

# Production Process of Fiberglass Fast Interceptor Boat in Malaysia

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## ABSTRACT

The conventional fiberglass boatbuilding is still widely practiced in Malaysia compared to the modern fiberglass boatbuilding. Every fiberglass boatbuilder has different methods or processes for the construction of fiberglass boats. The production process and procedure of conventional fiberglass boatbuilding is far from the influence of advance technology. This study presents the production process for modern fiberglass boatbuilding in Malaysia which uses Resin Infusion Method as the latest method in composite technology and applied on Fiberglass Fast Interceptor Boat. The study was conducted in UES International SdnBhd in Malacca, Malaysia.

**KEY WORDS:** *Production Process; Fiberglass Boatbuilding; Fast Interceptor Boat.*

## 1.0 INTRODUCTION

Marine transportation is a need in most parts of the world. A ship or boat is a complex vehicle designed to convey or transport people, goods from one place to another on water. Its production

combines three different areas of specialties: naval architecture, marine engineering and ship building. The overall process of ship construction is costly, time consuming and complex. Thus these are the reasons why efforts on constructing the most cost effective ship have been the main objective of almost all shipbuilders around the world. Ship production process is the act of producing a ship. The improvement in ship design and construction has been a process of evolution, slow at first, but which gathers speed over the centuries, leading ultimately to the sophisticated ships of the 21<sup>st</sup> century. Fiberglass has been used in the traditional boat building industry in Malaysia since the 1980s [1]. Fiberglass boats are much more attractive due to its strengths such as light weight, high vibration damping capability, high impact resistance, low construction costs, ease of fabrication, ease of maintenance and repair. The manual hand laminating technique has been gone through several evolutions since its first introduction in the 1970s [2]. Several new technologies have been developed since then, such as Resin Transfer Molding [3-5], Seeman Composites Resin Infusion Molding Process (SCRIMP) [6], Resin Infusion under Flexible Tooling (RIFT), [7-9] and Vacuum Assisted Resin Transfer Moulding (VARTM) [10-11].

Hand lay-up refers to the manual method where the application of resin and reinforcement is done by hand onto a suitable mold surface. Glass or other reinforcing mat or woven fabric or roving is positioned manually in the open mould, and resin is poured, brushed, or sprayed over and into the glass plies. On the other hand, the vacuum infusion process is a technique where vacuum pressure is used to drive resin into a laminated layer of fiber mat. Materials are laid dry into the mould and the vacuum is applied before resin is introduced. Once a complete vacuum is achieved, resin is literally sucked into the laminate via a carefully placed tubing. This study is conducted to find out the

production process for modern fiberglass boatbuilding using resin infusion method.

## 2.0 THE EVOLUTION OF FIBREGLASS BOATBUILDING METHOD

Fiberglass boat construction has gone through many years with the various methods in order to improve the techniques and skills for the boatbuilding process. The objective in the fiberglass boatbuilding is to achieve lightness in weight, vibration damping, corrosion resistance, and impact resistance, low construction cost and ease of construction. The boatbuilding industry methods can be divided into single skin construction, sandwich construction, resin development, unidirectional and stitched fabric reinforcement, advanced fabrication technique, alternate reinforcement materials and infusion method.

### 2.1 Hand Laminating

Hand lay-up is a simple method for composite production. A mould must be used for hand lay-up parts unless the composite is to be joined directly to another structure. The mould can be as simple as a flat sheet or complex as infinite curves and edges. For some shapes, moulds must be joined in sections so they can be taken apart for part removal after curing. Before lay-up, the mould is prepared with a release agent to ensure that the part will not adhere to the mould. Reinforcement fibres can be cut and laid in the mould. It is up to the designer to organize the type, amount and direction of the fibres being used. Resin must then be catalyzed and added to the fibres. A brush, roller or squeegee can be used to impregnate the fibres with the resin. The lay-up technician is responsible for controlling the amount of resin and the quality of saturation. Other fabrication processes such as vacuum bagging, vacuum resin transfer moulding and compression moulding can be used with hand lay-up to improve the quality of the finished part. In addition it also saves time.

### 2.2 Infusion and Vacuum Technique

Resin infusion is a specialized advanced laminating technique that greatly improves the quality and strength of fiberglass parts as opposed to conventional hand layup. Applying laminate engineering and resin infusion technology simultaneously allows for optimization of a part in terms of strength and weight. The use of resin infusion will likely become the standard in yacht construction and has been in use since the 1960s. From the inside of the mould, after the usual mould release wax is applied, the gel coat and skin coat of thin fiberglass reinforcement are applied in the conventional manner and allowed to cure. From here on everything differs. Next, in the infusion process, the outer skin of fiber reinforcement fabrics is carefully fitted into the mould over top of the skin coat. These are put to dry and held in place with a spray contact adhesive. Because the technicians are not hurried and concerned with the narrow resin curing period as would be in conventional layup, attention can be paid to quality and the conscientious cutting, fitting and orientation of the fabrics fibers and core. Next, in the case of a cored part, the structural core materials are cut and fitted, and adhered into place. Then the inner skin of reinforcement fabrics is carefully fitted over the core to form a sandwich.

### 2.3 Hand Laminating and Resin Infusion Setup

Hand lay-up refers to the manual method where the application of

resin and reinforcement is done by hand onto a suitable mold surface. Reinforcements are laid into a mold and manually wet out using brushes and rollers.



Figure 1: Hand Layup Method

General setup of resin infusion using the same principle of vacuum pressure is used to drive resin into a laminated layer of fiber mat. The same basic setup has been described in [12-15]. The setup is shown in Figure 2.



Figure 2: Resin infusion setup

## 3.0 FIBERGLASS FAST INTERCEPTOR BOAT BUILDING PROCESS

In production process, production of fiberglass boat is not much different from other kind of ship. The difference is only way of build which is using fiberglass mat and other chemicals. All of the process is done by manpower with minimize usage of electrical tools. The workers involved in fiberglass boatbuilding will be usually led by their production manager. The production manager will ensure all the process can be done according to the master schedule or production planning. The Fast Interceptor Boat process is shown in Figure 3 below.



Figure 3: Fast Interceptor Boatbuilding Process

**3.1 Fast Interceptor Boat Construction**

The construction of the Fast Interceptor Patrol Boat can be divided into six main job scopes. For easy understanding, the boat construction job scopes are listed as follows:

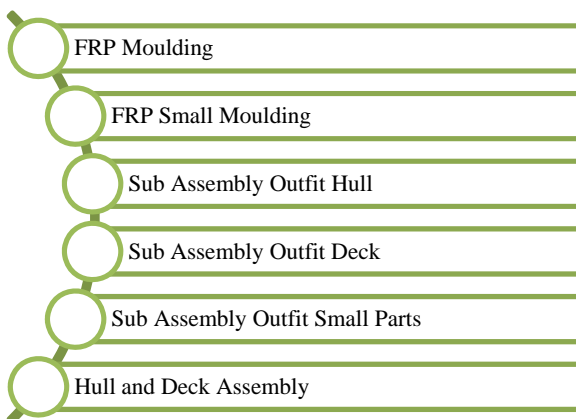


Figure 4: Six Main Job Scopes of a Fast Interceptor Patrol Boat

**3.2 Fiber Reinforced Plastic (Frp) Moulding**

Under the FRP Moulding job scope, the process can be divided into two sections which are the construction of Hull and also Deck. FRP Moulding construction focuses on the main parts of the Fiberglass Fast Interceptor Patrol Boat which is Hull Construction as shown in Figure 5 and Deck Construction in Figure 6.

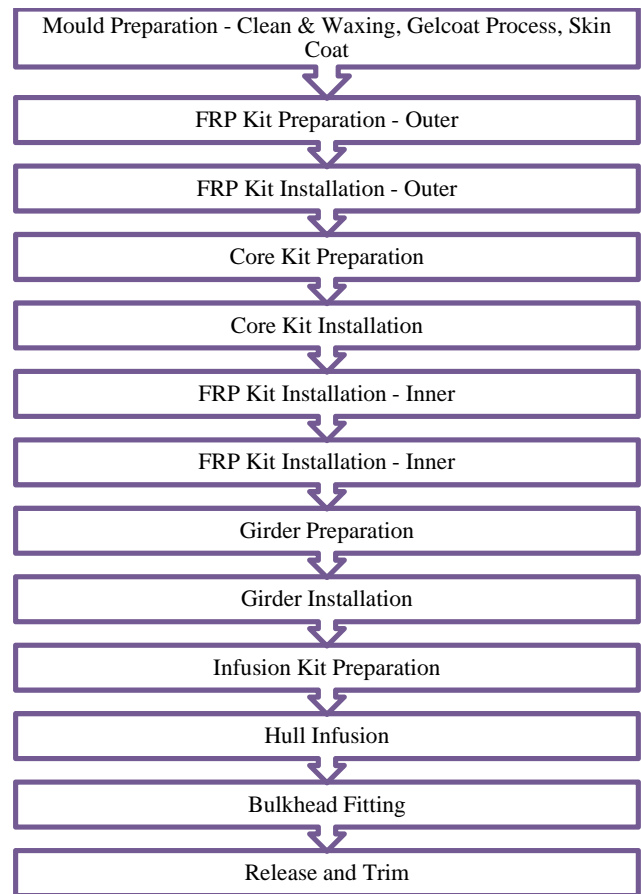


Figure 5: Hull Construction Process using the Infusion Method

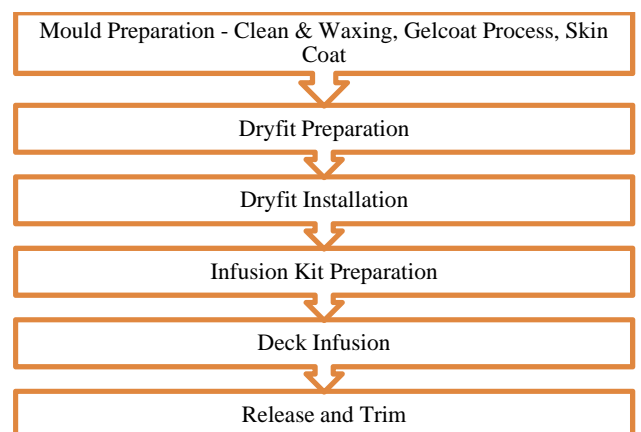


Figure 6: Deck Construction Process using Infusion Method



Figure 7: Mould Preparation – Clean and Waxing



Figure 8: Mould Preparation - Gelcoat Process



Figure 9: Mould Preparation – Skin Coat Process



Figure 10: Infusion process

### 3.3 Fiber Reinforced Plastic (Frp) Small Moulding

Under the FRP Small Moulding Job Scope, the process can be divided into twenty seven small parts which are constructed using the Resin Infusion Method. All the small parts are listed in Figure 11 and under Small Moulding Job Scope, the small parts have similar process of infusion such as in Figure 12.

#### SMALL PARTS UNDER SMALL MOULDING SECTION

<b>Hatch Cover</b>
<b>Radar Arch</b>
<b>Console</b>
<b>Console Door</b>
<b>Fuel Box Filler</b>
<b>Console Bulkhead</b>
<b>Fuel Hose Cover at console</b>
<b>Water tank</b>
<b>Water tank Cover</b>
<b>Fuel Tank</b>
<b>Fuel Tank Bulkhead</b>
<b>Fuel Tank Tray</b>
<b>Fuse Hose Line thru bulkhead</b>
<b>Fuel Tank Hatch</b>
<b>Battery Box / Battery Holder</b>
<b>Battery Box Cover / Battery Guide</b>
<b>Anchor Foundation</b>
<b>Hard Top</b>
<b>Helm seats</b>
<b>Crew seats</b>
<b>Gunman seats</b>
<b>Cable Duct</b>
<b>Battery Switch Box</b>
<b>Panel For Radar</b>
<b>Battery Top Cover</b>
<b>Wire Anchor Winch Cover</b>
<b>VHF Radio Cover</b>

Figure 11: FRP Small Moulding Parts

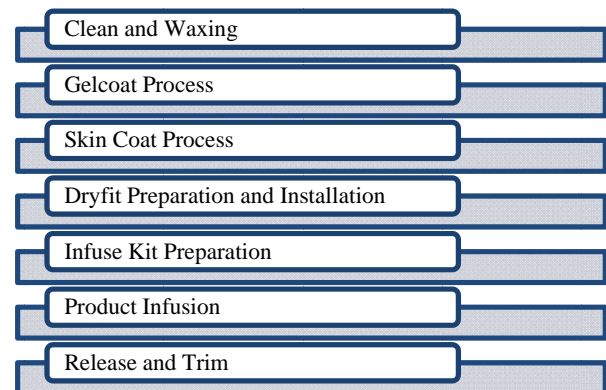


Figure 12: Standard Process for Small Moulding Parts

### 3.4 Subassembly Outfit Hull

In Subassembly Outfit Hull, the process will focus on the assembly of the FRP small part, electrical and electronics, pump and other in the hull before FRP Deck are attached to the FRP Hull. Below is the list of process under the Subassembly Outfit Hull.

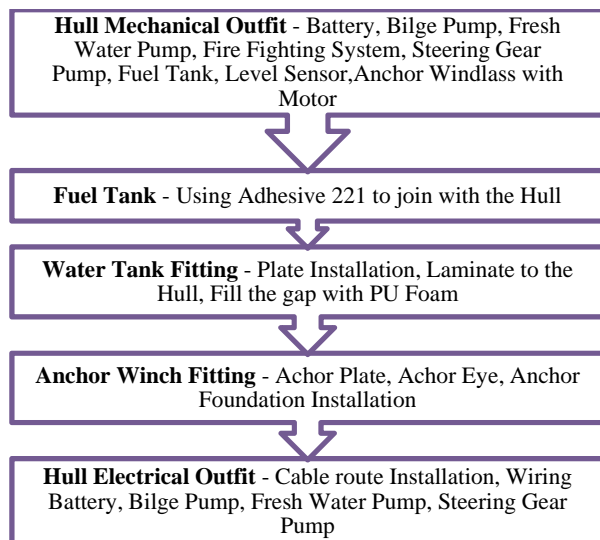


Figure 13: Sub-assembly Outfit Hull Process

### 3.5 Subassembly Outfit of Deck

In the Subassembly Outfit Deck, the process will focus on the assembly of the FRP small part, electrical and electronics, pump and other on the Deck area. Below is the list of process under the Subassembly Outfit Deck.

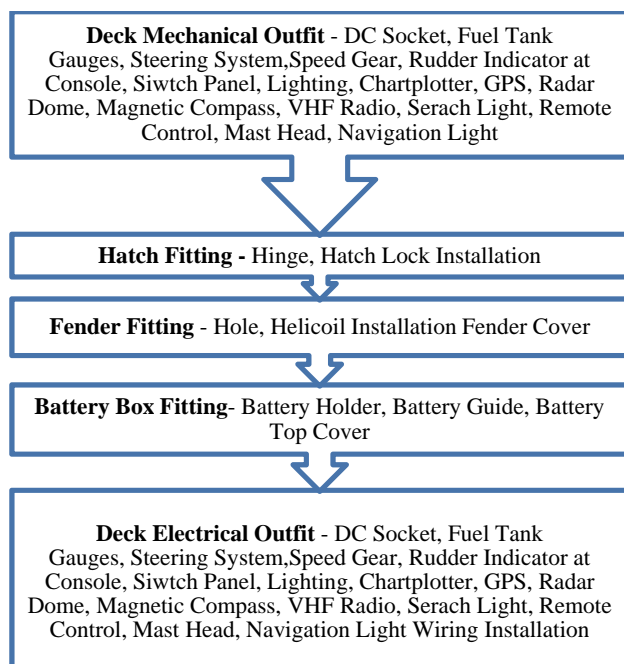


Figure 14: Sub-assembly Outfit Deck Process

### 3.6 Subassembly Outfit of Small Parts

In sub assembly Outfit of Small Parts, all the FRP Small Parts which is located on the Deck will be installed. The process for Subassembly Outfit Small Parts are shown as Figure 15.

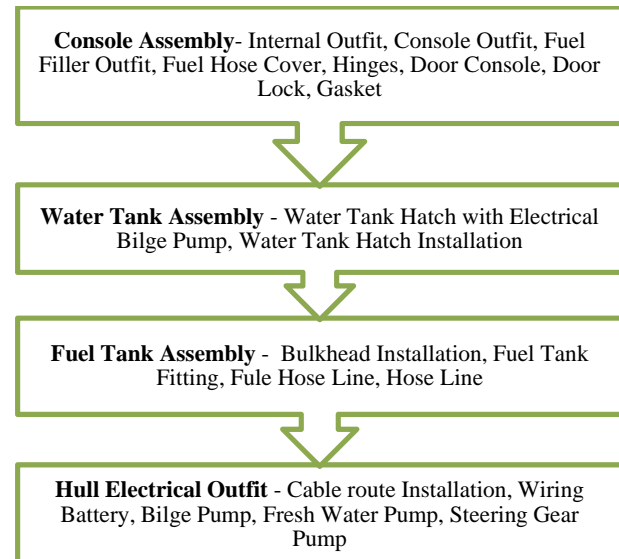


Figure 15: Sub-assembly Outfit Small Parts Process

### 3.7 Hull Deck Assembly

In Hull and Deck Assembly, all the FRP Small Parts and other mechanical and electrical parts will be installed for final assembly. All the details about the process in Hull Deck Assembly are listed in Figure 16 below.

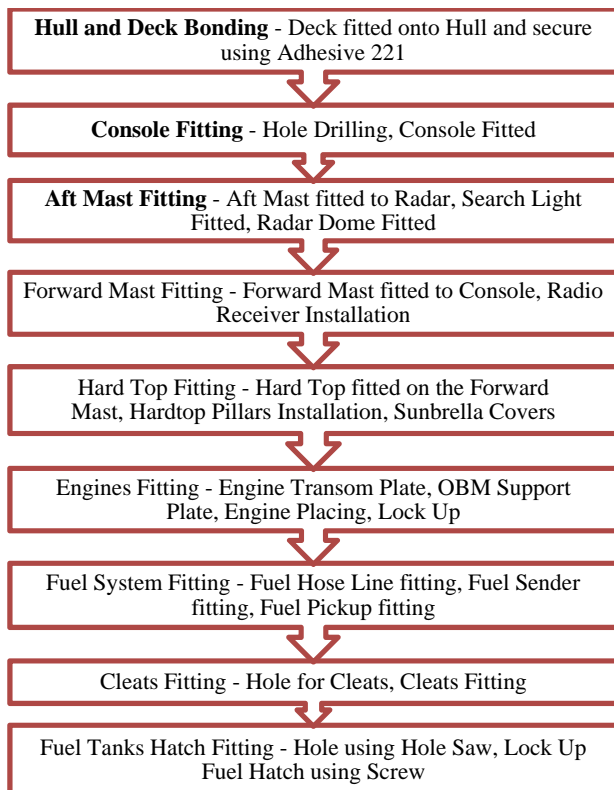


Figure 16: Hull Deck Assembly Process

#### 4.0 CONCLUSION

The production process of Fiberglass Fast Interceptor Patrol Boat in UES International SdnBhd, Malacca, Malaysia was the focused in the study. The production process and procedure are collected by interviewing the production worker and taking photos and video as documentations during our visit to UES International Sdn Bhd. The results showed that the production methods of Fiberglass Fast Interceptor Patrol Boat using Resin Infusion Method yielded a cleaner, easier, more interesting and faster compared to the conventional method.



Figure 17: Fiberglass Fast Interceptor Patrol Boat (UES International SdnBhd, Malacca, Malaysia)

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