

SOLUTIONS

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DIAB

<http://www.diabgroup.com>

DIAB WINS MAJOR ORDER FOR SKJOLD FAST PATROL BOATS

Following its extensive involvement in the prototype Skjold fast patrol boat, DIAB has been awarded a contract by Umoe Mandal to supply sandwich core materials and core bonding adhesives for the first five production vessels that are destined for service with the Royal Norwegian Navy. In addition DIAB will be supplying core materials for other projects undertaken by the Umoe Mandal yard.

The Skjold represents the first of a new breed of fast patrol boats. It utilizes the latest developments in 'stealth' and SES technology. As a result it is able to travel at high speeds (55 knots) even in high sea states while offering a very low electro-magnetic signature (EMS) and a stable weapons platform. Each Skjold will be 47 meters (154 ft.) long, have a beam of 13.5 meters (44 ft.) and a displacement of 270 tonnes. When underway it has a draft of just one meter and therefore is capable of operating in very shallow waters.

DIAB core materials will be used for all the structural elements (hull, deck, superstructure bulkheads etc.) in order to provide lightweight/high strength performance and a low EMS. In addition to their performance benefits, Umoe Mandal maintain that sandwich composites simplify the construction process and the subsequent fitting-out. The primary reinforcement is unidirectional glass fiber although carbon



Photo: Magne Anjem, RNOA

The 'Skjold' fast patrol boat that is destined for service with the Norwegian Navy.

fiber has been used where appropriate to achieve specific stiffness criteria. Infusion manufacturing techniques will be used for a significant amount of the construction.

FINITE ELEMENT ANALYSIS

Extensive use was made of both local and global finite element modelling techniques to develop the sandwich laminates and these findings were confirmed by a structural testing program carried out by Umoe Mandal and subsequent sea trials of the prototype vessel.

Umoe Mandal, a member of the Umoe Group, specializes in the production of FRP composite naval vessels. The yard, which is located at Mandal in the South of Norway, was established in 1989 and one of its first contracts was to build nine Mine Counter Measure Vessels (MCM) using surface effect technology (SES) for the Royal Norwegian Navy.

www.mandal.umoe.no

DIAB VOTED COMPOSITE COMPANY OF THE YEAR

The Swedish subsidiary of the DIAB Group (DIAB Sverige AB) was recently presented with the 'Composite Company of the Year Award' by the Swedish Plastics and Chemical Companies Association at a ceremony held at Södertälje in Stockholm.

Receiving the award on the company's behalf was Lars Andersson, Managing Director of DIAB Sverige AB.

The citation says "Through a combination of product and processing development, DIAB has provided an excellent solution (the DIAB Core Infusion Method) for closed molding. The DIAB development has made a decisive contribution to an improved working environment within the composites industry while at the same time providing a competitive advantage to its users."

New High Speed Catamaran Ferry Contract for Brødrene Aa

Norwegian ferry operator Rødne Trafikk has awarded a contract to the Brødrene Aa shipyard in Hyen, Norway for the construction of a high speed catamaran ferry.

This will be the eleventh FRP (fibre reinforced plastics) vessel that Brødrene Aa has delivered to Rødne Trafikk.

The new vessel is based on the same concept and construction techniques used in the previous catamaran produced by the yard, the M/S Rygerkatt, although at 20.5 meters (67 ft.) it is a meter longer. It also has more installed power in order that it can reach higher speeds (30 knots with its full complement of 96 passengers). The vessel will be in operation 22

hours per day and will make 200 stops. This new vessel will feature the extensive use of advanced FRP sandwich materials (Divinycell core and carbon fiber reinforcements) in the main structure. By using these materials plus the use of resin infu-

sion technology, Brødrene Aa estimates that it can achieve a 40% weight reduction compared to an 'ordinary' GRP hand lay-up. This substantial saving in weight will lead to a direct reduction in the operating costs of the vessel.



M/S Rygerkatt, the sister ship to the catamaran ferry being built by Brødrene Aa.

First Sportsfisher from Sunseeker

Prompted by requests from a number of its US clients, luxury UK-based powerboat builder Sunseeker has recently made its first foray into the sports fisherman market with the launch of the Sportsfisher 37. The 11.3 meter

(37 ft.) Sportsfisher 37 is ideal for those who want a rugged open-deck boat that is suitable for fishing, diving and general leisure use but don't want to sacrifice style or comfort. The Sportsfisher 37 has some key features that elevate her per-

formance to radical levels. A revolutionary twin-stepped hull configured to be ultimately effective at speeds in excess of 38 knots, also provides stable and precise handling at slower cruising speeds.



The new Sportsfisher 37 from premier UK builder Sunseeker.

The spacious open deck and well equipped helm station with double helm seat and self-draining cockpit finished in teak, is complemented by a comfortable saloon, galley and accommodation below.

As with all Sunseeker power boats, the 37 makes extensive use of sandwich composite construction and DIAB cores in the hull and deck.

www.sunseeker.com

NOR-TECH LAUNCHES SERIES 75 HIGH PERFORMANCE SPORTS BOAT

Since being founded in 1987, Nor-Tech Hi Performance Boats of Cape Coral, Florida has gained an enviable reputation for building powerboats with incredible on the water performance.

In last year's NYC Powerboat Rally, Nor-Tech boats swept the board by taking 1st, 2nd and 3rd places in the 'race to the bridge'. Jim Leonardo in the 50 ft. Supercat 5000 'Xtreme Xhibit' is the new "King of the Hudson". Finishing in 1st place in the race from the G.W. Bridge to the Tappan Zee ahead of the 131 boat fleet, Jim averaged nearly 160 mph (258 kmh) for the 16 mile (26 km) race distance. Following up in 2nd was Bob Christie of Typhoon Performance Marine in his brand new Nor-Tech 3600 Supercat. This boat was powered by Nor-Tech's own 1,000 hp motors achieving speeds of over 140 mph (225 kmh). In 3rd was Jim Courtney in another Nor-Tech 3600.



A Nor-Tech 3600 Supercat showing off its paces.

Following the success of their 38,42 and 50 ft. Vee bottoms and their 36 and 50 ft. cats, the company has recently added a 75 ft (23 meter) monohull to its range.

The decision to produce the Series 75 was taken to fill the void in the custom boat market for a true high performance vessel. As Nor-Tech explains, 'imagine a 75 foot boat speeding along at 60 mph (97 kmh), imagine being able to travel

in seas that would leave others stranded at the dock - you will arrive at your destination in a fraction of the time of other yachts and still be comfortable and unstressed'.

As is the case with the rest of the Nor-Tech range, the Series 75 uses sandwich construction and DIAB core materials for both the hull and the deck to achieve a light but ultra-strong structure.

The Series 75 is available in both open and hard top configuration and, despite its racing pedigree, its level of fit-out is to the highest standards of luxury.

A unique feature of the Series 75 is the hydraulically actuated helm station. Most fast motor yachts lose forward visibility either when coming onto plane or travelling at low speeds. With the Series 75 the entire helm cockpit area can be raised at the flick of switch for optimum visibility and safety.

www.nor-techboats.com



Three examples from the Nor-Tech range of high performance powerboats.

Three New Sports/Utility Power Boats from Edgewater

2004 is likely to be a bumper year for Florida-based EdgeWater Power Boats with the launch of three new models; two center consoles and one express. Mix the family-friendly features of the 225 CC with the looks and offshore capability of the EdgeWater's flagship 265CC and the result is the 24ft 6in. (7.4m) 245CC. With its all-composite construction, trailerable beam and a very roomy cockpit it is ideal for the keen angler or family boater.

Although smaller than the 245, the new 205CC and 205 Express models offer roomy cockpit areas along with plenty of storage.

In common with all EdgeWater boats, the new models are built to



The all new 245 center console sports/utility boat from Edgewater Power Boats.

withstand any conditions likely to be faced on the open water. One-piece construction, a variable "V" hull and extensive use of DIAB sandwich cores makes them strong, durable, stable and dry. The decks are self-

bailing and compartments empty overboard without pumps. Even if the unthinkable should occur, the hull is engineered to continue to remain afloat.

www.ewboats.com

Zap Skimboards

Over the last 20 years skimboarding has developed from a diversion for surfers when the wave conditions were poor or a pastime for children to a serious sport with both amateur and professional championships around the world.

Originally the idea was simply to hurl what could be described as a miniature surfboard onto the film of water at the edge of the beach and then leap onto the board to see how far you could glide.

Today, expert 'riders' are not only able to glide distances in ex-

cess of 25 yards (23 meters) but can also perform a multitude of tricks. They can even surf the

breaking waves despite starting their 'run' from the beach.

Throughout the development of the sport, Florida-based Zap

Skimboards has maintained its position as the premier skimboard producer.

Continuous board improvement in terms of shape, manufacturing processes and materials have been the keys to Zap's success. On the materials front Zap use a sandwich construction based on Divinycell foam core. This approach results in a light and ultra-strong board that is

able to withstand the repeated impacts that are an inherent part of the sport.

www.zapskimboards.com



A Zap skimboard in action.

SEA FORCE IX TAKE THE SPORT FISHING YACHT TO THE NEXT LEVEL

With the debut of the 81.5 Sportfish Yacht at the recent Miami Boat Show, Sea Force IX maintain that they have taken the classic sports fisherman to the next level.

Located at Palmetto on the West Coast of Florida, Sea Force IX was formed by a team of 'veterans' who share a common vision to design and build yachts that offer the ultimate in blue water performance for the serious sports fisherman.

Currently the line up comprises three models, 76.5, 81.5 and 86.5 ft. (23.3, 25 and 26.4 meters). All three models are offered in open bridge and command bridge configurations. With a range of 1,700 nautical miles these vessels allow direct access to exotic fishing grounds such as Venezuela and Costa Rica from the US mainland.

Key elements of the Force IX yachts include exceptional performance and safety in adverse sea conditions, rugged monolithic construction and classic and functional elegance both inside and out.



Sea Force IX's 81.5 returning from its successful debut at the Miami Boat Show.

The hull is based on a 'full lifting' bottom geometry principle that has been proven in the Stevens Institute of Technology towing tank and on the open seas of the world. The dynamic lift generated by the hull bottom ensures stability and dry, flat running while the modest keel provides dead-on tracking and fingertip steering.

Sandwich composites based on DIAB core materials was chosen as the principle construction technology to provide an ultra-high strength but lightweight structure that makes a major contribution to the vessels' go anywhere capabilities.

www.seaforceix.com

ULTIMATE LUXURY & STYLE FROM VERSILCRAFT

If you are looking for the ultimate in luxury and refinement, then the Italian shipyard Versilcraft may be your first port of call. Since being founded in 1968 it has built up an impressive reputation for hand-crafting motor yachts that are the epitome of Italian style and quality.



Over the years the company has progressively moved from wood, through aluminium and finally - in 1984 - to composites. In total it has produced more than 300 vessels.

Versilcraft's current line up, all of which make extensive use of Klegecell core materials, comprises 80, 90, 105 and 110 ft models.

www.versilcraft.it



Demolding the hull of the second 81.5 at the Sea Force IX facility.

Stiff & Light Panelling for Cruise Ships

One of the major benefits of sandwich cored structures is the increased stiffness values that can be achieved. A recent application that clearly highlights this feature is a series of light weight panels that were fabricated to cover the lifeboats on two large cruise ships, 'Radiance of the Seas' and 'Brilliance of the Seas'. For each ship around 980 square meters (10,550 ft²) of panelling was produced.

Manufactured by Hahlbrock GmbH, each panel has an unsupported span of approximately 3.70 meters (12 ft.) yet is capable of withstanding hurricane force winds. Divinycell H 80 core material was chosen because of its good dynamic load capabilities coupled with it being easy to form and fabricate using a resin infusion process.

When complete the edges of the panels were bonded directly to



The clean and uninterrupted lines of the sandwich composite panelling.

each ship's steel superstructure using a high performance adhesive. As can be seen in the photograph above, the 'rib-less' panelling allows

a clean, uninterrupted profile to be achieved that aesthetically enhances the ship's lines.

www.hahlbrock.de

SAAB Bofors ROV Shell - The Ultimate Kit ?

The capability of DIAB to produce extremely complex '3-D' kits to a high order of accuracy is admirably demonstrated by this 'all-foam' body shell produced for the SAAB Bofors Underwater Systems' Double Eagle Mark III ROV (remotely operated vehicle).

All the pieces shown here were machined on one of DIAB's 5-axis CNC machines.

Divinycell HCP foam core is an ideal material for this type of application. Not only can HCP core be readily machined with conventional woodworking tools but it also offers



The complex interior of the ROV shell.

a very high hydraulic crush point, excellent dynamic properties, low water permeability and exceptional thermal/acoustic insulation properties.

The finished 'shell' is coated with a layer of epoxy to improve its im-

proved strength and reduce the ROV's hydrodynamic drag. It is then spray painted ready for the insertion of the motors, sensors, cameras etc.

The Double Eagle Mark III has been developed by SAAB Bofors to fulfil a variety of tasks including off-shore exploration, environmental research, marine biology, power plant inspection and military duties.

It is controlled and powered via an umbilical cable from the mother ship rather than by telemetry so that its operating signals cannot be intercepted or corrupted.

www.saab.se/dynamics

The EarthRoamer XV-LT

– the ultimate, go anywhere expedition camper –

As more and more people venture further and further off the beaten track, an ideal vehicle to take them on their adventures would be the XV-LT, the latest in the line of expedition campers from EarthRoamer in Colorado, USA.

This is no 'beefed-up' motor home but a vehicle that has been purpose-designed and built to offer true off-road performance yet at the same time provide a very comfortable place in which to live for extended periods, irrespective of the terrain or weather conditions.

EarthRoamer was formed when the two founders of the company, both dedicated adventurers, were unable to find a suitable camper for themselves.

The XV-LT is the culmination of five years of rigorous testing in a wide variety of challenging conditions ranging from the bitter shores of the Arctic Ocean in Prudhoe Bay,



The EarthRoamer XV-LT in typical rugged surroundings.

Alaska to the Sea of Cortez at the southern tip of Baja California, Mexico and everywhere in between. The end result is an extremely robust, capable, stand alone, four-season camper where every component has been carefully chosen to provide years of reliable service.

DIAB-CORED BODY

Unlike many RV camper bodies, which are often constructed using a combination of aluminum, plywood and a pop-rivet gun and have no real inherent strength, the XV-LT features an engineered, one-piece, DIAB-cored sandwich composite body. Not only is the XV-LT shell light, extremely strong and robust but it is also completely weather-proof and rot-proof with no seams to fail or leak.

Also unlike many other campers there is no need to add unnecessary weight by way of subsidiary insulation materials such as styrofoam or glass fiber. DIAB structural cores come as standard with excellent thermal and acoustic insulation properties.

Even if the worst was to happen and the body was damaged in an isolated spot, running and ser-



The surprisingly spacious and light interior of the XV-LT.

viceable repairs could be effected using the simplest of tools.

Such attention to detail and fitness for purpose is evident throughout the vehicle. Again, unlike most class C motor homes, the XV-LT is based on a truck chassis - a Ford F-450 - instead of van chassis. This coupled with an efficient, turbo-diesel engine and permanent four wheel drive provide it with tough, roomy go-anywhere performance.



The XV-LT's single-piece body.

Other somewhat unique features of the XV-LT are the elimination of a generator and propane gas cylinders.

By using solar panels, large alternators and batteries the need for a noisy generator has been overcome. This results in a camper that is much more convenient to use and frees up valuable storage space.

Propane cylinders also take up space, restrict RV usage and can be difficult to obtain in more out of



Another view of the XV-LT.

the way places. All heating and cooking on the XV-LT is by high efficiency diesel appliances including a 'no flame' ceramic cook stove.

www.earthroamer.com

THE DIAB SANDWICH APPROACH FOR RACE CARS

Race car body construction has tended to be very much centered on the use of carbon fiber laminates and Nomex honeycomb cores to achieve the required stiffness and strength to weight ratio.

Now, however, this approach is being reappraised and the value of using foam sandwich cores to improve impact protection and, as a consequence, vehicle safety is gaining much wider appreciation.

applications that range from art frames to door panels.

One of the latest car bodies to be produced by SECART is a Daytona Prototype for Chase Competition Engineering. This mid-engined car makes extensive use of DIAB cores and sandwich construction in the side pods, doors, engine cover and nose.

Although increased impact protection and safety are the major



The Chase Competition Engineering Daytona Prototype.

One of the leading advocates of the greater use of foam sandwich composites in race car construction is Bethel, Connecticut-based SECART LLC.

SECART manufactures composite components primarily for the racing community but also makes hoods, wings, spoilers, dashboards, gurney lips, air boxes and other parts for the general automotive market. It also produces speciality items from fiber reinforced plastics for a variety of other

reasons for incorporating foam core technology, it also improves the fatigue properties of the component.

Foam cores are also easier to use than honeycomb materials, particularly when it comes to producing components where contours and compound curves have to be met. Moreover, DIAB cores are readily thermoformable allowing them to be pre-shaped prior to the actual lay-up process.

www.secart.com

www.chasecompetition.com

Bringing 'Element E' To Life

If variety is the spice of life then Amaral Custom Fabrications, Inc. is certainly an exciting place to work providing as it does unique structural solutions for projects as diverse as large scale artworks and military hardware.

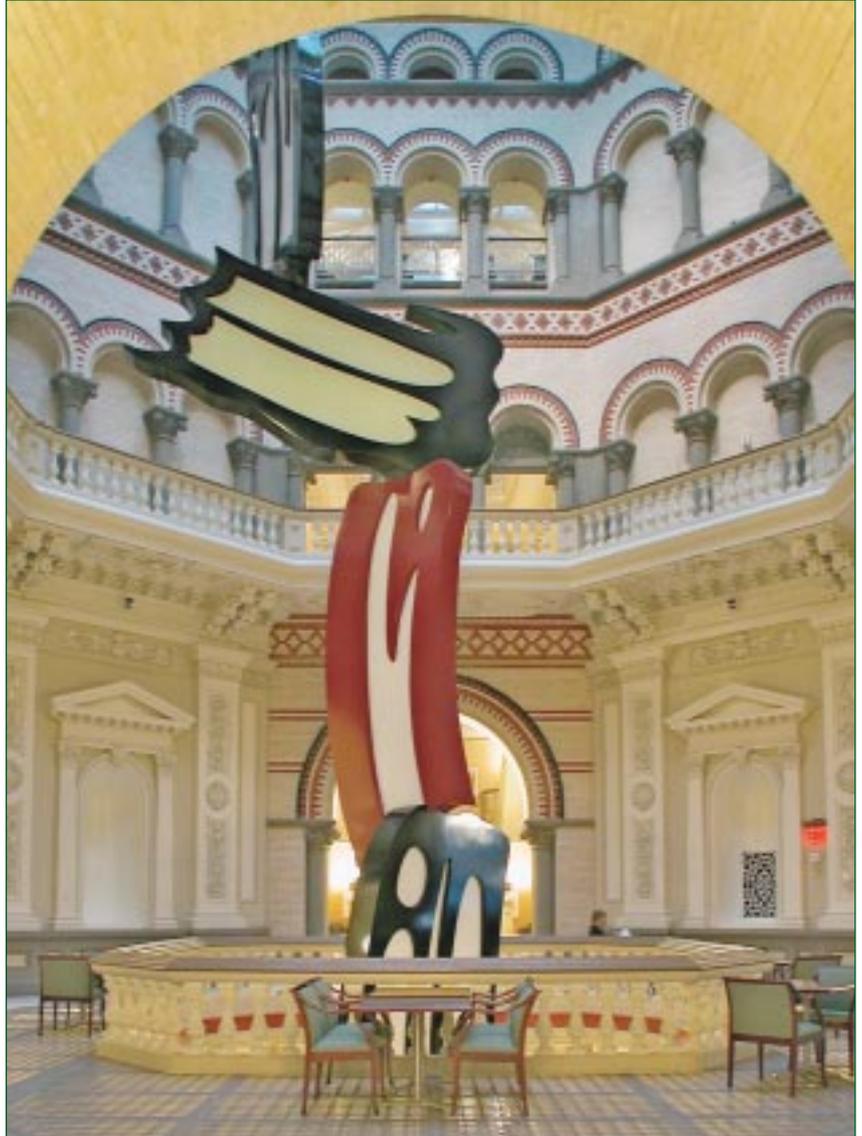
One of its most recent 'commissions' was to reproduce for the first time at full-size the late Roy Lichtenstein's sculpture 'Element E' (part of his Five Brushstrokes series) for an exhibition that is currently running at the City Hall Academy in New York (formerly the famous Tweed Courthouse).

Normally weight is not a major consideration when making static works of art but in this instance the location placed severe constraints on how the 55 ft. (16.76 meters) high sculpture could be fabricated.



Manhandling one of the sections through the narrow entrance way.

The first problem was that the sculpture would be displayed in the rotunda on a circa 1910 glass block floor where the maximum allowable static load is 75 lbs/ft² (5.27 kg/cm²). Secondly, the sculpture could only be erected using a block and tackle. Furthermore, access to the location was via doorways measuring just 96 x 72 inches (244 x 183 cm).



Roy Lichtenstein's stunning sculpture 'Element #E' from Five Brushstrokes' - Copyright: Estate of Roy Lichtenstein. Image: Courtesy of the New York Public Art Fund. Photo: Tom Powel Imaging.

Although various fabrication methods and materials could have been used to meet these 'environmental' issues - single skin composites for example - Amaral Custom Fabrications had to take into account two further considerations. The New York City Building Code requires free standing elements to be engineered to withstand not only seismic loads but also a 5 mph (8 kph) wind load.

Amaral's solution to meet these somewhat disparate requirements was to produce the lower element as a ProBalsa-cored sandwich with vinylester/E-glass skins. This approach not only met the structural requirements in terms of weight and stiffness but also fully satisfied the Foundation's aesthetic wishes.

www.amaralcf.com

www.lichtensteinfoundation.org

www.publicartfund.org

Eight-Seater, All Composite Jet from Kit Specialist Aerocomp Inc.

Florida-based Aerocomp Inc, has smashed the performance envelope for kit aircraft, with the unveiling of the CA-J jet. Offering the performance and looks of a corporate jet, the CA-J has seating for eight, a cruising speed of 400 mph (644 kmh) TAS @22,000 ft. (6,700 meters) and a range in excess of 1,000 miles (1,610 km). The pressurized cabin will be capable of maintaining 10,000 ft. cabin altitude up to the airplane's service ceiling of 29,900 ft. (8,800 meters). In common with Aerocomp's turboprop kit aircraft, the CA-J is particularly spacious, with its 68 in. (172 cm) wide cabin offering a headroom of 70 in. (178 cm).

Other key statistics include: an 8,900 lb. (4,037 kg) maximum gross takeoff weight and a projected 4,500 lb. (2,041 kg) empty weight, giving the CA-J an impressive load carrying capacity of around 4,400



Illustration: James Hauser

The revolutionary CA-J, eight-seater jet from Aerocomp Inc.

lb. (2,000 kg). Fuel consumption at cruising speed is expected to be 160 gph (606 lph).

The fuselage, wings and tail section are all constructed using carbon fiber sandwich composites to provide a light and strong air frame. In common with other aircraft in the Aerocomp range, extensive use is made of DIAB sandwich core materials.

Finished CA-J aircraft are expected to be flying for an out-of-pocket total of only \$550,000

to \$600,000 and within as little as six to eight months after kit delivery. At this price level the CA-J will take sports aviation to the next level at a fraction of the cost of other aircraft of similar performance.

www.aerocompinc.com

NORWEGIAN KIT BUILD



Compared to the CA-J, this aircraft is perhaps at the other end of the kit-build aircraft market. Based on Burt Rutan's Long Eze design, it took Norwegian Tore Bjølgerud 2,500 hours to build the plane from scratch from a set of plans.

Composite sandwich construction is used throughout the structure using primarily E-glass over a Divinycell foam core. Its performance is very impressive with a top speed of 190 knots (350 kmh) and a range of 800 km (1,500 miles).



The first CA-J in build at the Merritt Island, Florida facility of Aerocomp Inc.

Processing Focus

The DIAB Core Infusion Method

The DIAB Core Infusion Method brings together all the benefits of sandwich composites with the processing, performance and health and safety advantages of closed molding. In particular, it allows consistent results to be achieved and provides optimum bonding between the core and the laminate.

The DIAB process also allows faster flow rates and as a result enables the production of very large components in a single shot while substantially reducing lay-up time. With the DIAB system the specially grooved core not

only enhances the structural performance of the composite component, allowing high fiber volume fractions to be achieved, but also acts as the resin transfer medium. By eliminating the requirement for sacrificial distribution mats or nets the cost of consumables

and waste is significantly reduced. The system is completely compatible with polyester, vinylester and epoxy resins and a wide variety of reinforcement types and forms. It can be readily introduced using existing molds and without the need for heavy capital investment.



A demonstration of the DIAB Core Infusion Method.

your production operation. If required DIAB structural engineers can re-engineer the component to maximize its strength to weight ratio and other performance parameters using a variety of tools including finite element modelling.

DIAB process engineers can then analyze the actual

component and design the groove pattern so that the appropriate flow rates are achieved and the risk of resin rich or resin dry spots are eliminated. Once the process methodology has been agreed, DIAB technical services personnel can work with your own

production team to produce trial components and coupons that can be subjected to a variety of tests in DIAB's own mechanical test laboratories. At the same time on-site training can be provided for your personnel to ensure a trouble-free introduction.

TOTAL SUPPORT

With its extensive experience of infusion molding, the DIAB technical services team can guide you through every aspect of the process. In this way the changeover can be fast and smooth with the absolute minimum interruption to

DIAB is the world's largest producer of structural foam core materials with production facilities in Sweden, Italy, the USA, Australia and Ecuador.

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