UNDERBODY EVALUATION SURVEY FINDINGS

This is to Certify that the undersigned carried out an Underbody Evaluation Survey on the above vessel at ……..., Norfolk on the ……. 2007 at the request of Mr……., for the purpose of reporting on the vessels external hull condition, subject to the limitations below.

This Technical Survey was carried out on the understanding that I am legally liable to the above client only and not to any subsequent holder of the said report. Such liability must be constructed as a contract under British law and jurisdiction and any dispute arising hereunder shall be submitted to the exclusive jurisdiction of the courts of England and Wales.

CONDITIONS / FACTORS LIMITING SURVEY

- **Approximately four weeks prior to this Survey, the vessel in question, ……....., Freeman 24 River Cruiser had been lifted onto a hard stand by ……. Marine at their yard in ……. They proceeded as instructed to pressure wash clean the antifouling paint from the underbody and to apply two fresh coats of paint. At this stage it appears that personal of Corvette Marine contacted my client, ……..... to make him aware of their 'findings' to the immersed sections of the hull during this pressure washing process, and therefore this survey was requested in order to establish the factors, conditions, and defects found to the under body immersed sections of the hull at this time.**
- **The weather prevailing at the time of the survey was wet and damp.**
- **The vessel was ashore supported on chocks/slings. This allowing good access to the hull bottom.**
- **The vessel was not tested for transverse or longitudinal metcentric stability or buoyancy.**
- **Matters of design were not considered to be part of this brief.**
- **No liability whatsoever is accepted for any injury, death or damages arising from those parts of the vessel to which access could not be gained at the time of the survey and on the strength of which I am unable to comment.**
- **This survey is not undertaken with any intention to ascertain that the vessel would comply with any rule or code of practice as may be required by any authority under whose jurisdiction the vessel may be operated.**

VESSEL PARTICULARS

Name of vessel: ……..
Type: Freeman 24 Sport.
Builder: Freeman Cruisers.
Dimensions: LoA 24ft 6in (7.47m), beam 9ft 0in (2.74m), draught 2ft 0in (0.61m), displacement 3 tons approximated.
General: River cruiser with open plan cabin and four berths
Navigation Limits: Category D / inland waters.
Date of Survey: 14/6/ 2007.
Hull ID number: No: 5……
Index Number: ……..
Built: April / Circa 1982.

DESIGN AND CONSTRUCTION

A precise specification for the structural lay up was not available at the time of the survey and this cannot be confirmed. However the hull construction appeared to be of typical solid polyester laminate with fibreglass matt and woven roving. This precise chemistry could not be confirmed although the opinion gained some credibility from the nature of the scrapings taken under the Wetness Survey reported on later. The internal hull structure consisted of cored fibre glass floor stringers, partitions, plywood bulkheads and joinery bonded to the hull, and deck moulding. None of these items were inspected nor commented on and were not considered to be part of my initial brief.

The semi-displacement hull was of medium vee configuration, flattening sides towards the stern, with a three quarter length keel. A knuckle in the topsides appears to keep spray at bay. The hull was fitted with a fibre reinforced plastic deck moulding or similar construction and bonded to the main hull with the bottom and sides of the hull strengthened internally by what appeared to be encapsulated timber stringers and encapsulated transverse bottom frames. The above arrangements/scantlings may be considered to be average and typical for this type and size of vessel but no guarantee can be given as to their suitability in this particular case.

The vessel generally appeared to have been built to accepted recreational marine industry production standards and practices at the time of its construction, using commonly accepted materials.

EXTERNAL HULL EXAMINATION (BELOW LWL)

On first close inspection of the hull structure below the waterline, it became immediately apparent that a tool, commonly known as a Peeler had been used to remove the gelcoat and some of the underlying laminate. (similar to an electric planer. It is a hand held tool that can take off a measured thickness.)

It appears that this peeling process had been carried out previously during remedial works for hydrolysis / osmosis / blistering treatment and rectification. For seasons unknown by this Surveyor, the relaminating process with new material had not been carried out or completed. Thus leaving the hull structures prone to accelerated water ingress.

There was an apparent thin layer of epoxy type paint (see image above) which had been applied to the exposed laminates and fibres, but this was insufficient in thickness, and the majority of the coating system seen had been unprofessionally applied, and was poorly adhered with large sections missing.

The bottom was lightly hammer tested using a soft headed hammer to see if there were any obvious voids in the lay-up but no significant voids were discovered. Because the hull sections below the waterline have now been professionally peeled, only approximately 70% of the original hull thickness remains. This is a serious emission and should not be overlooked. Note: No guarantee can be given, that some voids in the laminate do not exist.

On carefully scrapping small areas of the hull sections, the presence of resin free, fluffy, glass fibre strands was also evident. (see adjacent photo image). There was however no indication of any sediment piles. (These typically indicate active hydrolysis, even though there was no visible blisters.)

There was no noticeable hull distortion when the vessel was viewed from a distance at various angles. No apparent or obvious signs of major longitudinal or transverse deformation or structural failure which might indicate earlier serious damage.

WETNESS SURVEY

A wetness survey of the hull was effected in accordance with the Code of Practice published by the International Institute of Marine Surveyors. A statistically significant number of patches on the underwater surfaces chose at random and in accordance with the method described in the Code were scarped clean (using a sharpened steel scraper) of surface coatings. The cleaned areas were thoroughly surface dried, great care being taken to achieve a dry surface in the moist atmospheric conditions prevailing, and specially examined. Moisture content readings were then taken by means of calibrated type Sovereign Moisture Meter machine on scale A on the scraped clean areas mentioned above. These extended well into the freeboard area and, with the bottom readings, into an area about 100mm above the normal load waterline of the vessel. Some 25 readings were taken on the vessels bottom. During the taking of all these readings the instruments calibration was checked a number of times to ensure that it maintained its accuracy.

ANALYSIS / RECOMMENDATIONS & SUMMARY

The bottom readings had a total range from 20 to 50 with a median of 40. A number of readings were taken on the dry topsides to give relative base to the readings taken on the underwater parts of the vessel. Both the specific readings taken, their numerical scatter and the statistical analysis may, therefore, be considered to be above average for a vessel of this age. From previous data work carried out, the mean bottom readings given (on separate sheet overleaf) would seem to indicate that the moisture content of the laminate for the points tested may not necessary lie within the manufacturers guidelines, and with the evident presence of the resin free, fluffy, glass fibre strands observed, leaves the laminate susceptible to further moisture ingress, wicking and is structurally significant, with laminate integrity affected and early remedial action must be taken.

Relaminating: Assuming the 'already completed' laminate removal has taken off all the hydrolysed laminate, the hull should now be ready for relaminating. It is obviously important that the vessel stays out of the water from this point forwards. Where it has not been practical to remove all the hydrolysed laminate, that which has been left will need to dry out. This can vary considerably, weeks, months, but assuming the worst of it has been removed, in practice, the drying time of the remainder is usually fairly short. The resin used in relaminating can be epoxy, polyester or vinylester resin.

Following the removal of any further hydrolysed material, drying and replacement of glass as necessary, a barrier coat should be applied.

FINAL CONSIDERATIONS

After the repair has been made, by which ever person or company, several points should be kept in mind. The coatings should be inspected annually for evidence of failure. Failure will usually be evidenced by blistering of the barrier. In my opinion, the repairer should warranty his work. Warranty terms may vary depending on the type of repair done and are defined at the time of contracting the repair. Most work carries at least a five year warranty.

SURVEY PRACTICE STATEMENT.

This survey report is for the benefit of Mr. ……..and is not transferable except for the named Owner's purpose and may not be used for other purposes and may not relied upon by any other person without written consent by the surveyor. The surveyor warrants that this report is a true and unbiased opinion of the vessels underbody hull condition, based upon a visual inspection on the date of the survey. The findings, opinions and conclusions are based upon the best professional judgment of the undersigned surveyor. If this survey does not discuss a specific item, it is not covered by this survey. While every effort has been made to conduct a thorough examination, there can be no guarantee or warranty, express or implied, as to the condition of the examined. This survey makes no representation and does not purport to describe any condition which may have changed since the date of the survey and the recommendations herein are limited to those that, in the opinion of this surveyor, are reasonably necessary and appropriate, based upon the conditions and circumstances as they existed at the time of the survey.

Note: Where considered necessary in the circumstances at the time of the survey, paint coatings were removed from the shell (in sample areas only) in order to evaluate the local gel coat condition in those areas. This was done to allow the surveyor to form an overall impression of the general status of this. It should be noted however, that, unless a hull has been completely cleaned back to the bare gel coat prior to the survey, we cannot confirm the detailed condition of the shell gel coat surface, fastenings etc. Our conclusion therefore based on the evidence of the sample areas examined.

Respectfully submitted,

Signed ……..…… SM TRUSS AssocIIMS INSIGHT

MEMBERS OF THE INTERNATIONAL INSTITUTE OF MARINE SURVEYING

STANDARDS

We have used throughout the survey the following standards:

1. **In assessing the wetness factor of the hull we have used the Code of Practice for the Measurements and Analysis of the Wetness of FRP Hulls published by the International Institute of Marine Surveyors.**
2. **Our Standard Contract of Employment.**

GLOSSARY

Resin: A generic name for any plastic material that starts out as a liquid and becomes solid through a curing process. Epoxies, polyesters, and vinylesters are all resins.
Polyester: A form of resin based on a phallic acid and glycol commonly used in fiberglass construction. Most boats are built with resin based on orthophthalic resin.
Orthophthalic: A form of polyester resin commonly used in yacht construction. Unfortunately, it is also the most likely to blister and suffer from the hydrolysis process.
Isophthalic: A higher grade of polyester resin based on Isophthalic acid. Though it less soluble than orthophthalic resin, it hydrolyzes and blisters as well. It is more expensive and somewhat harder to work with compared to orthophthalic resin.
Laminate: (verb): To build up a solid sheet of material by successive layers of fiberglass cloth and resin. (noun): The resulting final product of laminating fiberglass cloth and resin. The laminate is distin-guished from the gelkote or core material.
Hydrolysis: A chemical process of decomposition involving splitt-ing of a bond and addition of the elements of water (Webster's). When used in reference to the polyester bottom blister problem, the bond being broken is the ester linking molecule between the phallic acid and the glycol in the polyester compound.
Hygroscopic: A adjective referring to a material which absorbs water readily. Talc for instance is an extremely hygroscopic filler used in conventional polyester autobody putty and accounts for the rapid deterioration of this material when immersed.
Osmosis: Diffusion through a semi-permeable membrane separating a solvent and a solution that tend to equalize their concentration (Webster's). Osmosis is believed to be the process by which water is drawn into the laminate. The membrane is the gelcoat, the solvent is water and the solution is the acidic solution that forms when water and the "water soluble elements" in the polyes-ter resin are combined. Osmosis is why the small con-centration of acidic solution grows into a blister.
Vinylester: A modified epoxy resin in a ester linking system. High physical properties and outstanding corrosion resis-tance. To our knowledge, there has never been a blister in a boat built with vinylester resin.
Epoxy: A form of resin based on coal tar. Very high physical properties and corrosion resistance. The highest in water proof characteristics, but

difficult and expensive to use and only marginally tolerant of polyester resins, especially polyester laminates that have been damaged by hydrolys-is. Boats built entirely of epoxy resin do not blister but cost a small fortune.
Gelcoat: The solid, hard, pigmented polyester resin used on the vast majority of fiberglass boats as the protective outer coating on the bottom, sides and deck. Works well on the sides and deck, but is not waterproof enough on the bottom to prevent hydrolysis.
Barrier Coat: A protective outer coating applied to the bottom to reduce the ingress of water into the bottom laminate. Typically an epoxy or a vinylester resin, the barrier coat can be applied over an existing gelkote as a preventative measure or as a replacement after removal of the damaged gelkote and laminate.

ATMOSPHERIC CONDITIONS

Moisture meter readings are affected by atmospheric conditions. The day on which this particular survey was effected was generally warm, wet and damp, measured at the time of the survey, a thermometer gave 15 degrees centigrade as the ambient temperature.

MOISTURE METERS

Sovereign Moisture Meters cannot be used on hulls containing boran or reinforced with carbon fibres as these substances have a high electro conductivity. The readings may, therefore, as well as being affected by ambient conditions, also may be affected by the local thickness of the gelcoat, the presence of extra layers of reinforcement or structural items, epoxy coating systems, chain cables, ballast, bilge water, copper, fuel or water tanks, gas cylinders, batteries and electrical wiring and similar items on the inside of the hull and even the static electricity in the Surveyors body and clothing. It is also necessary to remove any antifouling in order to use these instruments as the surface coatings may carry large amounts of copper or tin which also cause false readings. It should also be pointed out that the effective practical depth of field of these instruments is only about 15 to 20mm. High readings therefore, do not necessarily indicate the presence of water.

Moisture meters of any type do not provide either an absolute or a percentage measure either by weight or volume of actual moisture content. It must also be stressed that there is no direct relationship between moisture content and laminate condition and a high level of readings on their own do not necessity mean that the laminate is suffering damage due to penetration by either permeation or osmosis or chemical or structural breakdown induced by hydrolysis. Such readings, therefore, cannot by themselves and in the absence of other information be used to make a diagnosis of structural breakdown. The danger sign is when readings taken at successive times remain persistently high and do not fall appreciably within two or three weeks of lifting the vessel from the water in accordance with Newton's exponential law as this *possibly* indicates the

laminate is retaining breakdown products and justifies a more detailed examination such as the taking of surface hardness measurements, core samples and similar actions.