COMPOSITE INTEGRATION
INNOVATION IN COMPOSITES TECHNOLOGY

CLIENT

EQUIPMENT & PROCESS

MARINE

The Composite Experts in the Marine Industry

INTRODUCING

CIJECT

Dependable Engineering

Specialising in resin transfer moulding (RTM) and resin infusion (RI), Composite Integration is committed to providing market-leading, innovative, and well-engineered solutions to the composites industry – whatever the scale of your project, we have the practical experience and technical capacity to find a solution that works.

Developed and refined across two decades by a dedicated team of engineers, our Ciject® range of injection equipment is world-renowned for its sophistication and reliability, combining award-winning design with the highest quality of manufacture. Your success is our objective.

“With Ciject systems now central to our manufacturing process, we’ve opened new possibilities for component design and have embraced a more creative approach with our latest product range.”

Rob Coleman

HEAD OF MANUFACTURING ENGINEERING | PRINCESS YACHTS LTD.

Above: **Princess Yachts Ltd., Newport Street.**

Ciject equipment is used to manufacture some of the largest and most prestigious vessels currently available.

Resin Infusion & Direct Infusion

DIRECT INFUSION™

As the infusion process has become more widespread the need to mechanise the handling, mixing and delivery of the resin has become more important. The traditional technique of hand-mixing bulk resin becomes impractical and potentially risky when using the process on any significant scale. Problems with material ratio consistency, potential bulk-exotherm and high levels of waste can have a significant detrimental effect on the viability of the process.

A meter-mixing machine can be used to simply dispense mixed resin 'on demand' into a suitable container but **Composite Integration** have taken the technology a step further by pioneering the development of systems capable of injecting 'directly' into the infusion process. The addition of strategically positioned in-mould pressure sensors (IMPS) to monitor infusion pressure, control flow rate and regulate volumetric compression, enables completely automated, precision control over the whole operation.

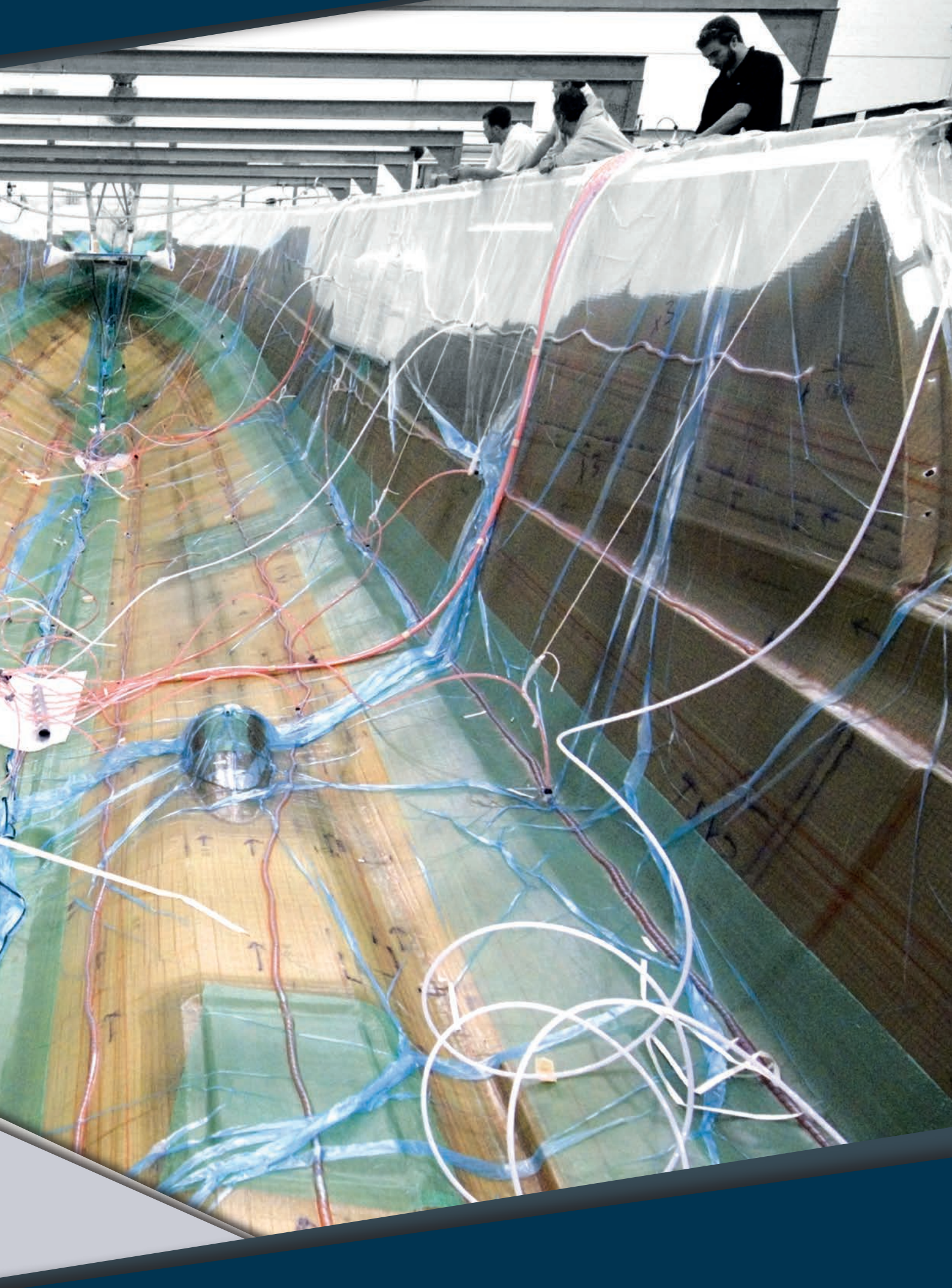
The Ciject® Advantage

Benefits of Direct Infusion:

- **Process repeatability**
- **Resin is delivered to the mould at the optimum pressure**
- **No bulk-exotherm risk**
- **No manual resin mixing**
- **Internal inline mixing avoids air entrapment in resin**
- **Waste reduction**
- **Process data recording**
- **Fewer man-hours**

Ciject machines are optimised for Direct Infusion, with the latest generation of models having been developed specifically for large scale processing where higher volume output is needed.

The Ciject Four and Ciject Five are used to infuse some of the world's largest composite structures currently in production.



Above: **Typical set-up of a large structure Direct Infusion.**

Typical Direct Infusion Strategy for Large Structures

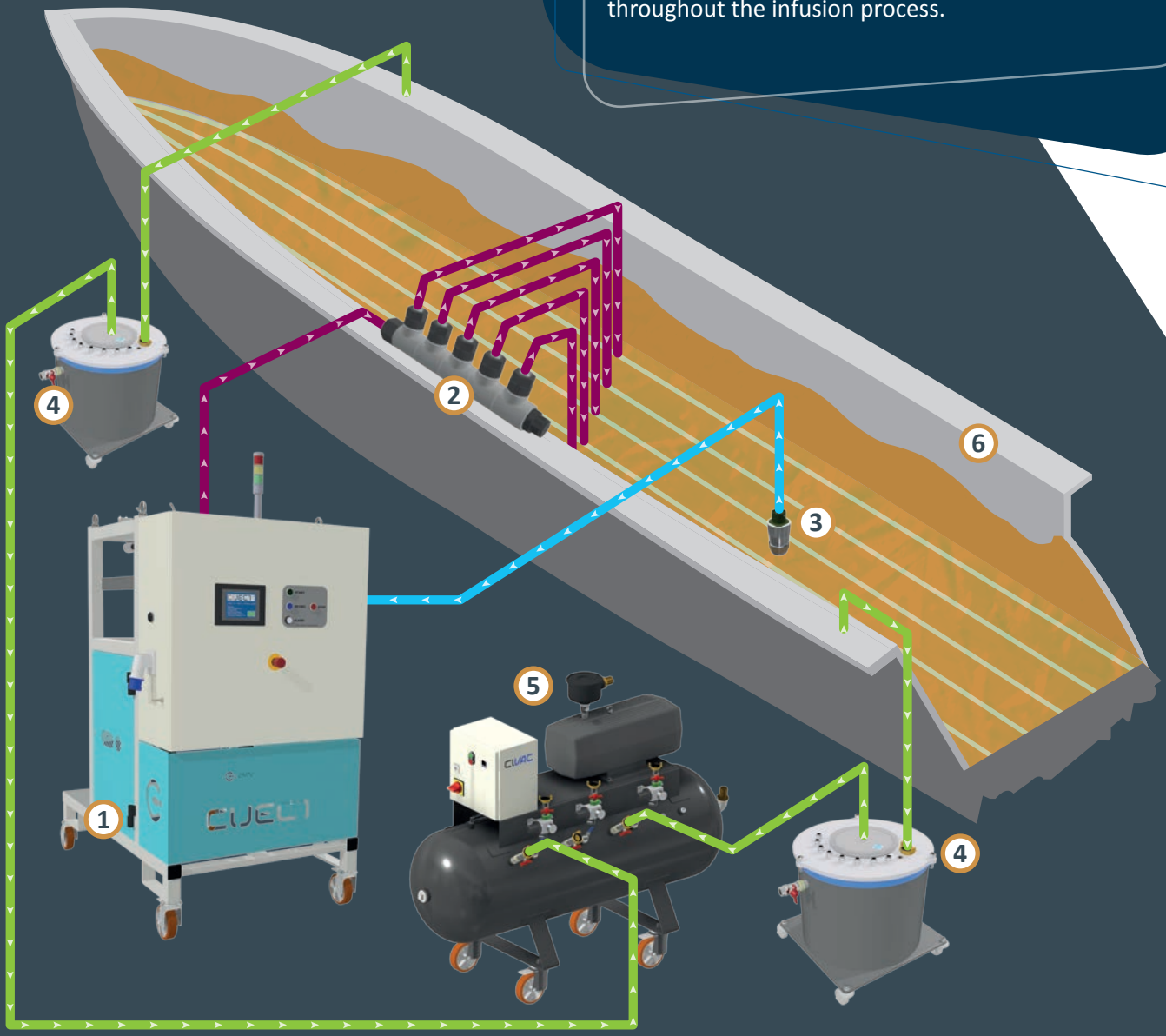
EQUIPMENT SET-UP

The Ciject Four infusion machine has been developed specifically for large scale infusion processing, managing mix ratio, infusion pressure and flow rates to provide unmatched levels of automation, efficiency and quality control.

CONTROLLED APPLICATION

To achieve accurate mixing consistency and avoid potential bulk-exotherm while also minimising waste, our systems feature intelligent reactive monitoring with real-time response capabilities.

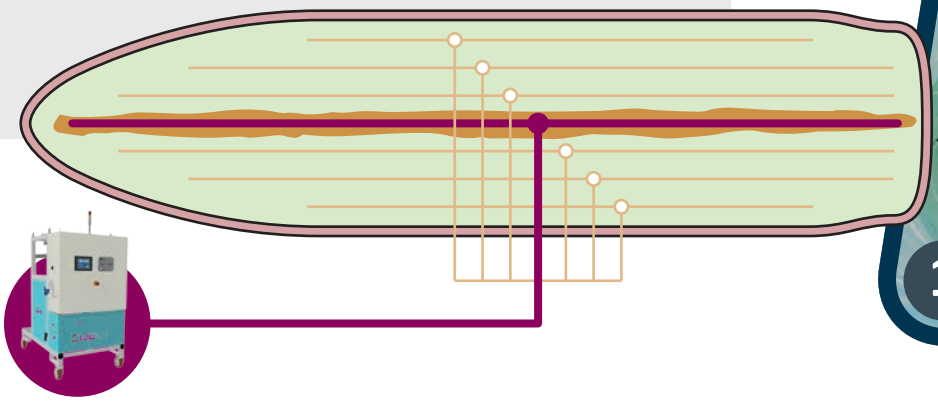
Our IMPS technology feeds constant updates back to the Ciject machine to ensure unrivalled accuracy throughout the infusion process.

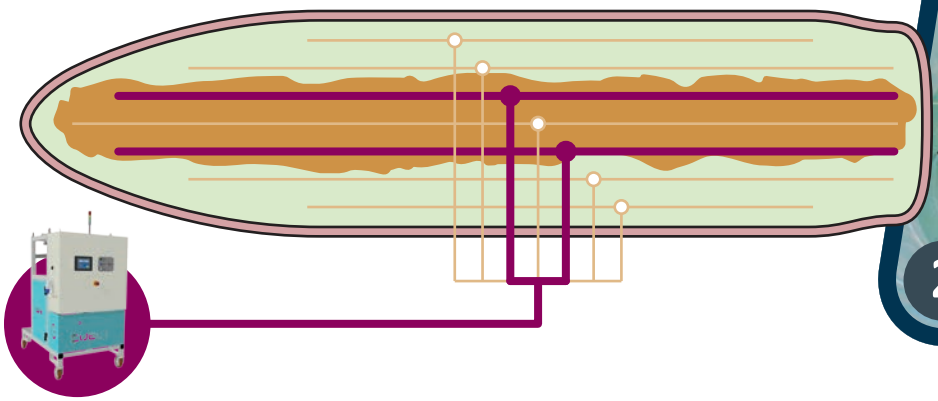


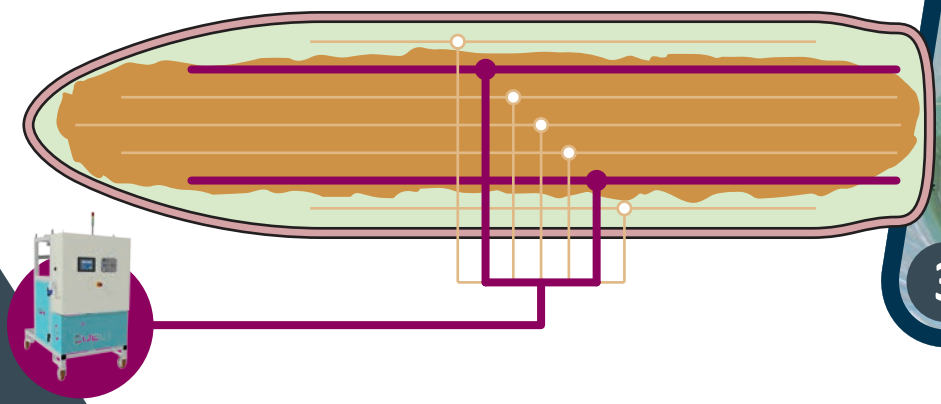
1. **Ciject Four** – resin mixing and infusion
2. **Manifold** – resin distribution
3. **IMPS** – data feedback and control
4. **Catchpot** – contaminant protection
5. **Civac pump** – vacuum system
6. **Consumables** – infusion film & PVC pipe

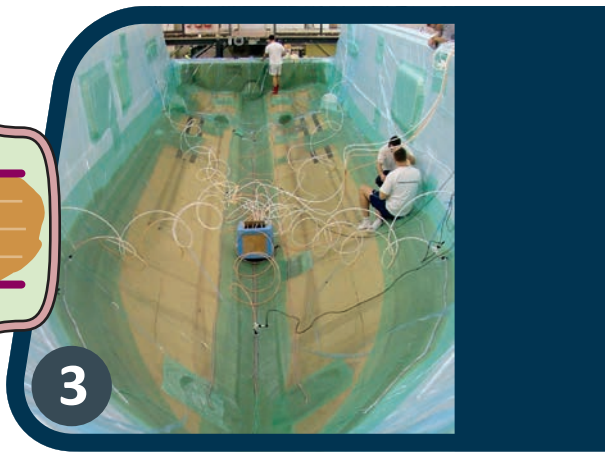
Resin flow IMPS data feed Vacuum

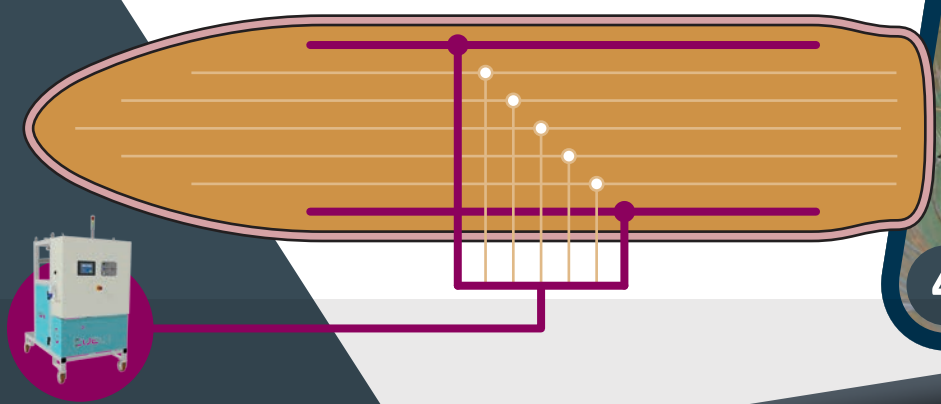
RESIN FLOW PROGRESSION

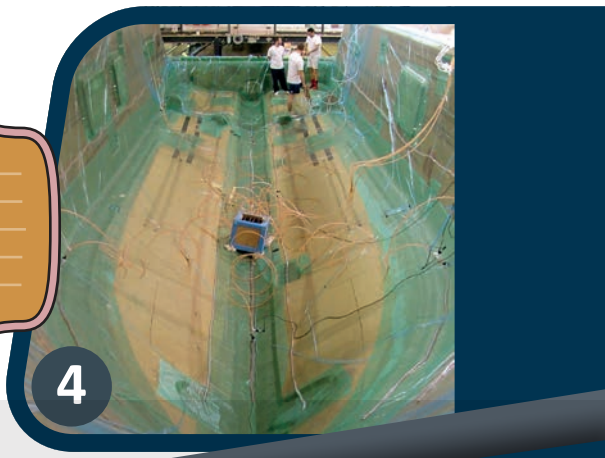












Business Philosophy and Working Practice

Optimised for Efficiency

We take a fully collaborative approach to every project we undertake; the best results are always achieved through balanced partnerships with a mutual respect for each party's knowledge and experience.

As a learning organisation, and members of Composites UK, ADS and UK National Composites Centre, our commitment to the practical development of resin transfer and infusion technologies is exemplary.

From our HQ in the south-west of England, we design, manufacture and comprehensively test our extensive range of equipment and software, and have links to distributors in more than twenty countries across the globe.

CUSTOMER LIAISON

- One-to-one client consultation
- Understanding your objectives
- Initiating an efficient action plan

SOLUTION FINDING

- Intrinsic knowledge of own brand products
- Options to tailor peripherals and accessories
- Specifying equipment for individual needs

RESEARCH & DEVELOPMENT

- Assessment of project parameters
- Feasibility and proof of concept studies
- Prototype production of components and tooling

COMPOSITE INTEGRATION

INNOVATION IN COMPOSITES TECHNOLOGY

"Composite Integration worked with us to help our team move away from conventional infusion to Direct Infusion using the Ciject equipment. Their level of support at every stage and the resulting efficiency improvements should be commended."

Adam Brangan

DIRECTOR OF NAVAL ARCHITECTURE & MATERIALS ENGINEERING
SUNSEEKER INTERNATIONAL LIMITED

PROCESS MANAGEMENT

- Installation team to implement on-site set-up
- Extensive supervision and guidance
- Projects overseen to maximise productivity

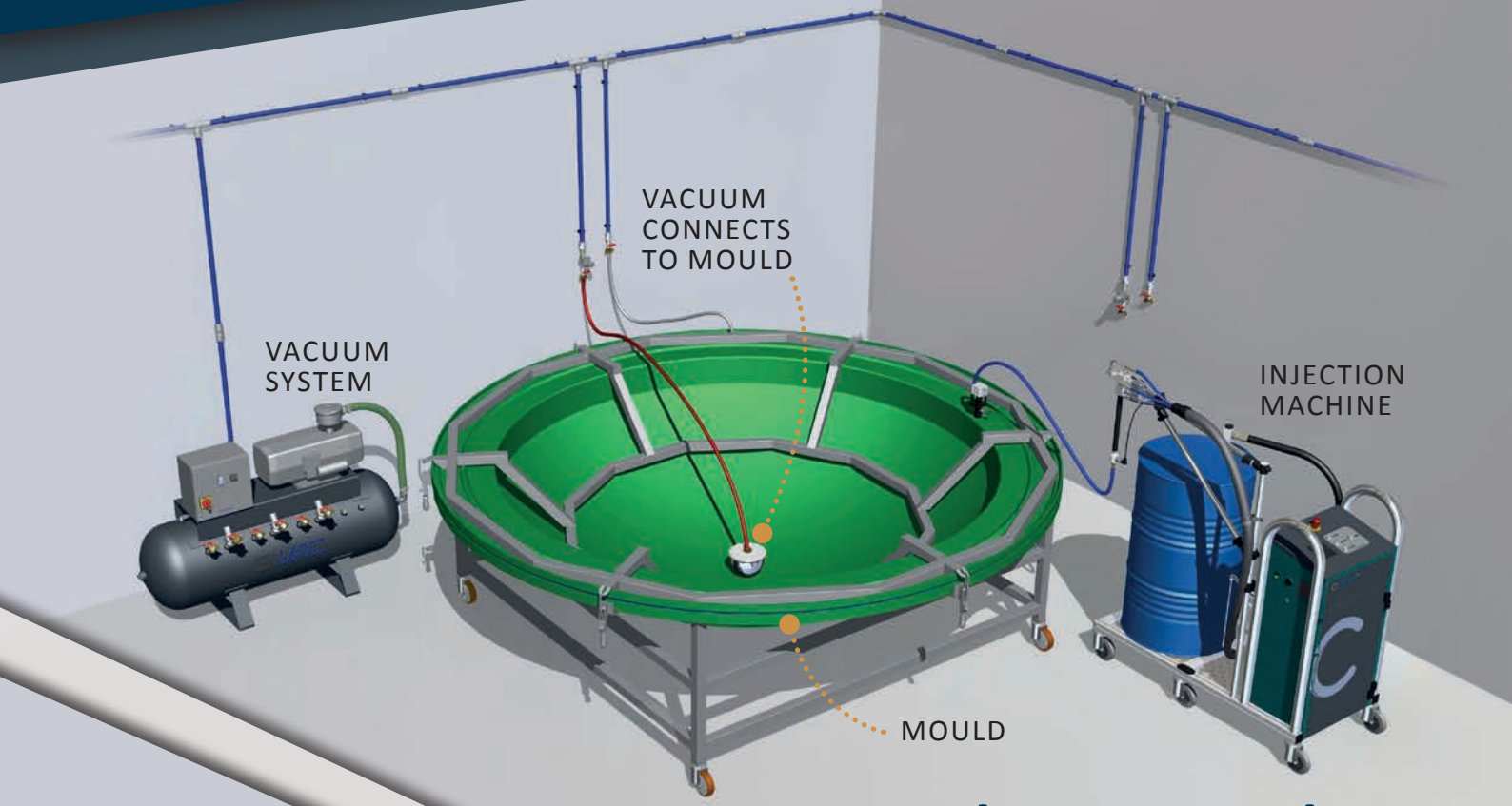
TRAINING & EDUCATION

- Theoretical, practical and technical support
- Delivery of application focused courses
- Member of the National Composites Centre

AFTERSALES SUPPORT

- On-going process support and development
- Cloud based support network
- Long-term customer collaboration

Resin Transfer Moulding & Vacuum Resin Transfer



RESIN TRANSFER MOULDING

RTM is the process of producing composite components within a mechanically-clamped, rigid, matched two-part mould.

Flanges compress a peripheral seal to prevent leaks before thermosetting resin is injected directly into the fibre-pack, and the mould is filled by positive pressure from the injection machine. The mould is normally vented at the furthest points from the injection point allowing the air to escape. Vacuum can also be drawn from the vents to improve laminate quality when necessary.

Traditional RTM relies on the mould/clamping structure being stiff enough to withstand the pressure of the injected resin without opening or distorting.

Selecting the right system

RTM and VRTM are both excellent strategies for small parts, with VRTM also suitable for some large structures.

VACUUM RESIN TRANSFER MOULDING

Vacuum RTM (VRTM or RTM Light) is the process of producing composite components within a vacuum-clamped, two-part matched mould.

Compared with the traditional RTM process, VRTM tooling is relatively lightweight and thus considerably more economical. The process relies on atmospheric pressure as a mould closing force, as opposed to the mechanical clamping methods and heavily reinforced mould structures used in RTM.

Vacuum is applied to the mould cavity and the resin is introduced under low pressure into a peripheral feed channel. This injection strategy provides the most efficient route to fill the mould, with the minimum of reaction pressure against the clamping force.

Due to the use of vacuum to provide a uniform clamping force, the VRTM process can be successfully used to mould large structures using relatively simple and low-mass tooling.

CLOSED MOULD ADVANTAGES

There are many plus points to the 'closed mould' process, making it the primary choice for many projects. Points to consider include the following:

- **Volatile emissions (styrene, etc.) are massively reduced**
- **It can be a fast, clean and repeatable process**
- **The laminate thickness can be closely controlled**
- **The process is far less reliant on the manual skills of the operator**
- **The 'B' surface of the moulding can be accurately defined**
- **The process can be automated**
- **High production rates can be achieved**

Sharing the knowledge

Composite Integration provides practical technical support and consultancy in all aspects of 'closed-mould' processing.

Training in mould construction is available in the form of structured courses and/or practical on-site assistance.

The standard training course consists of a mixture of theoretical and practical work, and is designed to give a practical basis for mould builders, an understanding of the design requirements for the composite component designer, as well as detailed knowledge of the moulding process in general.

We identified the need to develop a training course with practical demonstrations to clarify and clearly explain the advantages and disadvantages of each process, identifying the key influencing factors and the relevant materials used.

FULL TRAINING & SUPPORT

We provide training to meet your team's precise needs

Developed to Harmonise with Marine Applications

A Perfect Match

With over 20 years of experience behind us, we've continually evolved to meet the needs of our clients. In the marine sector, our close working relationship with industry front runners has generated a mutually beneficial climate of inspiration and innovation.

The models most frequently requested by specifiers within the field of boat construction and manufacture are the Ciject Two and Ciject Four.

Between them, these two superbly engineered pieces of machinery comfortably cover the vast majority of resin transfer and direct infusion projects undertaken by our customers.

CIJECT TWO

RTM/VRTM INJECTION MACHINE

MIXED OUTPUT CAPACITY
10 Kg/m

Modular and highly expandable, the Ciject Two offers a versatile, programmable logic controller, accessed by Siemens PLC Large touchscreen interface. The Ciject Two also provides the option of tank module connectivity.

An ideal solution for small to medium sized projects requiring mixed outputs of 0.1 to 10 Kg a minute (viscosity dependent).

Features include:

- **Fully enclosed cabinet with full operator control**
- **Siemens PLC and large touchscreen for ease of use**
- **Configurable mix ratios to suit polyester/ vinylester, epoxy or phenolic systems**
- **Injection pressure range of -1 to 10 Bar Gauge**
- **Seamless compatibility with our range of in-mould pressure sensors (IMPS)**
- **Low volume/high velocity mix-head flush system to ensure simple and quick cleaning with minimum solvent use**
- **Comprehensive configuration and recipe control**
- **Remote display access**
- **Inline flow meters to ensure material ratio accuracy**
- **Catalyst/hardener monitoring system**
- **Catalyst system includes return isolation valve to provide additional security**

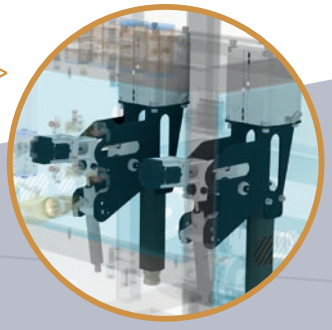
CIJECT FOUR

DIRECTION INFUSION EQUIPMENT

Based on the proven Ciject system, the Ciject Four uses a double pump system to provide optimum output plus a level of live process security; each pump/mix-head can be shut down and flushed if necessary, mid-infusion.

Designed for mixed resin projects over 1,200 Kg with flow rates up to 18 Kg per minute. Specifications can be adapted and the control system can be configured to suit individual parameters of any given project.

MIXED OUTPUT CAPACITY
18 Kg/m



Twin-pump system with the option to run independently >

Features include:

- **Fully enclosed cabinet housing pumping and control systems**
- **Seals designed and tested for service life in excess of 250,000 Kg of resin**
- **Fully automatic mix-heads feeding into an integrated manifold**
- **Skid mounted with castors, forklift and gantry lift points**
- **Resin inlets with cam-lock IBC connectors, large-bore inline filters and inline catalyst/hardener filters for easy cleaning without disconnection**
- **20 litre non-pressurised solvent tank**
- **Low volume/high velocity mix-head and manifold flush system to ensure simple and quick cleaning with low solvent use**
- **Catalyst/hardener monitoring system**
- **Purpose designed resin and 316 stainless steel catalyst/hardener pumps for high reliability and simple maintenance, which are modular for easy removal**
- **Recirculation isolation valves to ensure 100% material flow to mix-head**
- **Inline flow meters to ensure material ratio accuracy**

The Ciject Range – Versatile, Economic & Expandable

Completing the Picture

Precision engineering requires every link in the creative chain to perform its function with the highest possible accuracy. That's why we've developed our own catalogue of peripheral and ancillary equipment, specifically designed to complement the Ciject injection machinery range.

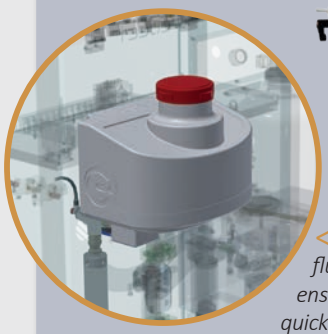
Guaranteed compatibility, combined with unrivalled quality and reliability make our accessories the premier choice for any Ciject-based operation.

Covering every aspect of resin transfer applications, our extensive parts list has evolved to keep pace with the latest developments in moulding technology, regularly updated and curated by our industry-leading team of experts.

And what's more, the knowledge gained through the real-life implementation of our own products is passed on to our clients, with solid practical advice available to help your project run smoothly.

CIJECT ONE

RTM/VRTM INJECTION MACHINE



< Integrated flush system to ensure simple, quick cleaning

MIXED OUTPUT CAPACITY
10 Kg/m

A sophisticated machine with programmable functions and an extensive level of control options.

The Ciject One's resin and 316 stainless steel piston pumps are built for high reliability with a unique pivoted mounting that provides easy access for maintenance.

A versatile combination of simplicity, durability and control.

Features include:

- **Advanced seal technology preventing leaks without the need for lubrication**
- **Available with mix ratios to suit polyester/ vinylester, epoxy or phenolic systems**
- **Alarm monitored injection pause control and gel timer with flush indicator**
- **Fully enclosed cabinet with full operator control**
- **110—240V industrial micro-electric PLC control with colour touchscreen operator display.**
- **Pre-Injection vacuum test with analytical feedback**
- **Catalyst system with return isolation valve**
- **Solvent level sensor**
- **Low volume, non-pressurized mix-head flush system**
- **Storage area for hardener/ solvent**
- **Inline resin filter allowing cleaning without removal of loading hose**
- **Catalyst filtration**

VACUUM EQUIPMENT

ROTARY-CLAW SYSTEM

Rotary-claw type pumps are ideally suited to large scale VRTM processes, combining exceptional toughness, high-flow rates and low output noise.

This type of vacuum system is not adversely affected by air-admittance during the moulding process, unlike oil-lubricated pumps, which will vent oil vapour if used in this type of application.

Available as a stand-alone pump or in a range of configurations.

Features include:

- **Multiple regulated & non-regulated outlets**
- **High output, oil free rotary-claw type 80 m³ vacuum pump**
- **Standard vacuum pump is three phase, 415 V supply with a rated output of 1,300 litres/min**
- **Achievable vacuum levels of <1.0 mbar (absolute)**
- **Highly reliable and relatively quiet**
- **High-flow rate ideally suited for multiple mould operations**
- **Long service intervals**
- **Fitted with a replaceable cartridge filter to prevent dust and fibre entering the pump**

ANCILLARY EQUIPMENT

DIRECT INFUSION FITTINGS

Fully supporting our Ciject injection machines, we offer a comprehensive range of modular components and fittings that will ensure the success of your infusion project, however large or small.

Composite Integration can guide you through each process, from injection strategies and moulding techniques to manifold configuration and fitting requirements.

Our knowledgeable team can also advise on equipment selection and help to tailor the configuration to meet your exact requirements.

IMPS

IN-MOULD PRESSURE SENSORS (IMPS)

Our IMPS range and readout units have been developed specifically for accurate pressure monitoring and control in RTM and Resin Infusion moulding processes, providing in-mould feedback control to Ciject machines.

Our resin distribution manifold features a clamping system to enable structured management of resin inlet hoses. Manual pipe clamps provide secure, practical control of infusion strategies.

SERVING THE MARINE INDUSTRY WORLDWIDE

COMPOSITE INTEGRATION
INNOVATION IN COMPOSITES TECHNOLOGY

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