



HORIZON

Aerospace Technology in Horizon Yacht Builds

Atech Composites, Horizon Group

Point 1



Horizon is the world's **first** and **only** shipyard to apply aerospace technology for Quality Assurance in every yacht build.

Point 2



Horizon inspects **every critical area** of **each yacht component** before delivery and issues inspection reports to the customers.





Point 3



Horizon utilizes **four aerospace-grade methods** to master the accuracy of every hull mold and to ensure the quality of each hull.

Aerospace-Grade Methods

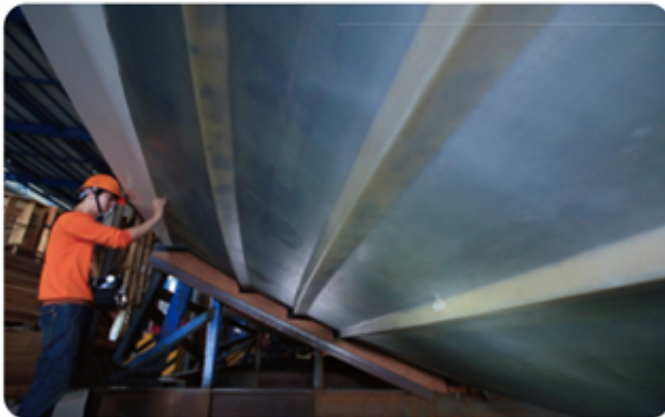


NO	Inspection Method	Analysis Basis	Inspection Target	Application
1	Ultrasonic Testing	Sound Waves 	Inner Defects	Used to ensure the overall integrity and quality of the final product
2	Infrared Thermography	Radiation Waves 		
3	Laser Shearography System	Laser Light 		
4	3D Optical Coordinate Measuring System	Optical Light 	3D Profile Measurement	Used to master the integrity of plug and mold

Non-Destructive Testing (NDT)

1. Ultrasonic Testing (UT)

- Ultrasonic Testing utilizes sound waves to penetrate the layers of the composite materials and detect air pockets, cracks or other defects.
- If a defect is detected, the reflecting sound wave will differ from the original wave, and the technicians will use the differing sound wave to mark the location of the defect.



Ultrasonic Inspection



Inspection Results

2. Infrared Thermography (IRT)

- Infrared Thermography uses a high-resolution thermal imaging camera to detect radiation and display it as temperature distribution.
- If identified, an area with a defect displays a temperature variance, allowing technicians to identify the type of defect.



Infrared Thermography Process



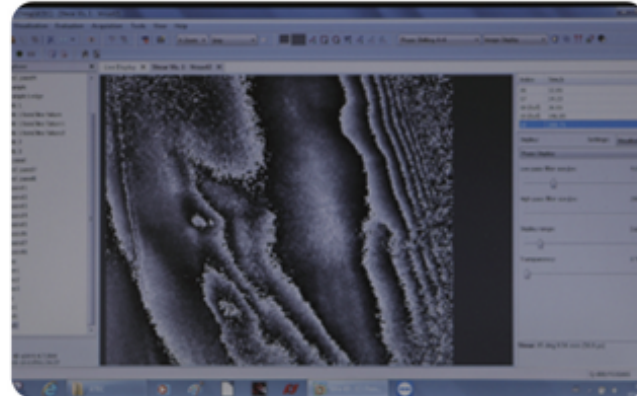
Inspection Result

3. Laser Shearography System

- Laser Shearography is the latest aerospace inspection technology.
- Laser light directed on a component provides information about the quality of different materials in strain measurement. A difference of less than a nanometer can be detected.
- This system is able to detect abnormalities in a composite structure, including disbondings, delaminations, dry spots, voids and cracks.



Laser Shearography System



Inspection Results

A Comparison of Inspection Methods

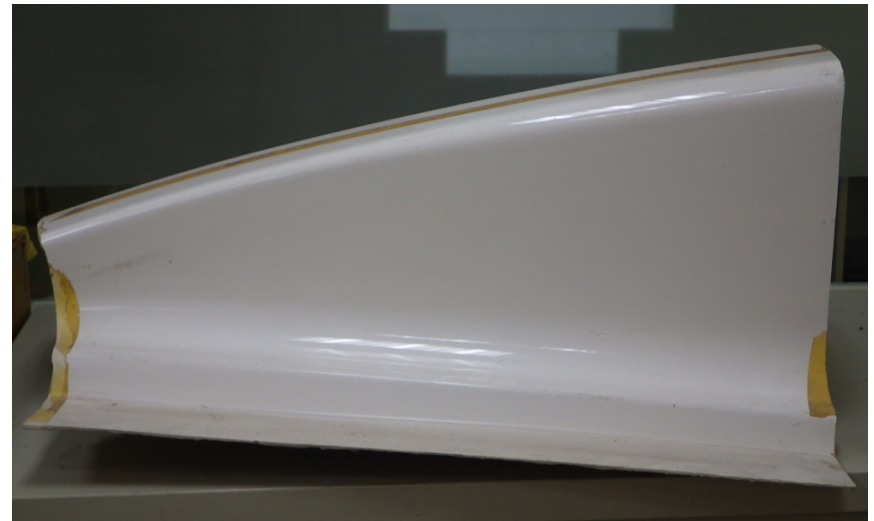
- We use two inspection methods to inspect the same specimen to show the difference between the two analyses.



Infrared Thermography



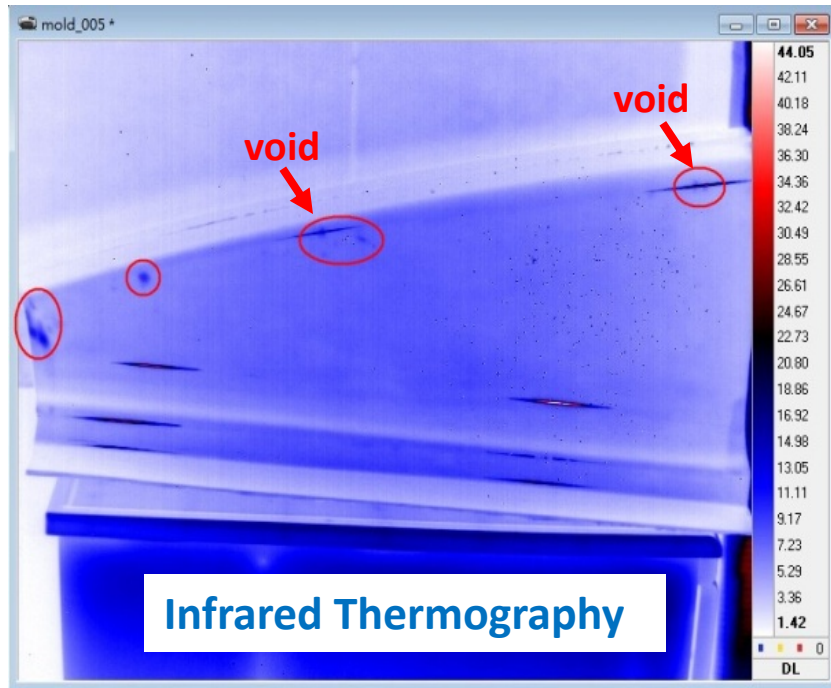
Laser Shearography System



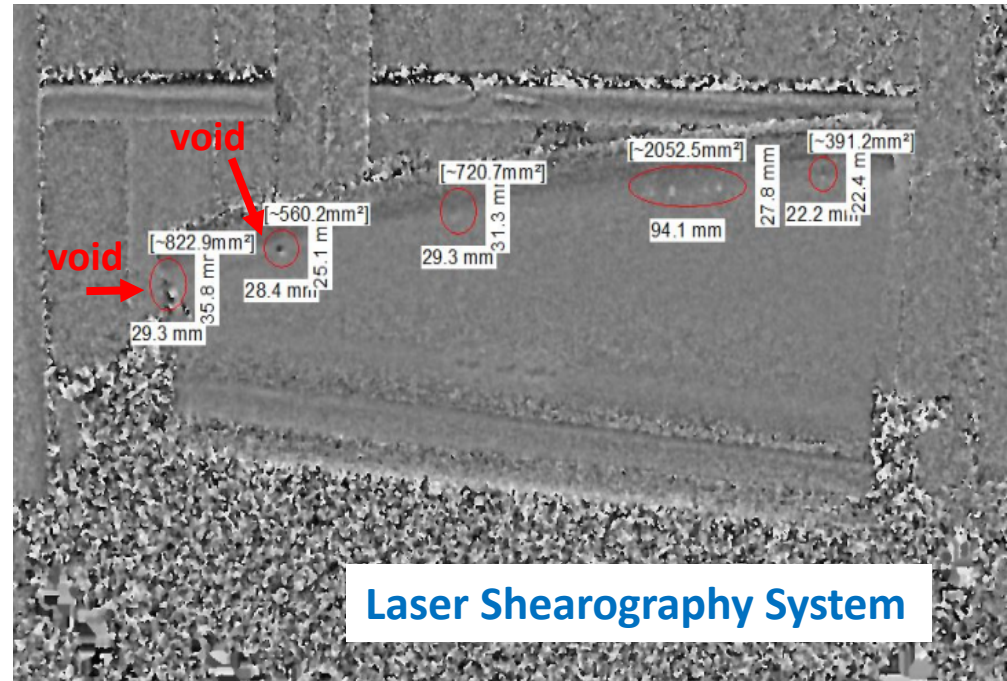
**Specimen
(60 x 45 x 27cm)**

Inspection Results

- Voids on the surface of the specimen are detected with two different methods.



Defects are detected according to **temperature variance**



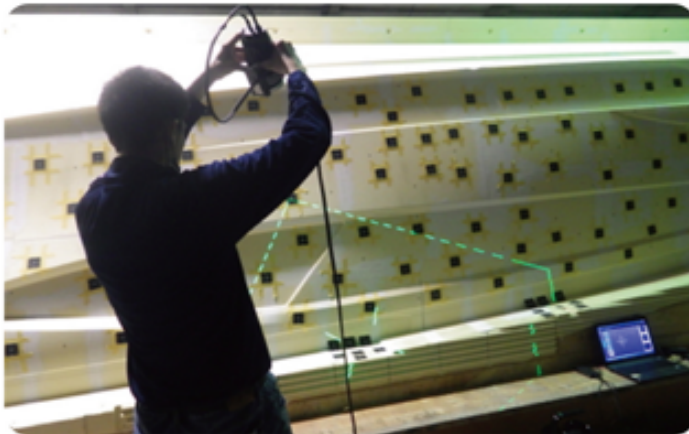
Defects are detected according to **rigidity variance**

Profile Measurement

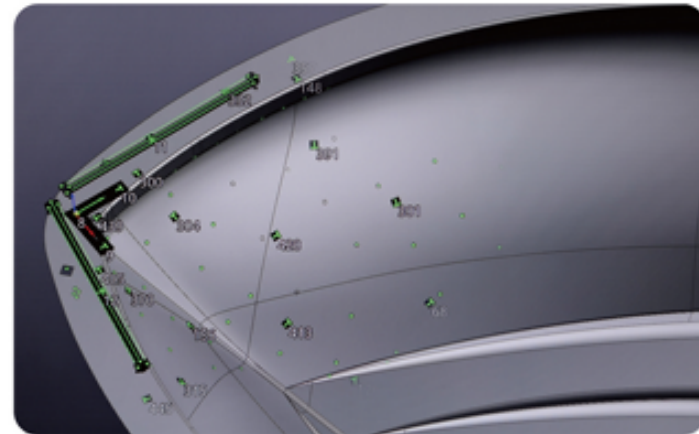
3D Optical Coordinate Measuring System



- This system incorporates a high-end 3D optical scanning machine with a computer-aided detection system to precisely measure the dimensions of the plug and female molds.
- Also known as Computer-Aided Verification (CAV), the system can be used to measure small- and large-scale molds as well as finished products.



3D Optical Coordinate Measuring System



Inspection Results

FAQs

Frequently Asked Questions



1. How are each of the three NDT methods selected for inspection?

- **Ultrasonic Testing (UT) is commonly used to inspect small parts, whereas Infrared Thermography (IRT) and Laser Shearography are applicable for large-scale components.**
- **The properties of the raw materials determine the best method. For example, if the materials have good thermo conductivity, we use IRT as it identifies defects according to temperature variance. When the thermo conductivity of the materials is not good, Laser Shearography is applied because it identifies the defects according to stiffness variation.**

Frequently Asked Questions



2. Is every component of Horizon yacht inspected with NDT?

- Yes. Specific and critical areas of every component are inspected with NDT before delivery. Those areas are inspected base on both quality and safety concerns.
 - A) Specific areas: Double L shapes, angles and surfaces with gel coat that are invisible underneath (usually above the waterline).**
 - B) Critical area: Thick lamination areas and thickness discrepancy areas that will influence the resin flow and resin distribution.**
- NDT certificates are required from the inspection technicians. The inspection report is submitted to customers for reference.

Frequently Asked Questions



3. Once a defect is identified by NDT, how is it repaired?

- Atech is the only shipyard in Asia with the GL Renewables' GL Shop Approval, a certification used in high-end wind turbine production and repair.
- Once a defect is identified, Atech follows the GL Renewables Certification norms to repair the defect and return it to the original laminations. The repair process depends on the type of defect. The part is re-inspected after the repair is completed.
- Strict quality control during production mitigates most inner defects. The defects are thus minor, such as voids or bubbles on the surface.

Frequently Asked Questions



4. Why is profile measurement important?

- **Every component of a Horizon yacht is pre-formed by and fabricated within a mold. Every mold plays a key behind-the-scenes role in each hull and must be inspected thoroughly.**
- **The 3D Optical Coordinate Measuring System is used to provide precise measurements and dimensions of each mold.**
- **Every new fabricated mold used at the Horizon shipyards is inspected using the 3D Optical Coordinate Measuring System.**

Frequently Asked Questions



5. What technology do other shipyards apply for inspection?

- **Horizon is the only composites shipyard in the world utilizing four methods of advanced aerospace technology testing.**
- **Many shipyards use vacuum infusion for a hull and parts, which has an inherent test for identifying defects. Most yards, however, still use conventional methods of inspection and measurement for the infused composite hulls.**
- **One of the conventional methods of inspection is utilizing hammers to tap on the surface and distinguish the defects by the sound difference.**

Conclusion

Horizon's continuous investment in the latest advanced composites R&D and aerospace technology testing methods ensures that:

- **Each yacht build is extremely durable and lightweight and the hidden defects can be reduced to a minimum.**