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Light RTM Application Guide

What is Light RTM

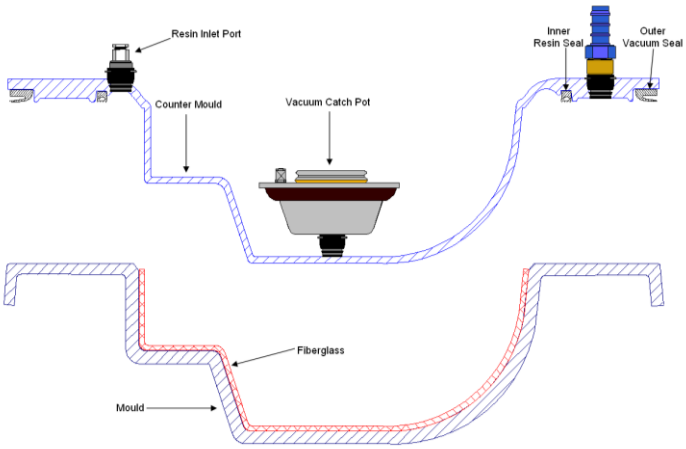
The process that forms a product when two moulds, one more rigid than the other come together by vacuum, creating a closed environment into which resin is drawn with the aid of vacuum and injection forces.
Vacuum is used to clamp moulds together as well as to encourage resin flow into the mould cavity. These vacuums are separate and at different levels, -0,8 to -0,9 bar for clamping and -0,5 to -0,6 bar centrally positioned venting vacuum.
Catalyzed resin is drawn into the mould cavity by the internal vacuum force and is also injected by machine at the same time.

The light RTM process is successfully used to mould parts for aerospace, general mouldings for truck and bus application, marine, wind energy and many other industrial applications. To date, parts as small as a 248-gram riding helmet, to 60M^2 boat hull and deck mouldings, have been produced with excellent quality and production output quantities. A Brazilian manufacturer recently produced over 800 telephone booths of 1.5M^2 surface area per day, with a gelcoat finish.

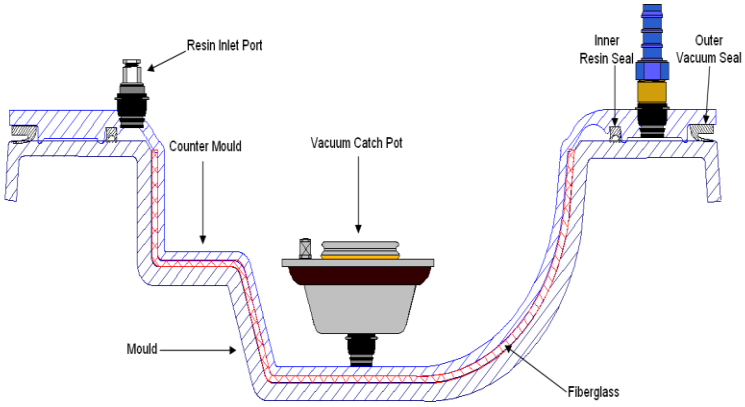
In Europe many major leading boat manufactures are moulding large 8-10M boat hulls and decks with high quality surface finish on both moulded faces using the Light RTM process. This is preferred to vacuum film infusion as only one cosmetic face can be achieved with that process.

Light RTM as a successful and economical moulding process, being limited only by the user's imagination.

A schematic Layout of the typical LRTM set up
The “A” mould is more rigid than the “B” mould or countermould



The Moulds are locked together by vacuum during mould filling and curing



The Principles that enable the process

- Vacuum Force, or Pressure Differential – 1 m² of air extending 1000m vertically exerts a force of 10 tonnes at sea level “the big press in the sky” – Colin Chapman – Chairman of Lotus Cars.
- Injection pressure by injector seldom goes above 1 bar and creates a push/pull situation in the cavity of the mould.
- Resin Viscosity – this is normally between 150 and 300 cps.
- Reinforcement Permeability – the core or flow medium as well as the reinforcement need to allow resin to flow.

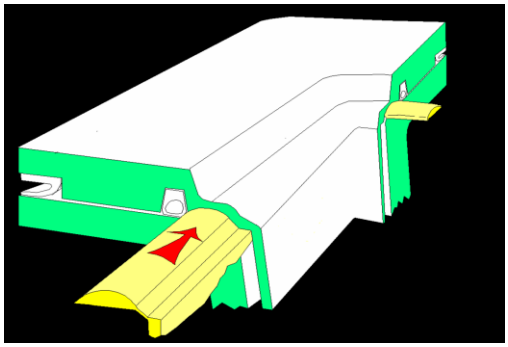
A **resin Injection machine** for LRTM typically operates at low injection pressure (up to 1 bar) and makes use of positive displacement pumps for resin and catalyst injection. The machine has a pre-determined stroke counter, a resin gel alarm as well as a pneumatic vacuum pressure pump control feature.

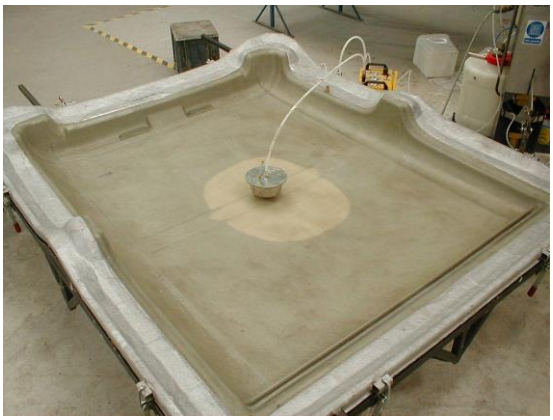
Pro Innovator Injector

Counter mould manufacture

The construction of the “B” mould or Counter Mould is done to introduce resin into the part with a peripheral fill with resin flowing toward a centrally located vacuum point or points.

Peripheral filling is proven to be 3 to 4 times as fast as a central filling point and was initially introduced in France in 1999.

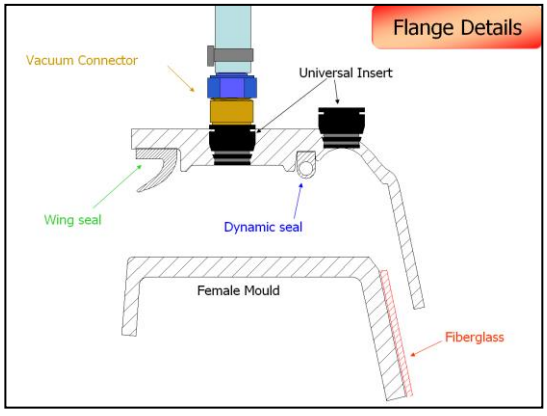


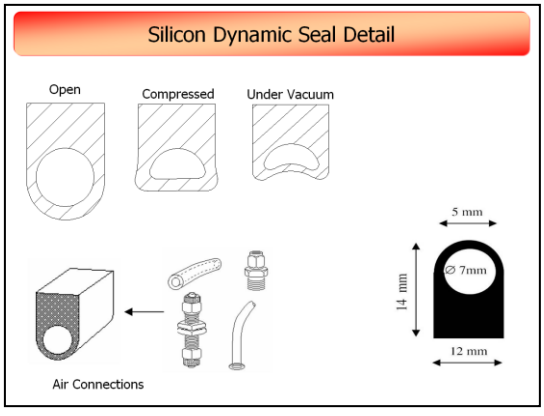


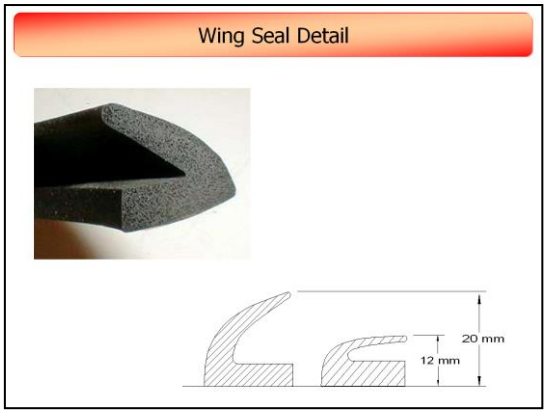
A moulding being filled peripherally

Technical flange details

The most important aspect of the counter mould making is the technical flange which holds both the peripheral wing seal for the vacuum ring as well as the internal resin seal. The technical flange should be stable and not have any warpage which could introduce leakage problems at a later stage.

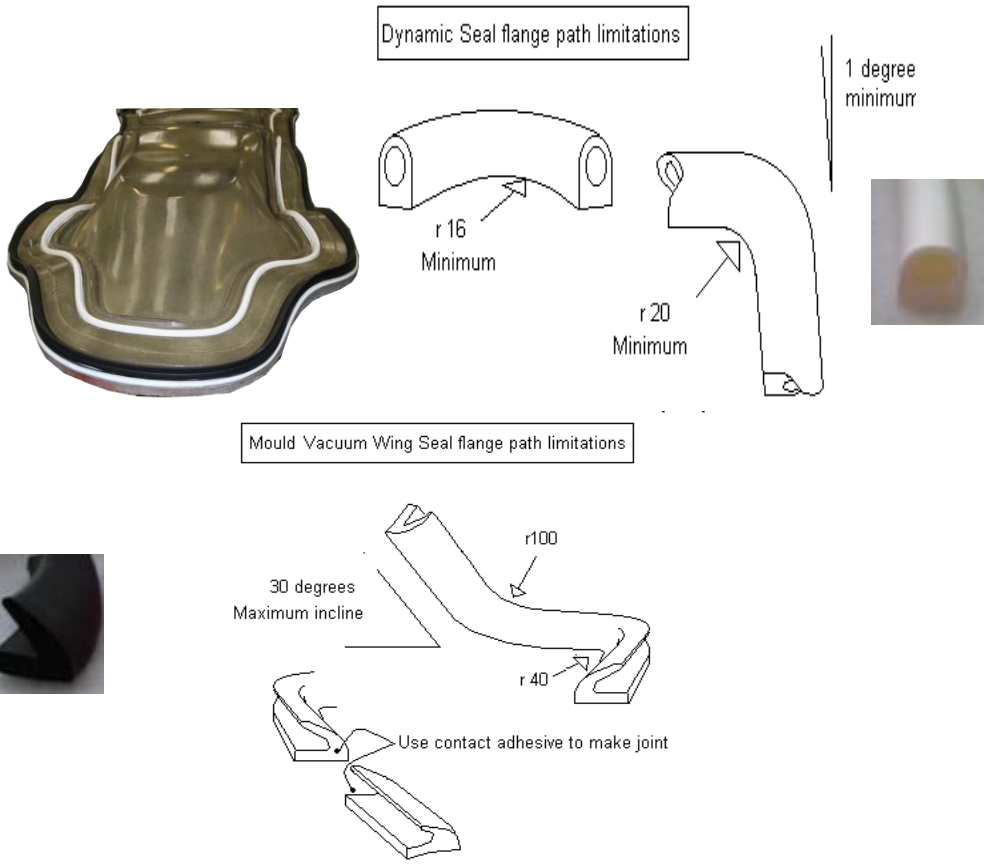






The “A” mould will need to be constructed stiffer than the counter mould and it is at this stage that the minimum flange width of 130mm is observed. A further detail can be initiated at this stage and is referred to as the “pinch off” detail and is useful in marking the product for trimming. The pinch of is constructed at a 45º angle to the edge of the moulding having a land edge of approximately 10mm before joining the horizontal flange. Draft angles for vertical walls are generally a minimum of between 2º and 3º but not less than 1º. When demoulding it is essential that the two moulds will separate easily before the part is removed.

The flange shape and pathway as it surrounds the product needs to be constructed in a way that does not let the seals undergo tighter radii bends than the seals are designed to work at. Failure to make these allowances could result in seals that leak.



Part Calibration

Before the counter mould can be laminated the thickness of the product to be produced is placed on the mould in the form of wax, cork and for flat areas an MDF board can be used. These products are placed at the correct and appropriate thickness, simulating the final product thickness.

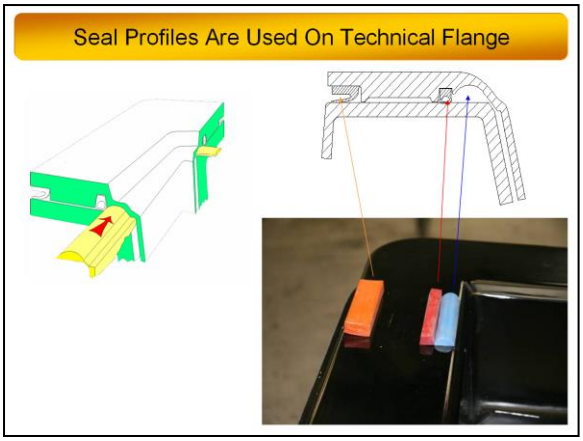
The technical flange lamination will benefit from the use of vacuum during the mould building and this is realized by the placement of a communicating strip (string or electrical wire – 1mm) below the 1mm wax sheet, passing under the universal vacuum insert for the mould clamping vacuum.

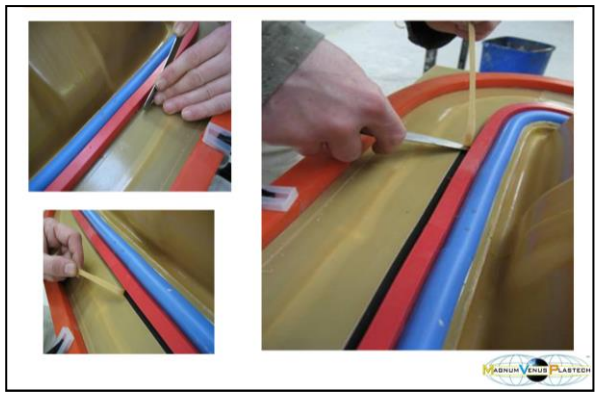
Silicone, reusable seal and resin runner profiles are used to create the cavities necessary and are referenced as follows

- Outer vacuum wing seal profile – p/n 3391

- Inner silicone resin seal profile – p/n 3340

- Resin runner profile – p/n 4530





Lamination of Counter Mould

Once calibration has been completed, the mould making accessories loaded and the PVA release applied, the lamination of the countermould can begin. This is done in the following sequence

- Clear tooling gelcoat applied over the entire mould.
- ECR M524 30S glass tissue laminated with VE Resin (DI 9133-800) – entire mould.
- Laminate 2 x 450g CSM over part area only, ending at Resin seal profile.

Flange lamination

- 2 x 450g CSM placed between seal profiles (DI 9133-800)
- Woven glass tape (280g) placed on top of wing seal profile and resin channel profile (DI 9133-800) and leave to cure.
- Spatula FSP 1528 L and build up to 15mm over the entire technical flange.
- Complete lamination by 2 x 450g CSM over entire flange while the FSP Bulkfill is still liquid.

Demoulding and commissioning counter mould

The countermould will need to be removed from the calibrated “A” mould carefully to avoid any damage as it is a thinner laminate. Stripping of all calibration materials and cleaning the moulds is essential before compounding and polishing.
At this stage the silicone Dynamic resin seal is bonded into the groove left behind by the profile, RTV silicone is used and masking tape is used to hold the seal in place during the silicones curing. RTV silicone and a short piece of a 4mm silicone tube are used at the seal joint.

The neoprene Wing seal is bonded to the mould around the peripheral contours using Cyanoacrylate glue. The same glue is used to join the seal.

RTM Light resins supplied by NCS Resins

Orthophthalic resins

- NCS 236 PA and 236.
- NCS 313 PA and 313.
- NCS 284 Series - Rigid

Fire Retardant

- DION FR 840338 – Filled
- DION FR 821M761 - Unfilled

Marine Iso/DCPD resins

- Polylite 33282-00 and Polylite 33282-15

Superior Surface finish

- Polylite 31515-08

Troubleshooting guide

Defect	Cause	Solution
Trapped Air (Preferential Channel)	Poor Calibration – areas where cross sectional thickness is greater than designed for – thickness variation	Ensure calibration results in uniform part thickness.
	Glass stretched to conform to the shape, resulting in uneven thickness	Load the glass without stretching.
	Part geometry results in uneven filling	Add an extra vacuum point.
Inconsistent part thickness (thin) Thick	Counter mould deflects and compresses the fibre pack Part is injected too fast or at a pressure higher than 1 bar	Reduce the part/internal vacuum level. Slow injection speed and reduce pressure.
Poor part surface quality	Incorrect resin – resulting in high shrinkage	Correct resin or catalyst type and addition rate. Consider using a filler ($CaCO^3$) in the resin – reducing shrinkage.
	Surface of mould is poor	Repair moulds surface.
	Part is under cured when demoulded	Allow resin system to cure fully – consider the use of in mould heating.

	Part is resin rich – the glass content is below 25% Cold temperatures	Increase the glass content to above 25%. Warm production environment, resin and moulds.

May 2020