



STRUCTURAL ASSESSMENT OF THE RUDDERBLADE OF A HIGH-PROFILE RACING YACHT

Problem:

The owner of a high-profile racing-yacht requested a full assessment of the conditions of the composite rudder.

Outer skins of the assembly were of unidirectional carbon fibre / epoxy. The core was of unknown material; however believed to be high-density PVC foam. Rudderstock was carbon fibre / epoxy. The whole blade was faired by a thin layer of fairing compound and finished with paint.

NDE Limitations:

The rudder was inspected using: Visual inspection, Hammer tapping, Infrared Laser Shearography, Infrared Thermography and Ultrasonic Flaw Detection. However, the latter two methods gave no indications of anomalies, confirming that the carbon fibre laminations of the two skins were in good order.

However, even though Thermography and Ultrasonic Flaw Detection have great ability in detecting some type of defects, they have very limited capability in detecting flaws sited deep into a composite structure made of dissimilar materials.



Rudder-blade removed and placed over trestles for the inspection.



NON-DESTRUCTIVE EXAMINATIONS SPECIFIC FOR THE YACHTING INDUSTRY

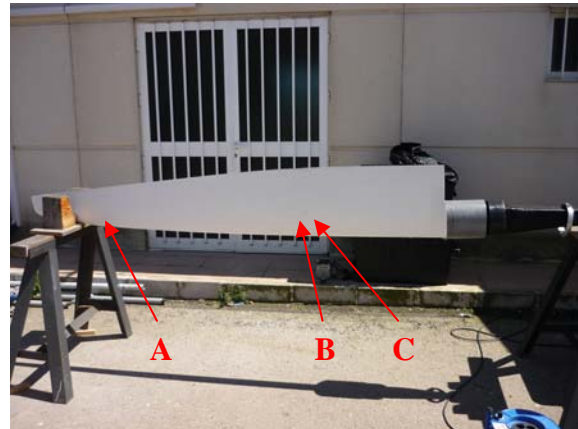
NDE Solution:

Shearography proved to be the right NDE technique for this type of assessment. The entire blade was inspected using Dynamic excitation with Ultrasounds. The whole blade was inspected by sweeping twice from 800hz up to 15.000hz with a single piezoshaker placed in two different locations. This guaranteed that all depths and thicknesses of the composite structure were scanned, including areas embedded inside the foam core.

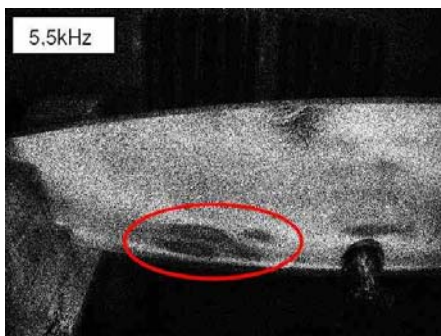
Shearography examination indicated three areas of discontinuity in the composite structure. These were believed to be partial disbonds of the secondary bondline between the carbon fibre rudderstock and the half-shells.



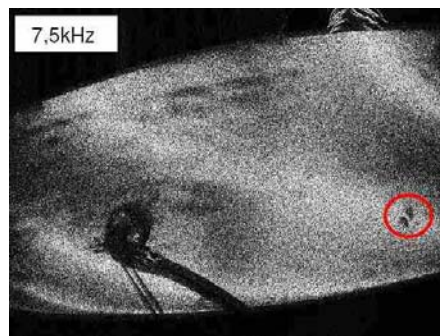
Shearography equipment attached to the rudder



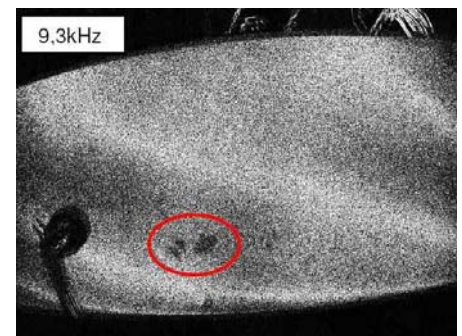
The three discontinuities detected on the rudder



Discontinuity 'A' on the port side of the rudder



Discontinuity 'B' on the port side of the rudder



Discontinuity 'B' and adjacent discontinuity 'C'.