of the Rore Kahu building in the Bay of Islands, New Zealand, where Gurit engineers worked closely with the project managers and architect to meet the tight budget while achieving a modern geometric design and ensuring the roof is structurally sound for the years to come. Engineers undertook extensive analysis of the design using a parametric model to combine shape and laminate optimisation where ultimately a final epoxy infused laminate of E-glass and Gurit PET foam was selected, providing an optimum balance between minimum material cost and structural integrity while realising the architects design.

The Gurit engineering team is proud to be able to share their know-how in these industries and others, along with comprehensive case studies demonstrating a solid track record of key engi-



neering services for racing yachts, super yachts, production boats, workboats, cars, buses, civil and architectural structures and industrial components. For your next project contact one of the team to see how Gurit engineers can work alongside your team and help optimise your project.









# The Flow on Effect of Foiling Technology

Foiling as such is not a new concept with pioneers developing motor powered models in the early 1900s. However, it has not been until recent years where we have seen big advancements in technology and design that has moved this technology from small sailing dinghies into large and offshore racing yachts. Ultimate performance boats like the America's Cup Class and the International Monohull Open Class Association (IMOCA) 60s are responsible for these advancements and continue to push the boundaries on what is possible in their quest for victory.

Once only the domain for the most elite professional sailors lucky enough to be selected as part of a team, hydrofoils are now much more accessible to recreational users as the design and technology expertise continues to trickle down. Club sailors competing in the International Moth class to kite foilers are all benefitting from these advancements, each able to achieve faster, more controlled speeds than ever before. But with foiling engineers continuing to seek greater performance and better aerodynamic and hydrodynamic designs for the next generation of ultimate performance yachts, what is possible for these yachts on a competitive level? And how far will the technology and design filter down?

The IMOCA 60s are a playground for new developments and improvements with big budget teams sparing no expense in searching for the winning design. Leading teams are currently using fibre optic strain gaging to analyse, measure and ultimately enhance the performance of the foils by understanding the loads seen on the ocean.

Measuring the bending and twisting of the foils under load is particularly difficult via sight when foiling yachts are moving, instead fibre optic strain gaging works to overcome this difficulty. The method works by placing very low diameter fibre optic cable into the laminate where multiple sensors are setup to measure the foils compression and elongation. Due to the high complexity of processing the data and creating design improvements based on these, the technology is relatively unused by recreational and club level sailors. Instead ultimate performance boats like the top level IMOCA 60 yachts are using this technology to generate valuable data from the foils. Gurit is then instrumental in extracting the raw data provided by the fibre optics and coupled with the analysis and simulations provided through the engineering team are able to integrate the results into design improvements for the next generation of foils.

Technology like this is vital to the development of the foiling industry as although in the short term the effects are seen only by the teams able to afford

and harness this technology, the insights the data provides inevitably trickle down to less competitive uses. Already Gurit engineers are enhancing foil designs by creating low weight, low drag foils that are designed to bend and twist under load to the optimum design, saving energy and hopefully allowing competitive sailors to achieve faster and safer speeds.

We can see the trickle down of technology evident in the International Moth Class sailing dinghy which was perhaps one of the earliest adopters of foiling technology in the racing scene. Competitive sailors vying for a place at the International Moth World Championships are indeed testing, modifying and pioneering designs, much like the elite IMOCA 60s and America's Cup teams, however it is the production Moth Class boats where we see proven foiling designs made available to more budget restricted recreational and club sailors.

A handful of designers have created Moth Class foiling dinghies which are affordable, durable and well suited to sailors without experience on a foiling yacht.





**“The development of foiling boats has come a long way over the past 10 years with big budget teams crucial to the success and performance.”**

These dinghies feature proven designs from successful foiling yachts and Moths that have been adapted to enable beginners to quickly begin foiling and with a few adjustments still remain reasonably competitive for advanced sailors, making them well suited to club use. Foiling designs have been replicated and optimised however manufacturers have used lower performance materials like aluminium to achieve an attractive entry price. Hull designs are again focused on catering to the many rather than to the elite, providing the capacity to handle a wide range of sailor weights and using a strong and durable laminate to provide purchasers with longevity.

With foiling boats constantly reaching higher speeds and gaining in popularity with amateur and professional sailors alike, minimizing the risk to sailors is paramount to the success of the sport. Gurit is a sponsor of The Foiling Week Forum where leading builders, engineers, designers and sailors come together to share knowledge. One of the key topics of this Forum is safety and how to minimize the number of accidents, addressing the topic from all relevant angles – from club rules for safer competitions, crash simulation to the design of safer foilers.

Gurit engineers have harnessed the tools and technical know-how developed through the crash testing of cars and now have the capacity to simulate what happens when a foiling boat hits a semi-submerged object and slamming simulations when a boat falls off the foils and nose dives. These simulations will help Gurit engineers better predict what will happen if a similar circumstance arises and address some of the safety concerns around these issues. Predictions can then be used by designers to create boats with safer features in areas most affected should an accident occur.

With the level of technology and rate of advancements that hydrofoil yachts are seeing presently in terms of both safety and performance, where to next with these designs? Shape spoke with Gurit Principal Engineer, Paolo Manganelli, who believes we will likely see a lot more offshore foiling boats in the future, both monohulls and multihulls as well as on more mid-size inshore racing multi hull yachts. However even now that the America's Cup class has introduced true foiling to large monohulls, Paolo doesn't see a complete shift towards foils for recreational cruiser sailors, who continue to favour the modern luxuries over the lean, low weight that foiling requires. Likewise, at this stage Paolo sees only limited uptake from the commercial sector as passenger ferries shift towards transporting higher loads and energy requirements to lift on the foil are currently uneconomic however the advent of trim management for larger motoryachts may provide ferries with improved fuel efficiency in the future.

The development of foiling boats has come a long way over the past 10 years with big budget teams crucial to the success and performance. Effects and learnings from top level technology like fibre optic strain gaging continues to filter down and create improvements on all different types of boats and foilers, from racing to leisure and possibly even commercial in the future but with the technology first pioneered in the early 1900s but only recently making significant advancements, only time will tell what is possible.

**“Technology like this is vital to the development of the foiling industry as although in the short term the effects are seen only by the teams able to afford and harness this technology, the insights the data provides inevitably trickle down to less competitive uses.”**

# Facing the Future of Tactical Helmets

One of the most important pieces of equipment for any soldier is their combat helmet. A far cry from the old Brodie helmet worn in the mid twentieth century, today's helmets have evolved to meet the needs of a modern military and serve purposes beyond just protection.

Given the current need to mount accessories such as night-vision devices on helmets, weight has become a critical factor. Recognizing the fact that lighter weight protection meant a higher likelihood of it being worn properly, a US Marine and Iraq war veteran founded MTEK over ten years ago to address this concern.

Benjamin Mahan, owner and lead designer of MTEK, also saw that many of his fellow soldiers were receiving severe maxillofacial wounds due to a lack of lightweight, easy-to-use lower face protection. Existing solutions, such as Lexan shields, were too heavy for regular use, and were cumbersome to attach.

Beginning with their lighter weight FLUX helmet (only about 2 pounds), Mahan's team developed an advanced, modular helmet system. These are designed with rails that allow accessories to be easily secured or released, and work with MTEK's mandible systems that provide protection to the lower face from projectiles, with the potential to mitigate the traumatic brain injury which can result from bomb blasts.

When MTEK then decided to create a carbon fiber version of the FLUX helmet, Gurit's SE84LV prepreg was selected in order to increase the shell rigidity and impact performance. The material, a 12K 660 GSM, was recommended by Composites One Technical Sales Representative, Jeremy Clifford.

"Utilizing Composites

One's vast product depth and breadth

coupled with solid technical knowl-

edge of potential solutions,

our Technical Sales Rep-

resentative found the right

solution to meet MTEK's require-

ments," says David Smith, Composites

One's Director of Marketing. "Partnering with MTEK's

team to understand the needs of the

application, Jeremy suggested Gurit's SE84LV because the carbon twill offers the attributes of strength and conformability. SE84LV positioned MTEK to produce the FLUX helmet without the worry of wrinkles affecting the finish on the completed part."

As a result of their efforts, MTEK has received contracts from the US Department of Defense, as well as support from the military and law enforcement organizations. Through forward-thinking design, the use of composite materials, and an abiding and personal concern for military and law enforcement personnel, MTEK is helping keep those on the front lines safer from harm.



**For more information about MTEK and their products, please visit**

 [www.mtekusa.com](http://www.mtekusa.com)

# Robb Holland: Conquering Pikes Peak



The Broadmoor Pikes Peak International Hill Climb (PPIHC) in Colorado isn't a race for the faint hearted. The track measures 12.42 miles and features over 156 turns while climbing from 4,720ft to 14,110ft. Enough to make most sensible drivers ease their foot off the accelerator. But not Rotek Racing's professional driver Robb Holland.

Robb isn't new to the PPIHC. In 2016, he broke the front-wheel drive record as a rookie with a time of 10.56:878 in a Gurit sponsored Audi TTRS which utilized composite panels for weight reduction constructed from Gurit SC 110 cosmetic carbon prepreg. This year, Robb set out with an equally ambitious goal: competing in a salvage car turned into a fully functional, high performance race car in a very limited time frame.



## Purchasing a Salvage Car

Returning again in 2017 the Rotek Racing team initially hoped for a quick sale of the Audi TTRS to fund a new car, but with a very late sale 3 months from race day the team was left with a short timeframe to source a new car that could fulfil a tight list of requirements.

After feeling the effect of the thin, 10,00ft altitude air in the 2016 PPIHC challenge which robbed the Audi TTRS of almost 40% of its power, the Rotek Racing team had formed a shopping list of key requirements to improve upon the 2016 performance. Specifically, more power, better gearing and more downforce for those tight hairpins. Equally as important was the cars weight, it had to be light or have the ability to be lightened.

With limited budget and time, the Rotek Racing team searched through used car lots and salvage auctions, eventually purchasing a 2017 Chevrolet Corvette Z06 in “good” salvage condition. The race was on. The team had 90 days to get the car track ready and have Robb acclimatised with it. 9 months less than the average year it takes to develop a new race car.

## Upgrades for Maximum Performance

Vital in the decision to race the Corvette Z06 was the ability to increase the performance and safety through aftermarket parts. Complying with safety regulations, the Rotek Racing team stripped the car bare and installed a roll cage, providing Robb with some essential protection in a worst case scenario. The car was then shipped to a motorsport specialist to begin putting the engine back together and add some high performance aftermarket parts to increase the cars handling and squeeze a few more horsepower from the engine.

Next up was weight reduction. Being a huge performance factor at Pikes Peak due to the high altitude and numerous hairpins, Robb needed to reduce as much weight as possible from the Corvette Z06.

Crucial to this was replacing a number of the cars standard panels with custom, made to measure carbon fibre prepreg panels.



Gurit worked closely with Koko's Collision Repair who created the moulds for the production of the carbon prepreg panels. In order to get a quick, cheap and easy to build mould which would still produce a number of good quality parts, the team decided to use vinyl ester rather than steel or carbon. Koko's Collision Repair then used Gurit's SC 110 cosmetic carbon prepreg to create the accurate and lightweight panels destined for the Z06 which can be cured at low temperatures of 175F over 12 hours or rapidly at 300F in 15 minutes.



Originally the Rotek Racing team wanted to replace each of the body panels with a carbon prepreg panel however unfortunately the tight time frame prevented this. Instead the heaviest panels were selected, the doors and the rear deck lid. Also selected were the T-top roof panel and the hood as the higher the weight is placed on a car the farther from its centre of mass which in turn has a more negative effect on the cars handling. Overall the team estimated weight savings of around 100 pounds in comparison to the standard panels.

## Final Preparations and Testing

With race day approaching and the carbon fibre prepreg panels installed on the car along with the various performance parts, Robb was left with very little time to familiarise himself with the car prior to race day. In a normal motorsport project like this, his team would have finished the car several months prior to its first round, allowing the team to test and optimise it extensively. Instead, Robb found himself about to tackle one of the most dangerous races on the planet with very little time behind the wheel.

One day of testing was lined up at the High Plains Raceway where Robb was able to get a feel for the car and test out the new brakes and handling. Unfortunately, only four laps into the test day a rear wheel was punctured, bringing the day to an end, leaving Robb with only 6 laps of testing prior to the race.

## Race Day

With final preparations complete and the car running as optimally as possible given the extremely short testing, the car was transported down to Colorado Springs to begin the racing.

Despite a few teething issues with excess heat slowing the performance and electronic sensors having a negative effect on the handling, Robb was able to pull off an impressive 10:55.166, the 16th fastest car overall, 4th place in Time Attack 1 and the fastest Corvette ever! An amazing effort considering Robb's very limited time behind the wheel.

Gurit is proud to have sponsored the Rotek Racing team for the past years, supporting the team with SC 110 carbon prepreg and production advice while building the moulds and developing the lightweight panels. Unfortunately, the team was not able to participate in the Pikes Peak 2018 challenge due to technical issues. But we are confident that the Corvette will see further stellar successes.



# Mapping Underground Reservoirs with Composites

**As groundwater reservoirs face increasing pressure conservation and mapping has become vitally important in managing their sustainability. SkyTEM have developed an airborne system designed to detect and manage water reservoirs by flying a lightweight composite frame closely above the ground and tracing the underground features with an electromagnetic measuring system.**

The Canadian province British Columbia (B.C.) is favored by an ample supply of water. But the region is experiencing growth and expansion of agriculture, mining and the natural gas and oil sector. These industries will create a rising demand for water especially in the Northeast of B.C. Therefore, several stakeholders from the province promoted a sustainable use and management of natural water resources in the region, which culminated in the Water Sustainability Act, issued by the parliament in February 2016.

However, the precondition to protect water resources is to know where they are located. To answer these questions, the Danish company SkyTEM was engaged in 2015 to map 8,000 square meters for aquifers. These underground layers of rock conduct ground water without absorbing it and are thus perfect spots for wells.



## A glimpse below the surface

SkyTEM is capable of accurately resolving subtle changes in geology in fine detail – from the very near surface to depths approaching 600 meters, discovering not only groundwater but other geological resources. These data are acquired via a helicopter-borne transient electromagnetic (TEM) system which describes the subsurface of the earth. By flying over the terrain in parallel, pre-defined lines the SkyTEM system basically sends signals into the ground, and analyses the resonance. Aquifers for example are electrically resistive whereas layers from sand and clay are electrically conductive. By combining the data from the parallel lines it is thus possible to see, where exactly the aquifers run underground. Preliminary data can be produced already within 48 hours of acquisition.

## Flying frame

The carrier frame which bears the measuring equipment during the flight is a crucial element of the SkyTEM solution: Gurit composite materials guarantee that it is lightweight but robust and perfectly corresponds to the high landing loads and aerodynamic requirements. The robustness is a prerequisite to perform reliably and economically. Keeping the weight as low as possible is a key factor of the SkyTEM airborne frames.

Firstly, weight is an important factor for economic savings: On the one hand, less weight means less fuel consumption of the helicopter. On the other hand, more fuel can be

carried onboard to allow longer flights without having to refuel. Secondly, with the robustness and less weight attached, the helicopter can fly faster and thus data is acquired faster. Last but not least, less weight generates less disturbing frequencies during the flight. The recorded data therefore promise a better reliability and might need less reconditioning afterwards.

Throughout the years Gurit and SkyTEM continuously improved the frames and the materials to create ever lighter devices. The new SkyTEM system SkyTEM312FAST includes a lightweight sandwich construction with prepreg SE 84 LV and the structural core material Corecell M. This material combination is characterized by its especially high durability which indispensable during operation. Another reason for this specific material combination is their high thermic and mechanical stability during production, which guarantees highest process reliability. "Since we went from the old wooden frame to composite frames, we did not have any collapsing frames, even in extreme weather conditions like minus 30 degrees Celsius," says Kristoffer Rasmussen Mohr, Project Manager R&D at SkyTEM.

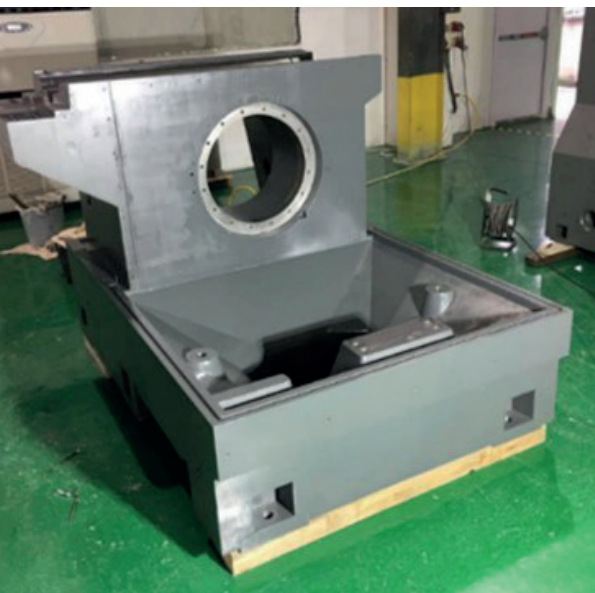
"And the support from Gurit to achieve this has been outstanding."

## Ever faster, ever lighter

The project in British Columbia was one of the first operations for the new SkyTEM system SkyTEM-312FAST. Here, the task was to map aquifers to a depth of at least 300 meters on a terrain of 8,000 square meters. Consequently, shallow subsurface data and water conductors in the depth had to be recorded at the same time and at high velocity due to the areal size which had to be covered. On the one hand, the recording of such a complex data scheme required a new exceptionally rigid and aerodynamic carrier frame maintaining an especially low noise level. On the other hand it also needed to be extremely light to raise the velocity: SkyTEM-312FAST impressively fulfills these requirements: Due to its lightness the frame can be flown 50 meters above the ground at up to 150 kilometers an hour. The result: In Canada SkyTEM operated at an average speed of 118.5 kilometers per hour and delivered high quality high resolution data covering 21,000 line kilometers in only 43 days!



# Smart Foundations for High-Precision Machines



The growing digitisation of production processes within the scope of Industry 4.0 and the increasing miniaturisation and customisation of goods place ever higher demands on machines. Faster production cycles require more efficient machines; at the same time part precision and quality must not be compromised. How can these seemingly conflicting aspects be integrated sensibly?

A CNC machine bed tailored to customer needs and delivered to highest precision

One of the answers that starts right “at the base” of things is Composite Mineral Casting. Composite Mineral Casting, also known as resin concrete, is a material mix consisting of mineral filling materials, such as quartz gravel, quartz sand and rock flour, and a small proportion of binding agent. Even though this material mix is no new concept, it is gaining more and more interest recently since it offers a solution to the challenge of combining speed with even the highest precision requirements.

This is possible because of the properties that composite mineral casting has to offer. Machines operating at high speed, cutting and drilling, grinding, milling, dynamic positioning devices and similar equipment used for precision parts production at micron level all have one side-effect in common: vibration. Machine bases made from “traditional” materials like steel and cast iron and are not capable of absorbing this vibration – which limits accuracy and also creates higher maintenance effort over time. Mineral casting, in contrast, offers excellent damping properties and absorbs vibration approximately six times faster than cast iron and eight to ten times faster than steel.

Another side effect resulting from high-speed operation and constant machine rotation is heat. Mineral casting has a much lower heat conductivity than the mentioned traditional materials, which makes it an effective addition to an actively managed cooling system. Further benefits of machine bases made from mineral casting include design freedom, high dimensional precision of the machine bed and pre-embedding of functional parts into the design - thus significantly reducing finishing and assembly effort. In addition, mineral casting offers corrosion resistance, shorter lead times and better recyclability.

Gurit started its Composite Mineral Casting business at the Gurit Tooling premises in Taicang, China in 2014 based on its long-standing, comprehensive expertise in mould design and manufacturing as well as the formulation and production of resin systems. A dedicated team of material engineers developed and patented three resin base formulations that are used with different blends of stones in order to be able to adapt the material mix to different customer requirements.

Today, the Gurit Composite Mineral Casting business comprises a dedicated facility in the city of Taicang, China with a production space of 4,000 square meters and a production facility in Wittlingen, Germany with a production area of 1,400 square meters. Dedicated R&D resources and a 120 square meter laboratory are aimed at further improving and tailoring the resin formulations to specification and market needs.



The Gurit Mineral Casting production facility in Taicang, China



The Gurit Mineral Casting production facility in Wittlingen, Germany

The Gurit Composite Mineral Casting service offering is aimed at providing a full solution from design support for tailored and optimised solutions, in-house structure and mould design with ANSYS software, performance testing to fast and cost efficient volume production at highest precision and constant part quality.

#### For more information:

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# Composites in Architecture

Advanced composites are well proven in a number of industries with benefits over traditional materials well realised. Designers and architects have taken note, using composites to provide design, weight, longevity, fire resistance and modular assembly advantages over steel and concrete materials. Today there are a number of projects where architects have challenged the norm and taken advantage of these benefits: facades with aesthetically pleasing curves made possible through composites; large roofs with modular designs that “click” together for fast installation and fabrication of panels; and sculptures that utilize the high strength-to-weight ratio composites are famous for, allowing designs unachievable with steel or concrete materials.

## **Facades – Shaping 411 Different Panels to Create One Design**

Creative facade designs benefit from the design freedom composites provide, allowing designers to realise almost any design or shape their project requires. The facade design for the William Barak Apartment Tower in Melbourne, Australia is an artistic pro-

ject for ARM Architecture who styled the building to resemble the face of the famous Aboriginal leader, William Barak when viewed from afar.

The creative design was taken from a photograph of William Barak which was then adjusted in a photo editing program, turning the image into horizontal bands of black and white, each varying in thickness and design. Next, the bands were converted into 2D and 3D CAD files to determine the measurements and design for the composite panels.

Australian design and engineering company, ShapeShift made the design a reality through the use of 411 differently curved ShapeShell panels, each playing a crucial role in the overall design and each needing to be perfect. Seen from a distance the white panels layered against the black of the building compose the face of William Barak, which spans 35 floors.

The ShapeShell panels are a matrix of resin and structural glass reinforcements, which excel due to their thickness, solid construction and structural stiffness while being very lightweight. The core consists of Gurit® G-PET™ which was vital to the success of the project due to its structural performance and ease of moulding to create the 411 differently shaped panels. ShapeShift tested each panel individually, taking them up to a load of 6.4 KPa without any damage or deformation, before positioning them in the facial mosaic.

The ability for composites to form any shape was essential to this design, with 411 differently shaped panels. Each had to be individually shaped and lightweight to ensure the panels didn't excessively load the building structure – a perfect solution for composites.







## Roofs – Modular Efficiencies for Construction and Design

Large roofs that feature repeating designs are ideal for composite construction. Moulds provide modular efficiencies and the low weight nature of composites provide construction advantages well suited to staged building schedules or where rapid construction is required.

Spanning four hectares, the Te Awa Shopping Centre is a significant retail development in Hamilton, New Zealand which provides around 30,000 square metres of retail space. Owner and developer, Tainui Group Holdings wanted to create a flexible space that could be built in stages, with each stage remaining open to the public while works on the next stage were underway.

At the heart of the building's design is the roof. Leading technology was used in its creation with the translucent panels above the centre of the mall being formed with EFTE (ethylene tetrafluorethylene) film which provides natural light to the space and is supported by wish-bone steel structures. Along either side of the clear EFTE film is a series of curved domes created from composite panels that form the iconic saw tooth pattern seen down each edge when viewed from the shopping areas.

Composite panels in the curved domes were constructed with Gurit supplying E-glass skins over Gurit® PVC foam core which also formed the weather proofing where it rested over the steel structure.

Essential to the success of the staged production schedule was construction of the roof through utilizing large, prefabricated parts which were designed to be fitted outside of trading hours to minimise disruptions. 64 moulded panels making up 2300 square metres of roofing were fabricated by FRP Ltd of Auckland using precise female moulds to create the modular panels ensuring perfect dimensions.

The foam and glass for each panel was supplied to FRP Ltd as a Gurit B3 SmartPac kitset which ensures core materials and reinforcements are accurately produced to the specified dimensions through CNC cutting.

Key to the success of this development was the staged production schedule. Use of composites facilitated this with modular construction allowing offsite production while the use of moulds ensured high accuracy of parts, allowing smooth overnight installation of new panels.





## Sculptures – Unparalleled Lightweight Strength and Stiffness

Artistic sculptures are well suited to composites with the high strength of carbon fibre allowing long and slender, unsupported spars and the ability to form complex shapes which allows almost limitless creativity.

Out of the Strong Came Forth Sweetness is a sculpture by architect turned sculptor Ian McChesney for the Angel Building in London. The design of the sculpture is based upon the inverted result of treacle falling from a spoon and has an oval seating area at the base which extends to a 22 metre long and narrow spar which presents the unique challenges.

Gurit was initially approached to evaluate the feasibility of creating the structure in carbon fibre with the challenge in producing the long and slender spar which has a diameter of only 100mm at the midpoint and 25mm at the tip. The spar's design required a very high stiffness-to-weight ratio which carbon fibre was able to provide.

The composite components were manufactured by AM Structures and featured Gurit's Ampreg 21 resin system and carbon fibre reinforcements.

Increasing numbers of architects are turning to composites as more and more projects such as the William Barak facade continue to push the boundaries on what design limits are possible. Structures already created with composites have helped pave the way with each revealing some of the benefits and possibilities composites can provide to architectural projects. In comparison with traditional structural materials like concrete and steel, composites are providing a number of advantages and are particularly suited to unique projects that require a degree of flexibility or designs driven by low weight requirements. Crucial to the success in each of the projects was early collaboration with the designer which ensured the optimum materials and technologies were used to meet the architects design goals and vision.



# Gunboat's Latest Weapon

Gunboat started producing catamarans in 2002 with the simple vision of producing comfortable cruising catamarans that utilized the very latest in race boat technology. Naturally since then race boats have become more advanced as teams continue searching for improvements in design, material advances and techniques to minimise weight. Gunboat has kept up with these developments, adapting their processes and materials over the past 16 years.

The first Gunboat catamaran produced in 2002 was built using E-glass with vacuum-bagged/wet lay up over Corecell™, a technique well ahead of its time but now relatively outdated. This has since been surpassed in their latest yacht, the Gunboat 68; an all carbon composite catamaran produced using Gurit's PRIME™ 27 premium epoxy infusion system and Corecell™ M foam sandwich panels.

From the development of the Gunboat 68, Gunboat wanted to continue to innovate and push the boundaries of modern production boat building; however they needed to be realistic to the markets price sensitivity. Starting at square one, the team were able to investigate the full range of options and weigh up the pros and cons of construction techniques to material choices such as infused carbon and foam core versus all prepreg carbon and nomex core.



Evaluating the material options Gunboat realised that prepreg offered a significant 15% weight saving over the composite structure of the catamaran while ensuring maximum strength properties, but at additional cost. However, unlike an ultimate performance racing yacht the composite structure of a luxury catamaran like the Gunboat 68 typically only comprises of around 30% of the total catamarans displacement making the overall weight saving relatively less significant than on a racing yacht.

Gunboat decided the best option was to leverage their expertise in infusion for the larger composite elements and to outsource their flat panel parts of the structure that



could be built in prepreg on a vacuum table and easily shipped. This provided the structural benefits of prepreg while reducing Gunboat's risk and need for an in-house high temperature mould for the carbon fibre.

Gunboat selected Gurit's PRIME™ 27 premium epoxy infusion system to ensure the best results with the larger composite elements to be infused in-house. The system offers high mechanical and thermal properties with a lower viscosity and improved wetting and working times than other systems, allowing even the thickest parts of the composites to achieve the optimal resin uptake. This was essential for the Gunboat 68 as it has numerous transition zones where the thickness of the carbon reinforcement varies and a complex shape with turns and curves that slow down the resin infusion speed in some areas.

Complementing the infusion system is Gurit® Corecell™ M foam which provided the Gunboat 68 with excellent resistance to slamming and further weight savings through

reduced resin absorption compared with some other cores. Thermofforming the core was also possible with the Gunboat team heating the foam and moulding it around tight curves to reduce the resin uptake in tight radiuses, allowing Gunboat to minimise the weight and ensure the maximum structural properties of the M-foam are maintained.

The past 16 years has seen significant developments in composites within the racing scene with teams innovating for a place on the podium, Gunboat have kept up with these developments in the Gunboat 68, selecting the latest, commercially viable materials and processes to achieve a catamaran equally at home racing or blue water cruising. The developments have led to reduced resin absorption, reducing weight and improving structural properties while the use of carbon fibre and prepreg technologies provides further optimisations. With these changes just over the past 16 years Gunboat has truly established itself as a leader in implementing new technologies and we look forward to following their future projects.





# Gurit's Next Generation Balsa and PET Core Materials

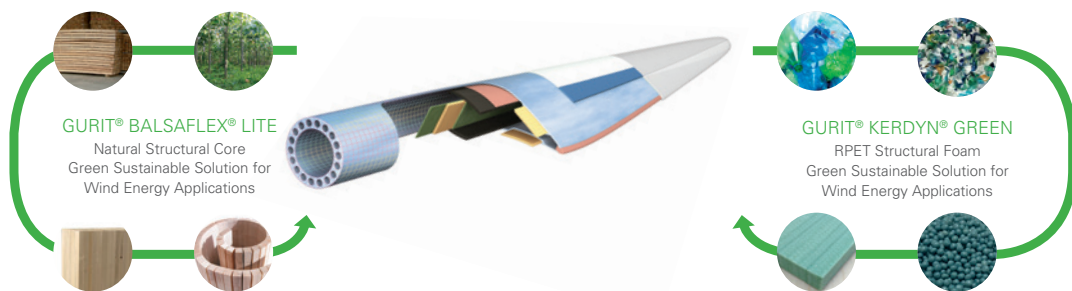
**Gurit has launched its latest innovative range of core materials earlier this year, Gurit® Balsaflex™ Lite and Gurit® Kerdyn™ Green.**

Gurit® Balsaflex™ Lite is the proven end-grain balsa wood core with a novel coating system that is capable of reducing the resin uptake in infusion processes by up to 50% for rigid panels and up to 40% for flexible balsa wood sheets. This saving enables customers to save cost through reduced resin absorption and achieve overall weight savings while still achieving excellent mechanical properties and being compatible with both epoxy and polyester resin infusion processes.

The coating system also provides advantages with

Introduced alongside Balsaflex™ Lite is Gurit's new PET core range, Gurit® Kerdyn™ Green which is manufactured from 100% recycled (post-consumer) PET materials.

The Gurit® Kerdyn™ Green range has been developed to respond to the growing need for structural core materials with stable properties and improved resin uptake while also providing a more environmentally friendly option that assists with waste reduction. The foam is a highly adaptable, recyclable, thermoplastic core



humidity ingress, as balsa wood is a natural resource the fibre can absorb ambient humidity if not stored in climate controlled conditions. Compared to an uncoated balsa wood panel Gurit® Balsaflex™ Lite 150 is capable of delaying humidity ingress.

Due to the limited global availability of natural low density Balsa, Gurit® Balsaflex™ Lite 150 offers a suitable alternative when considering the total infused density.

material that provides an excellent balance between mechanical properties, temperature resistance, density and cost, making it ideally suited to a wide range of applications and processes.

For more information on the Gurit® Kerdyn™ Green or Gurit® Balsaflex™ Lite ranges or to see if they are suitable for your next project please contact your local sales representative.

# New Wet Laminating System: Putting Workers' Health and Safety First

Safeguarding workers' health and safety requires a comprehensive approach, including training, education, protective equipment in the working environment and effective control mechanisms. To support this, Gurit has launched Ampreg™ 30, a new low toxicity epoxy laminating system for the manufacture of large composite structures in the marine, wind and construction industries. The laminating system has been reformulated through the careful selection of base chemicals to prioritise user health and safety during hand lay-up and vacuum bagging production techniques.

Ampreg™ 30 features a robust resin matrix resulting in excellent mechanical and thermal properties of laminates, even at ambient temperature cures. The laminating system is available with a range of hardener speeds from fast to extra slow, all applying the same simple mix ratio, allowing for the ability to blend hardeners to achieve a range of intermediate working times.

Ampreg™ 30 is also available as LRT (Light Reflective Technology) version. This soon-to-be-standard addition to the resin matrix causes the resin or mixed system to fluoresce under UV light without changing the mixing and handling properties of the laminating system or cured resin performance. LRT enables easy inspection of surfaces, equipment, clothing and skin. Resin contamination can be easily detected, ensuring minimum exposure for workers and helping to avoid transfer of resin outside the workshop. Suitable UV-A or UV-B inspection lamps for use with LRT are widely available and help establish a reliable control routine after each working period.

We are pleased to announce that we are in the process of expanding our Ampreg™ low toxicity epoxy laminating product range. Further resins and ancillary products will be launched at METSTRADE 2018. The new resins will all come with LRT (Light Reflective Technology) as standard.

[For further details, please click here.](#)



Gurit® Light Reflective Technology (LRT) is an additive that has been introduced in order to reduce workers' exposure to hazardous chemicals.





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