Neutral Citation Number: [2020] EWHC 3334 (Comm)

Case No: LM-2018-000220

IN THE HIGH COURT OF JUSTICE

BUSINESS AND PROPERTY COURTS OF ENGLAND AND WALES

LONDON CIRCUIT COMMERCIAL COURT (QBD)

Date: 4 December 2020

Before :

HIS HONOUR JUDGE PEARCE

- -

Between :

GLOBAL TECHNOLOGIES RACING LIMITED **Claimant**

- and -

Defendant

5 WEST LIMITED (t/a ALEX THOMSON RACING)

- -

- -

ADAM F. GRIFFITHS (instructed by **Freeths LLP**) for the **Claimant**

PETER LAND (instructed by **Lester Aldridge LLP**) for the **Defendant**

Hearing dates: 13, 14, 15, 16, 17 and 20 July 2020

- -

APPROVED JUDGMENT

This judgment was handed down in private at 10am on 4 December 2020. I direct that no official shorthand note shall be taken of this judgment and that copies of this version as handed down may be treated as authentic.

His Honour Judge Pearce:

Introduction

1. The Vendée Globe is a solo round the world yacht race that takes place every four years, starting in November. Alex Thomson has competed in the race several times and intended to do so in the 2016/2017 race in his boat, The Rockcliffe Bill II (otherwise known by the name of a sponsor, the Hugo Boss, but hereafter referred to as "the Boat").

2. The Defendant is a company that operates with a view to Mr Thomson participating in and hopefully winning the Vendée Globe.

3. The Claimant is a specialist manufacturer of carbon fibre parts, producing specialist items for the aerospace and medical industries as well as motor and yacht racing. It is based at Westergate near Arundel.

4. In the 2016/2017 race, boats participating were for the first time allowed to use hydrofoils of a new design, so-called Dali hydrofoils, apparently because of the similarity of their shape to that of Salvador Dali's moustache. The hydrofoils are intended to lift the boat out of the water thereby reducing the wetted area of the hull. In 2015, the Claimant produced a pair of hydrofoils for the Boat pursuant to a contract with the Defendant. Later the Claimant manufactured a second pair with modifications to the Defendant's order. (These two pairs have been distinguished by calling the first version "the V1s" and the second, "the V2s," a convention that I shall follow.) Both the V1s and the V2s were designed by VPLP, a French naval architecture company, and Guillaume Verdier, a naval architect with whom it would seem VPLP regularly worked.

5. Whilst Mr Thomson was testing the port hydrofoil of the V2s on the Solent on 3 September 2016, the hydrofoil suffered a catastrophic failure, the result of which rendered it incapable of being used. As a result, Mr Thomson reverted to using the V1s both in training and in the race itself. In the event he came second. Coincidentally, the starboard foil broke during the race, although Mr Thomson nevertheless finished second.

6. The Defendant has paid some of the purchase price of the V2s. The Claimant sues for the balance of the purchase price and storage charges relating to the starboard foil (which was never delivered). The Defendant denies liability and

counterclaims on the basis that the V2s were not manufactured to the appropriate quality and were consequently worthless. It seeks to recover the money spent on the V2s, as well as alleged consequential losses.

The Trial

7. This action was tried in the Civil Justice Centre in Manchester in July 2020 during the COVID-19 pandemic. The location was considered suitable because of the desire to have a number of people attending court as well as witnesses giving evidence remotely in a so-called "hybrid" hearing. Although this was achieved, there were formidable technological problems leading to it being necessary repeatedly to change the platform on which the remote evidence was taken, and remote participants listened in. This in turn caused significant delays during the hearing.

8. A separate problem arose from the manner in which the trial bundle had been assembled. An electronic bundle was prepared for the hearing, which was sensibly bookmarked and was OCR enabled as far as possible to allow internal searching. Further the pages were mostly inserted so that rotation was not required to read them. This all accords with good practice, for which those preparing the bundle are to be commended.

9. It was paginated in ascending numeric order in the conventional way, but with additional pages inserted with an alphabetic suffix. Herein lay the problem. The insertion of such additional pages at various points in the bundle created unpredictable discrepancies between the number physically written on the page and the electronic numbering. Using an electronic bundle, it was only possible to get to the relevant pages by estimating the electronic number and scrolling through. This is a burdensome task, adding to the difficulties in a hearing which was interrupted for reasons identified above.

10. It is highly likely to be the case that electronic bundles will be extensively used in the Business and Property Courts for the foreseeable future. However, where some people use the electronic version and some a hard copy version, problems arise if the numbers are not the same. In the case of bundle numbering, the obvious solution is to ensure that the electronic page numbering and physical

page numbering match. The need to do this is identified in many places, including the Supreme Court's Practice Direction 14.

11. In so far as it is necessary to refer to specific documents by page numbers in this judgement, I have used both the electronic and the physical page numbering, in the form **electronic page number/physical page number.**

12. During the trial, the following lay witnesses gave evidence by way of written statement and oral evidence:

    (a) For the Claimant

        i. Jamie Keogh, former Commercial Director of the Claimant, whose statement is dated 8 May 2020;

        ii. Matt Easton, now Chief Engineer of the Claimant but at the time the Claimant's Lead Composite Design Engineer, whose statement is dated 8 May 2020; and

        iii. Gareth Robinson, Technical and Commercial Director of the Claimant, whose statement is dated 8 May 2020.

    (b) For the Defendant

        i. Ryan Taylor, a sub-contractor employed by the Defendant, in a statement dated 8 May 2020;

        ii. Alex Thomson, whose statements are dated 8 May 2020 and 22 May 2020; and

        iii. Ross Daniel, Technical Director of the Defendant, whose statements are again dated 8 May 2020 and 22 May 2020.

    Each of them was cross examined.

13. I was satisfied that all of these witnesses were seeking to assist the court. Whilst, as is so commonly the case, in particular in commercial litigation, the witness statements at various points contained passages that seemed to be an attempt either to promote the case of the party who was calling them or to score points against the opposing part, they all gave evidence in a straight forward fashion. For this reason, I can accept much of their evidence on matters within their own knowledge without further comment and, save as specifically identified, where I

refer to a witness' account in this judgment, I do so accepting the evidence to be accurate.

14. In addition to the lay witnesses identified above, Mr Antonio Reis, instructed by the Claimant, and Mr Julian Smith, instructed by the Defendant, gave expert evidence both in writing and orally. There are significant differences between their opinions, and I assess that in greater detail below. In so far as I cite their evidence without comment, I do so, accepting it to be accurate.

15. At the start of the trial, an issue was raised as to the reliance by the Defendant on a report from Portsmouth University. The report was referred to as one of the items seen by Mr Smith at paragraph 3 of his report. However, in the joint statement reference is made to results from Plymouth University (paragraph 2.3.4). At trial, it became apparent that the reference to testing at Plymouth University was erroneous. The Defendant's case was that this probably should have been a reference to the Portsmouth University test results referred to in Mr Smith's report.

16. The Claimant complained that the Portsmouth University test results had not previously been seen by the Claimant's legal team or Mr Reis because the Defendant had not disclosed them until just before the trial. The Defendant conceded this to be the case. The agreed solution was that reference to the test results should be struck out of the report of Mr Smith and the joint statement and that Mr Smith be asked not to refer to it. Since the conclusion of the joint statement was that no conclusion could be drawn as to the presence or absence of squalene from the available material (a position that the Claimant was happy with), this course of action ensured that no prejudice was caused to the Claimant by the failure to disclose the relevant material earlier.

17. Ultimately the squalene issue has been shown to be of no importance to the determination of the case because, even if it were present as a contaminant (and the evidence is so equivocal that, if I had been required to reach a conclusion on the issue, it would have been that I was not persuaded on balance that it was), Mr Smith accepted that such contamination may have arisen after rather than before the failure of the hydrofoil, as a result of the damaged part being dragged through the Solent, and so its presence would not be indicative of any failing in the

manufacture process. It is not necessary for me to refer to the evidence on this issue further.

The Contract

18. As noted above, the Claimant manufactured the V1s for the Boat to the Defendant's order in 2015, the build being completed in Autumn 2015. That project had not been without incident because non-destructive testing of the foils showed an issue with voiding. There was a dispute about whether this was a problem down to the materials used or to the manufacturing process. In any event, the Claimant replaced the V1s at its own cost as a result of which it suffered a loss on that contract.

19. On the available evidence, I do not draw any conclusion on the reason for the failure of the V1s, still less as to whether that failure was due to any failure on the Claimant's part. That is not necessary to decide the case before me and the evidence is far too scant to reach any conclusion. The failure of the original V1s for whatever reason is however of a little relevance to issues relating to the price of the V2s for reasons identified below.

20. On 24 March 2016, Simon McGoldrick of the Defendant emailed Matt Easton at the Claimant to discuss a plan for new hydrofoils for the Boat. Mr Easton responded that the Claimant would be happy to tender for these. The Claimant duly tendered for the project in June 2016, Mr Jamie Keogh taking responsibility for negotiations on the Claimant's behalf. Mr Keogh states that the Defendant asked the Claimant to provide an estimate of costs based on the V1 project (which it seems had cost £80,000). The Claimant however put forward a higher figure (£265,000).

21. The Defendant's case is that, when Mr Ross Daniel of the Defendant asked Mr Easton whether the Claimant was seeking to recoup some of the money that the Claimant had lost on the V1 foils, Mr Easton confirmed that this was so. Mr Keogh said in cross examination that this was not an attempt to recoup losses from the V1 project, though he acknowledged that he would have liked to recover something on the V2 project to make up for the loss. Although Mr Keogh's account lies uncomfortably with contemporaneous documents, nothing of

relevance to the determination of this case turns upon the issue and I do not need to explore it further.

22. Following further discussion, it was then agreed that the Claimant be employed on a time and materials basis.

23. The Claimant's tender was accepted with a proposal to start manufacturing at the end of June 2016 and for the V2s to be delivered on 8 August 2016. It is common ground (see paragraphs 11 of both the Particulars of Claim and the Defence) that the contract was contained in a written document called "The Supply Agreement" provided by the Defendant. However the copy of the Supply Agreement within the trial bundle is unsigned and neither party has been able to produce a signed version. This might have been of some significance because there are annotations on the document in the bundle, suggesting that the Claimant may have sought some amendment of the original. However, in the event there is no issue as to the written terms of the contract or the specification of the product.

24. In his oral evidence, Mr Daniel said that he was sure that there would have been a signed version of the document and that he would not have expected the Defendant to enter into a contract of this nature without a signed document.

25. The agreement is stated to be for the supply of "*1 x (port and starboard handed) carbon fire curved boards with tips, detailed spec to be confirmed by quote and purchase order*."

26. Appendix 1 to the agreement provides the specification of the product :

"*Carbon fibre curved boards with tips*

- *Geometry as per 3D Model of 07/06/16; HB60_DSS_2016_3105_stp.stp*
- *Structure based on 2D structural drawing*
- *Material – Carbon Fibre prepreg Uni direction T800, T800 Nano, M40J and T700n woven*
- *Process - half moulded using Autoclave/vac, CMC machined lower face*
- *Finish - delta surface film for the entire length of the shaft on both sides. Unfinished from start of elbow to end of tip.*
- *Delivery 8th August 2016."*

27. Appendix 2 to the agreement included a Schedule of Pricing reflecting the time and materials basis agreed by the parties.

28. Relevant express terms of the Supply Agreement included:

    (a) That the Claimant would produce and supply the hydrofoils "*to agreed timescale and highest standard of workmanship;"*

    (b) That the Claimant would ensure that the Defendant's representative, Ryan Taylor, "*is fully integrated into the build process and given full transparency throughout the build."*

29. As to price, whilst the V2s were being constructed, the Defendant made payments on account totalling £119,600 plus VAT, as follows:

    (a) £41,666.67 plus VAT on 27 July 2016;

    (b) £41,666.67 plus VAT on 27 July 2016;

    (c) £36,266.66 plus VAT on 4 August 2016.

30. By September 2016, the Claimant had issued invoices totalling £413,385.50 plus VAT (see paragraph 16 of the Particulars of Claim at **6/6**). However, there had been various delays and issues were arising as to the total cost on a materials and time basis. Mr Daniel says in his witness statement that the labour hours for which the Claimant was invoicing had "*rocketed out of control."* On 2 September 2016 Mr Hosford on behalf of the Defendant emailed Mr Keogh offering to pay a total of £275,000 plus VAT.

31. Mr Keogh states that, in a further discussion with Mr Hosford on the same day, it was agreed that the Defendant would pay a further £161,000 plus VAT (bringing the total to £280,600 plus VAT) plus a win bonus based on Alex Thomson's position in the 2016/2017 Vendée Globe, as follows:

    (a) First place; £50,000;

    (b) Second place: £30,000;

    (c) Third place: £20,000.

32. In his witness statement, Mr Keogh asserts that "*I remember well that it was to be paid irrespective of what foils were used…"* However, he does not indicate whether the issue was discussed or whether he is simply speaking of an

assumption on his part. In oral evidence, he said that he had deliberately not sought to clarify whether the win bonus was payable regardless of which foils were used. He did not know whether in fact it would be the V1s or the V2s that were to be used.

33. In respect of the conversation between Mr Hosford and Mr Keogh in which further payments were agreed, Mr Daniel (who was not present) states that a total payment of £275,000 plus VAT, plus 4 small invoices of £5,600 plus VAT, a total of £280,600, was agreed. Since £119,600 plus VAT had been paid already (see figures at paragraph 29 above), the balance due for payment was £161,000 plus VAT. Thus, he and Mr Keogh agree on those figures, albeit that the breakdown is slightly different. Nothing turns on this.

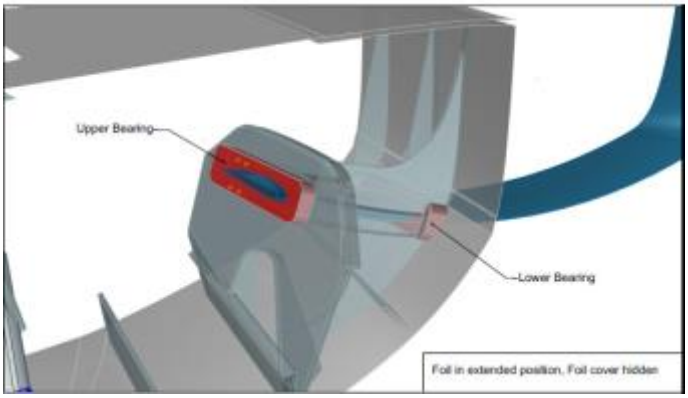
34. Mr Daniel further agrees with Mr Keogh that bonus payments were as set out at paragraph 31 above. He says nothing as to whether the bonus payments were payable regardless of which foils were used, but the Defendant's pleaded case at paragraph 28(b) of the Amended Defence and Counterclaim is that it was an implied term that "*the additional sum would only be paid if the V2 hydrofoils were used during the Race…"* In cross examination, Mr Daniel accepted that all he knew of the variation in the contract was what Mr Hosford had told him. Mr Hosford of course was not called to give evidence.

35. The Defendant paid a further £100,000 on 2 September 2016. However, events overtook the revised agreement as to pricing, in that the failure of the port hydrofoil on the following day, 3 September 2016, led to the Defendant declining to pay the remainder of the price.

An Overview of the Design and Engineering

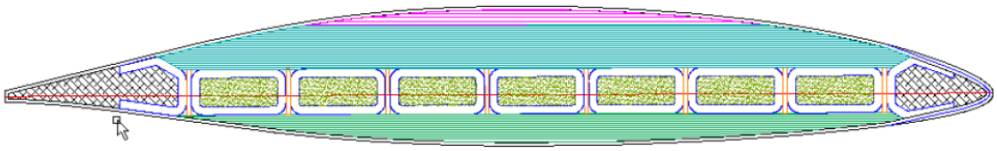
36. The hydrofoil is a removeable part, principally made of carbon fibre reinforced plastic, projecting from the side of the boat. The V1 port foil can be seen on the Boat in the photograph at page 3 of a document within the trial bundle called ATR T2 Foil Timeline at **628/610**. It is described by Mr Smith as being similar to a springboard.

37. The foil is attached to the boat via two bearings, the upper bearing inside the boat and the lower bearing in the hull shell. Mr Smith illustrates this at paragraph 5.4 of his report at **552/534**.



38. As indicated above, the purpose of the foil is to create lift so as to enhance the performance of the Boat. In so doing, the foil bends and considerable compressive and tensile forces come in to play. The surface of the foil in the photograph at paragraph 36 above which is on the upper side (where the foil runs horizontally) and the inboard side (where the foil curves through to the vertical) is that which takes the preponderance of the compressive force, whereas the lower and outboard surface takes the tensile force.

39. The broad design of the hydrofoil can be seen from this cross-section, which appears at paragraph 5.3 of Mr Smith's report, again at **552/534**.

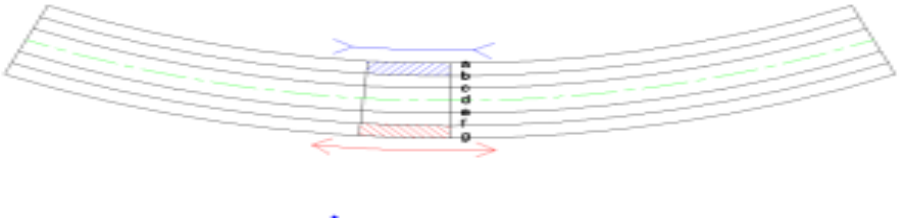


The top of this diagram equates to the upper and inboard surface of the photograph above taking compressive force and hence is described at times as the compression side. Correspondingly the bottom is that taking the greatest tensile forces and is called the tension side. The leading edge, that which is nearest the front of the boat, is to the right and the trailing edge to the left.

40. The construction is described at paragraph 5.3 of the report of Mr Smith, cross referring to the diagram at paragraph 39 above, as comprising an outer (white) skin within which there is on the compression side, a so-called unidirectional plank (shown in magenta and cyan here) and on the tension side a unidirectional plank shown in green. The unidirectional planks comprise laminate layers of carbon fibre which has been pre-impregnated with a resin. (The pre-impregnated layers are called, at times, "pre-preg"). The term "unidirectional" reflects the fact that fibres in the laminate run in one direction. The manufacturing process is described further below.

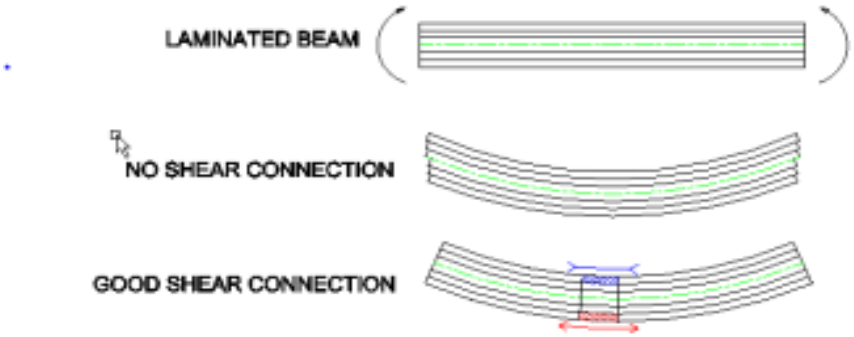
41. Between the two planks is an area in the centre comprising so-called "shear boxes" (alternatively sometimes called "webs"), depicted as white rectangles (representing carbon fibre plies) wrapped around a khaki core that was made of Rohacell, a type of foam. The use of foam is intended to lighten the whole hydrofoil but the foam on its own is not sufficiently strong to resist the shearing force to which it would be subject. The purpose of the shear boxes is to resist the shearing forces caused by the stretching and compression of the layers in the structure as a result of the foil bending. The specification, which appears at **985/950** required that 4 of the 16 plies (25%) be laid in an 0˚ orientation and 12 of them (75%) be laid at a 45˚ angle.

42. Mr Smith explains the compression, tensile and stress forces in a laminated beam of the nature of the foil by way of the upper diagram at paragraph 4.4.9 of his report, (**549**/**531**) where the top part of the diagram represents the compression side of the foil and the bottom the tension side.



(The seven layers shown are lettered in black from a to g, though it is not easy to make this out.)

43. The force created by bending of the beam, known as interlaminar shear stress, will tend to cause interlaminar shear (in other words separation of the layers) unless there is good shear connection. This is illustrated by Mr Smith at paragraph 4.4.6 of his report (**548**/**530**).



With no shear connection, one can see how the laminates tend to debond creating a ragged end of separate layers, whereas with good shear connection, the laminates stay bonded in a neat line. The capacity of the material to do this is called inter-laminar shear strength.

44. Four points are of particular note:

(a) The compressive force is greatest on upper side of the foil (letter a in the diagram referred to at paragraph 43 above);

(b) The tensile forces are greatest on the lower side (letter g);

(c) The compressive and tensile forces reduce as one moves from the outer surface to the middle, such that, at a point known as the neutral axis (letter d above), both forces are zero;

(d) The shear forces are maximum at the neutral axis.

45. At paragraph 4.2 of his report, Mr Smith explains how good shear connection is achieved in a structure made of a composite such as carbon fibre reinforced plastic so as to resist the effect of the compressive forces:

> *"4.2.3 A laminate is composed of fibres and matrix. We could start by thinking of the fibres as being like a ponytail and the matrix as a strong hair-gel.*
>
> *4.2.4 If we want to carry a load in tension, say lifting a bucket out of a well, we could cut off the ponytail, attach our load to each end then pull. The load we could carry would be proportional to the number of hairs, and aside from the difficulty of attaching the load to the ends of the hairs, we wouldn't really need a matrix to contribute to the tensile strength - each hair would take its share of the tensile load.*
>
> *4.2.5 If on the other we want to carry a load in compression, as in the case of a table leg, the bundle of hairs would be no use at all as individual strands would buckle and collapse. Gluing the hairs together with gel (like a punk spike hairstyle), would resist the tendency of the individual hairs to buckle and increase the capacity of a given bundle to resist compressive loads. If the matrix properly bonds to each strand and there are sufficient hairs in the bundle we could make a table leg capable of supporting the top and whatever is on it. The matrix is therefore important for compressive strength*."

46. Mr Smith explains how the interlaminar shear strength depends both on the strength of the matrix itself and the matrix to fibre bond strength. Bond strength may be affected by the ratio of resin to fibres, since if there is too much resin, the matrix will tend to carry the shear load and if there is too little, dry fibres may lie next to each other with no shear load carrying capacity. Contaminants may also reduce the binding between layers. The processes of de-bulking, described below, contributes by avoiding air becoming trapped between layers.

47. One issue with hydrofoils is a tendency for what is called ventilation, that is to say the drawing in of air onto the surface of the foil as it cuts through the water. Mr Thomson explained that ventilation slows the boat and reduces the capacity of the foil to lift it out of the water. Mr Thomson became aware that an adjustment of the shape of foils by the use of what has been called a 'camel toe' detail had

been tried during the America's Cup (another well-known yachting race) and was thought to be successful in reducing ventilation and thereby enhancing performance. He raised this with the designers, Guillaume Verdier and VPLP, and they came up with an adaption to the leading edge of the V1, involving the manufacture of a separate moulded component which was then bonded onto the leading edge of the main foil. The 'camel toe' name arises from the series of notches or grooves in the leading edge of the moulded component.

48. The purpose of the V2 design was to accommodate the camel toe feature and to improve on performance from the V1 foils. There was debate during cross examination as to the extent to which the V2 design was experimental. Mr Thomson did not accept this to be so, saying simply that the design changes were intended to improve the ventilation effect without affecting reliability or safety.

49. The result of the change to the camel toe feature was a difference in profile of the foils. Mr Thomson compared the V1 at figure 24 on **715/697** with the V2 at **714/696.** (It should be noted that the upper skin is on the bottom on the V2 but the top on the V1 indicating that they are in opposite orientation). In any event, the point made by Mr Thomson is that the thickest part of the foil is further forward in the V1 than in the V2, this having been moved rearward to accommodate the recess with the camel toe on the V2.

The Manufacturing Process

50. The laminate planks are constructed in a process known as lay-up. The pre-preg layers are applied one on top of the other. In order to avoid the presence of air between layers, which would compromise the strength of the plank, a process known as "de-bulking" occurs from time to time, in which the layers that have been applied are sealed and a vacuum is used to remove any air. Also, from time to time, the layers are cured using an autoclave. This involves heating the planks whilst they are under pressure. The evidence indicates that both the temperature of the cure process and the length of time spent on it affect the ultimate strength of the plank.

51. An individual layer, prior to use, comprises the ply itself made of resin and fibres, with a plastic film on one side and paper on the other. The paper is removed prior to the ply being laid down. The ply will be hundreds of fibres in thickness, albeit

that these fibres are very small (Mr Smith describes them at paragraph 4.2.1 of his report as being approximately 5μm in diameter, that is to say about 1/10 of the thickness of a human hair), such that the ply may have an overall thickness of as little as 0.27mm. Once the ply is properly positioned, the plastic backing sheet is removed. This will be followed either by the application of another ply or the debulking process depending on where one is in the manufacturing process.

52. The manufacturing process is specified in a document at **942/924.** The first column contains the ply refence letter or number. Ply A is the surface film, and thereafter one sees plies B to G, which are the remainder of the surface skin. The "orientation" column indicates the angle at which the ply is applied. Thus ply B is applied at 45˚ to ply A and thereafter the plies in the surface skin are applied at alternative 90˚ angles. The thickness of the individual ply can be seen in the sixth column and the seventh column gives the cumulative thickness of the build from the outer edge up to the further edge of the particular ply. Thus the surface skin is in total 2.4mm thick (the figure being that in the row for the last ply, G).

53. The column headed "Material" shows the particular type of ply being used. The reference to a percentage is to the percentage of resin in the ply. It can be seen that the resin percentage is different in the surface skin than the unidirectional plank that begins with ply 1, and that the percentage of resin changes again after ply C30. It can also be seen that there is reference to both "DT120" and "DT124". This is a descriptor of the resin that was used, these both being products manufactured by a company called Delta Technologies. Further reference will be made to DT124 later.

54. The plies are cut by machine and applied in layers as identified by the rows in the document. After plies G, C50 and 108, one can see reference to the cure process that took place at this point in the manufacture. Mr Easton on behalf of the Claimant agreed that the cure process was exothermic, heat being given out during the process. This meant that it was important to avoid the plank overheating as it was cured at the various stages.

55. The manufacturing process is conducted using a check sheet, as shown at **986/951**. This describes the debulking process in greater detail. Mr Easton said in

respect of these documents that they reflected a decision to debulk after every 2 plies rather than 3 plies as had originally been agreed.

56. In his report at paragraph 4.4.4, Mr Smith comments on the importance of manufacture to the compressive strength of a laminate: "*if there is too much resin then the fibre may be able to buckle within the matrix itself since the resin is roughly 100 times less stiff than the fibre. Or if there is a void, i.e. air, where there should be matrix, then the fibre will be even more poorly supported and prone to buckling. And once again it is also important the fibre to resin bond is good so that the fibres can adequately share the load and transmit it to one another."*

57. Mr Easton explained that the shear boxes were a complex manufacture, comprising a foam core which was provided by an external supplier. The Claimant then needed to wrap the cores with carbon fibre by hand. He described this is a "significant" stage in the laminating process.

58. The design specification of the shear boxes required that the plies laid around the Rohacell foam core were predominantly laid at 45˚ to the axis of the board rather than in line with the axis board in the ratio 1:3. Mr Smith explains at paragraph 5.6.4 of his report that this is the most efficient way to resist the shearing forces (the reason for wrapping the foam cores).

Events during the Manufacture

59. Mr Taylor was employed by the Defendant as an "owner representative", a role he describes at paragraph 4 of his witness statement (**481/464**). This role involves close working with the manufacturer and the designer in order to protect the interests of the client. He would be expected to observe important parts of the manufacturing process. The nature of his role is described in an email at **1289/1248**.

60. Mr Taylor stated that he is not an engineer and that it was not his role to check drawings. He would however observe parts of the manufacturing process. Since the build was taking place around the clock and he lived in Cornwall, he could not be present at the Claimant's premises at all times.

61. An example of his role can be seen from emails on 10 August 2016 at **1374-5/1325-6.** A machining error had occurred causing a light indentation into the foil.

Mr Taylor was notified of this and the problem was discussed with the Claimant. A solution was agreed.

62. It is apparent, both from Mr Taylor's statement and from oral evidence that there was some conflict about his role. From the point of view of the Claimant, it would seem that its employees were concerned that he might use information gained through this project to assist a Company called Magma for whom he works and whom the Claimant sees as a competitor.

63. During the manufacture process, the Claimant proposed that a different fibre resin be used. Whilst Gurit was specified, the Claimant proposed a product from Delta on the grounds that the quality was better and the lead time shorter. This was the product that the Claimant was using in manufacturing for Ben Ainslie Racing (another leading name in yacht racing). The Defendant asked the Claimant for details of the Delta product and these were supplied by Mr Easton to the Defendant and the designers under cover of an email dated 31 May 2016 (**1260/1220**). The variation was agreed by the designers, as Mr McGoldrick acknowledged on behalf of the Defendant (see **1258/1218**).

64. Mr Taylor considered that the plies should have been subject to a process called roller spiking. Mr Easton explains his view of the issue at paragraph 35 of his statement (**458/441**). The views of each are set out in an email dated 1 July 2016 at **1334/1286.**

65. As to the quality of the manufacture, Mr Taylor said that he had some concerns about the wrapping of the cores. He accepted that the core starts with a rectangular profile, but that as it is wrapped, it becomes rounded because of the layers that are being applied. He accepted that this was a complex job, but maintained that the work was unsatisfactory. However, while he complained that he had not seen all stages of the process, he accepted in cross examination that he had no reason to think that the laying up of the plies was inappropriate.

66. Mr Taylor was asked about the design detail of the camel toe component. He accepted that, during the manufacturing process, discussions were taking place as to the precise detail of the design and variations to it. For example, at **1321/1273** he noted an email from the designer Mr Verdier to Mr Easton about the detail. He

considered it to be perfectly normal that design matters like this might arise during the construction.

67. In the same email, there is a reference by Mr Verdier to a variation to the design of the leading edge, apparently intended to strengthen the edge against impact. There was discussion of the use of Tuffnol (which Mr Thomson said is a form of plastic) then a suggestion by Mr Verdier that it be replaced with carbon rods in resin, although he describes this as "*a big compromise."*

68. Mr Taylor agreed that the suggestion of using carbon rods surrounded by resin in place of Tuffnol was not a good idea, even though he stood by his description of Mr Verdier as a designer who was *"at the top of his game"*. Mr Easton stated his view that the carbon rods idea would not work (email of 23 June 2016 at **1320/1272**). Following comments from Mr Taylor at 11.40 that a C—plate, that is to say a solid carbon component, would be a better idea, Mr Verdier replied by email at 11.53 (both at **1319/1271**) accepting that the use of a C-plate was acceptable.

69. Mr Taylor agreed that a company called Pierrepoint analysis carried out non-destructive testing to the port foil and that the findings were in general that the foil was of good quality.

70. Ultimately the port board was signed off on or about 26 August 2016, Mr Taylor stating that "*as far as I am aware the board has been built in accordance to* [the designers'] *drawings."* (see **Supp21**).

Events on the Solent in September 2016

71. The port V2 hydrofoil was collected by the Defendant from the Claimant's premises on 27 August 2016. Testing began on 1 September 2016.

72. Mr Thomson states that there were three objectives to the testing:

    (a) To test the bearing mechanism, including the deployment and retraction of the foil;

    (b) To test the fit, adjustment and operation of the foil under increasing load;

    (c) To test the performance of the foil, in particular the optimal angle of attack.

73. The testing involved people both on board the boat and on land carrying out a variety of observations and measurements.

74. On 1 September 2016, the wind is stated by Mr Thomson to have been 13-17 knots, a moderate breeze. The foil was tested to a maximum load of 12.5 tons.

75. On 2 September 2016, the wind was a little brisker, 16 to 22 knots, described as a fresh breeze. A maximum load of 12.9 tons was recorded. Mr Thomson describes how, when the boat was close to the end of a test run, a loud bang was heard. This led to the boat returning to land and being checked over, but no defect was identified, whether in the foils or elsewhere.

76. On 3 September 2016, the wind was stronger again, 20 to 25 knots which is described as a strong breeze. They found flat water between Cowes and Beaulieu and started to do upwind and downwind tests, travelling upwind to Beaulieu and downwind to Cowes. Mr Thomson describes what happened thereafter in paragraph 9 of his witness statement:

"On our third run the foil angle of attack was changed from 2.8˚ to 3.8˚ and boat was sailing at around 26 knots downwind when there was a huge bang and the boat heeled violently. The helmsman reacted very quickly and turned the boat downwind and the boat slowed. When deployed the foil curves out from the side of the boat. Looking over the side of the boat we could immediately see the foil had broken. It was not completely separated but it was hinging up and down at the break point. We managed to get a halyard on the end of the foil to support it clear of the water and returned to port. The load cell was averaging 11.5 tons and reached its maximum reading of 13 tonnes when the foil broke."

77. In the following paragraph, Mr Thomson goes on to comment on the load cell measurements:

"The load pins that were measuring the load in the foil were working and recording what I believe to be accurate loads. The pins were supposed to be setup to read up to 16 tons, however there was a mistake and the limit during the testing was set at 13 tons. This meant that any load over 13 tons appeared as 13 tons. When we reinstalled the V1 foils the pins were set up to 16 tons. The data recorded during the 2016-2107 Vendée Globe shows that in only a few instances did the foil loads exceed the maximum reading of 16 tons. That was over the full

length of the race during which all conditions were experienced from light to storm force winds and wave heights over 6m. Boat speeds in excess of 30 knots were experienced on numerous occasions."

78. In comparison with some of the more extreme weather and wind conditions that he has experienced, Mr Thomson describes the conditions in the few hours of testing before the foil broke as "*extremely benign."*

79. The delaminar failure of the foil can be seen in the photographs at **1228/1193** and **1229/1194**. A crack is apparent in the compression plank. The consequent failure of the foil can be seen in the photographs at **1202/1167** to **1223/1188**.

The Claimant's alleged losses

80. The Claimant's case is that it delivered the port foil to the Defendant in accordance with the contract and that it was ready and willing to deliver the starboard foil. However, the Defendant refused to pay the purchase price in accordance with its obligation under section 27 of the Sale of Goods Act 1979.

81. The Claimant contends that its recoverable losses are:

(a) The balance of the price originally agreed in the supply agreement, as set out at appendix 2 to that agreement, which the Claimant contends is £252,542; alternatively

(b) The balance of the payment price plus bonus as agreed in the discussions summarised at paragraph 31 above, which the Claimant contends is £92,480 together with the bonus of £30,000 to reflect Mr Thomson's second place in the 2016/2017 Vendée Globe; and in any event

(c) Storage charges in the sum of £35,600 relating to the hydrofoils which the Claimant contends are a contractual obligation pursuant to the terms of their invoices (see paragraph 33 of Mr Robinson's statement at **476/459**).

82. The Claimant's argument that, notwithstanding the contractual variation referred to at paragraph 31 above, it is entitled to the purchase price on the basis agreed in the original contract is predicated on the argument that the variation agreement was subject to a condition precedent that the entirety of the purchase price be paid within two days of the agreement. This is drawn from paragraphs 18 and 19 of Mr

Keogh's witness statement (**440/423**). There was no further elucidation of this issue in oral evidence.

83. In response, the Defendant contends:

(a) The Claimant is not entitled to payment for the hydrofoils because they were not in compliance with the contractual standard and as a result were worthless; alternatively

(b) If the Claimant is entitled to payment of the purchase price, the varied price referred to at paragraph 31 above was not the subject of any condition precedent and therefore the Claimant is entitled to the balance of that sum;

(c) The bonus depended upon the Defendant using the V2 hydrofoils in the Vendée Globe. Since they were not used, the Claimant has no entitlement to a bonus;

(d) Whilst the Defendant pleaded no case in respect of the storage charges, at trial, it argued that the Claimant was unable to show that any contractual terms was incorporated to the effect that storage charges were payable if the goods were not collected. It is incorrect for Mr Robinson to state that the invoices refer to storage charges. In fact, the invoices in the disclosure do not contain a term as to the payment of storage charges though the delivery notes do – compare for example the delivery note at **1515/1454** and the corresponding invoice at **1516/1455.** There is no evidence (or indeed pleaded case) that the delivery notes created contractual terms, nor is it obvious how they would do. Further, the Claimant has not shown any trade practice or established course of dealing.

The Defendant's alleged losses

84. The Defendant's counterclaim is for the following losses:

(a) Diminution in value of the foils as a result of their substandard quality. The Defendant contends that they could not be used for the Vendée Globe, their primary purpose, and therefore are worthless. Accordingly it seeks to recover the element of the purchase price that was paid, £243,520 plus VAT.

(b) As a result of the Claimant's breach of contract, the Defendant contends that it suffered the various losses set put at paragraph 66 of the Amended Defence and Counterclaim (**45**/**45**), either as wasted expenditure on the manufacture of the V2s and modification of the Boat to accept them, or as consequential losses. Those items are:

Engineering and studies for V2 hydrofoils and bearing designs	£37,142
Costs of changing the bearing system on the Boat to accept the V2 hydrofoils	£38,430
Modification to the Boat to accept the V2 hydrofoils	£15,937
Modification to the Boat to accept the V1 hydrofoils again	£7,400
Investigation and analysis by APD	£5,600
Investigations and analysis by Gurit	£5,020
Wasted costs of Mr Ryan Taylor	£65,580
Wasted costs of cancelling professional sailors due to broken hydrofoils	£20,020
Other costs	£6,642

85. The evidence in support of the Defendant's losses is set out at paragraphs 44 to 48 of Mr Daniel's statement.

86. In addition to the matters set out above, Mr Daniel claims the costs of a third set of foils. The argument for the recovery of these costs is that, when the Defendant came to sell the Boat after the 2016-2017 Vendée Globe race, there were no available foils because the V2 had broken in the instant incident and the V1s had been damaged in the race itself. The Defendant contends that the boat would not have achieved the same value if it had been sold without foils.

The Expert Evidence

87. A convenient starting point for examining the expert evidence is the joint statement of the experts. At paragraph 2.3.1, they agree that there was a significant interlaminar debonding at a depth of around 13.5mm from the compression side outer surface of the hydrofoil. They further agree that "*it is a logical assumption that the failure occurred initially interlaminar at this interface (the loud bang), and that on the second run the unidirectional piles collapsed under the compressive load"* (paragraph 2.3.2).

88. It is further common ground between the experts that the failure of a carbon fibre laminate will lead to catastrophic damage. Whilst there was some disagreement about whether the term "*explosive*" correctly described the forces involved, there is no doubt that the kind of delaminar failure that the experts agree happened here involves the release of significant energy, as appears from the photographs of the failed foil.

89. Mr Smith considers this in somewhat greater detail within his report at paragraph 7.3. Putting aside for the moment why the there was an interlaminar failure at this level, Mr Smith explains that a failure occurred on 2 September (when the loud bang was heard) the effect of the failure was to prevent the 13.5mm of laminates that lay above the level of failure from contributing to the overall compressive strength of the foil. On the following day, this failure coupled (in Mr Smith's view) with the general underperformance of the laminates would have led to a situation in which the foil might fail at a load of less than 13 tonnes. Again setting aside the reason for the interlaminar failure and, for the moment, ignoring Mr Smith's assertion as to general underperformance of the laminate, Mr Reis agrees that was a case of interlaminar failure on day two of testing and compressive failure on day three. He adds that the failure of the unidirectional laminates on the third day "*is such a high energy failure that the shock waves create massive damage propagation."*

90. The experts stated in their report that the maximum load that was recorded for the foils was 14.7 tonnes. However it is common ground that this figure is drawn from a report relating to the damage to the V1 starboard foil during the 2016 Vendée Globe and is of no relevance. When further questioned about it, Mr Smith agreed that all that could be said was that, at the time of the ultimate failure, the load exceeded 13 tonnes because of the load cell data at **1487/1438**.

91. At points in the Claimant's evidence, it appears to be suggested that failure of the foil was due to overly aggressive testing by Mr Thomson. Mr Thomson was described as having as reputation as a "risk-taker" (see for example paragraph 37 of Mr Keogh's statement). But, as Mr Keogh conceded in response to a question in cross examination, if he were going to sail round the world in a boat, he would want to test it very hard first. That was a sensible concession. I can see absolutely nothing to suggest that Mr Thomson's testing was excessive in a way that might

lead the court to conclude that it was his testing rather than some weakness inherent to the foil, whether through inadequacy of design or fault of manufacture, that caused the failure.

92. I accept Mr Thomson's evidence as to the weather conditions and the manoeuvre being undertaken at the time of the failure on 2 September. It follows that the load to which the hydrofoil would have been subject at the time of the failure was not so gross as itself to be the cause of its failure unless the foil was weaker than intended.

93. The Defendant's case is that the immediate cause of the failure of the foil is undisputed – it was that interlaminar debonding at 13.5mm from the outer surface of the foil. The question to be addressed is whether the design provided to the Claimant was, if properly executed, sufficient to produce a foil that should have been able to resist the interlaminar shearing forces that caused the debonding (in which case the failure is to be attributed to the failure to construct the foil to the highest standard in accordance with the Claimant's contractual obligation). If the failure lay in the design itself, the Defendant concedes no breach of contract on the Claimant's part could be demonstrated.

94. As to the ultimate cause of failure, Mr Smith and Mr Reis came to seemingly similar conclusions at paragraph 9.1 of the Joint Report, in answer to the question *"what do you consider to be the most likely cause of the failure of the port hydrofoil?"* Mr Smith replied: "*It is not possible to identify a single cause of failure; it seems to be a combination of various effects. Testing indicates that the materials were weaker than could have been expected, and visual inspections of the failed components reveal a number of less-than-ideal build features in the areas which can be seen."* Mr Reis replied to the question at paraph 9.1 of the joint report: "*It is not possible to identify a single cause of failure: it seems to be a combination of various effects. Also, critical information like the component structural report and failure load, is not available which does not allow a complete analysis.*"

95. The features of the manufacturing process identified in the joint statement that Mr Smith considers to be "*less than ideal"* are:

(a) The construction of the shear boxes did not comply with the design specification in that the plies laid around the Rohacell foam core in that it appeared that ratio of plies in the 0˚ orientation to those in the 45˚ orientation was 1:1 rather than 1:3.

(b) The layup of the laminate wrapped around the Rohacell foam core was not as good as it could have been.

(c) In the final machining of the V2 port hydrofoil, a handheld grinder cut through the external laminate at the edge of the recess into the leading edge into which the camel toe feature was bonded.

(d) The board appears not to have been exactly in accordance with the drawing in that the measurement from tip to toe appeared to be offset by 17.5mm (though in cross examination Mr Smith accepted that this could simply have been a measurement error);

(e) The camel toe was not fitted straight and was not in alignment;

(f) The camel toe was not finished to an acceptable standard.

96. However it should be noted that none of these are said to have been causative of the failure of the plank. The construction of the shear boxes is specifically discounted as a cause by Mr Smith at paragraph 8.2 of his report and by Mr Reis under reference ASol 1.6 in his. Mr Reis discounts the other criticism as being causative under reference ASol 8.3 to 8.5.

97. The experts considered the evidence as to the strength of the components in the hydrofoil. They noted two respects in which testing had shown the foil to be less than ideal;

(a) Testing of the compressive strength of the compression side unidirectional plank following the failure showed on average a compressive strength of 814 Mega-Pascals (MPa). A low result of 522 MPa was considered a possible outlier and, discarding that, the average strength was 872 MPa. However, they would have expected a compressive strength in the region of 1197 MPa (see the agreed answer to question 2.1).

(b) Testing of interlaminar sheer strength on samples extracted from the damaged foil which was carried out by the manufacturers showed results

which were either "*low*" (according to Mr Smith) or "*lower than the theoretical values obtained from pristine components*" (according to Mr Reis).

98. In his report, Mr Smith deals further with the cause of the failure at paragraph 6.1. He identifies possible causes of low compression strength as:

(a) Poor material quality from the suppliers of the laminate, resulting from poor distribution of resin matrix or contamination of the fibres resulting in poor resin adhesion;

(b) Failure to use a material with nano particulates;

(c) Poor consolidation during the debulking process;

(d) Wrinkles in the laminate;

(e) Issues with the curing process;

(f) Poor fibre alignment relative to the board axis during the lamination process.

These criticisms in part reflect possibilities raised in a report from Applied Polymer Development into the failure of the hydrofoil, which appears at **659/641,** although it should be noted that that report expresses no confident conclusion on the cause of failure other than noting poor interlaminar sheer strength referred to above.

99. Mr Smith notes that, Deltatech, the manufacturer of the resin, found low interlaminar shear strength in the compression plank and commented on four deficiencies in the laminate, without attributing the low strength to any one in particular, those deficiencies being:

(a) A small amount of dry fibre in the laminate;

(b) Voids in the laminate;

(c) Fibre distortion locally in areas of the foam cores;

(d) The presence of an unidentified foreign substance.

100. As to the interlaminar failure identified at 13.5mm into the laminate from the upper surface of the compression plank, Mr Smith considers this to be significant

because the shear force within the whole structure would be at its minimum on the outer faces and its maximum in the neutral axis (see paragraph 44 above).

101. Mr Smith interprets the laminating records as showing that the first full cure of the unidirectional plank occurred at this level. Whilst he accepted at paragraph 8.1 that the general laminating quality of the foil was good, in paragraph 8.2 he concludes that the failure was caused by a weak interface at the level identified approximately 13.5mm from the upper surface, with inadequacies in the resin.

102. In the joint statement, the experts commented on the resin used in the unidirectional plank. They agree that it used DT124 which *"is a toughened epoxy and does not contain nano particles in the same way that SE84LV does"* (see 2.1.3 at **519/501**). The use of DT124 is described as "*a major change"* that "*should have been verified with VPLP"* (the designers) (see 8.2 at **523/505**).

103. The alleged failure to use a resin containing nano particles is an important part of the Defendant's case. The use of a resin containing such particles is specified in appendix 1 to the contract where it identifies "*Material – Carbon Fibre prepreg Uni direction T800, T800 Nano, M40J and T700n woven*" (emphasis added) and, in the Defendant's skeleton argument, this is said to be a cause of reduced compressive strength. In fact, for reasons dealt with below, the experts' agreement that DT124 does not contain nano particles is probably wrong.

104. Mr Smith also referred in cross examination to the report of Pierrepoint following NDT (non-destructive testing) analysis carried out between 21 July and 23 August 2016 (that is to say before the hydrofoil failed) that appears at **883/855**. He drew attention to the report of Scan 1 at **889/871** and noted the statement that "*the secondary bonds within the skin are also visible as blue lines in the B-scans."* He stated that this was about 12mm from the outer surface and concluded from the scan and report that this was an area where the resin had not moulded together. He then referred to the SEM (scanning electron microscopy) image at the report of Applied Polymer Developments (APD) at **678/660** and noted what he said was evidence that there were few fibres running across the screen at this same level. This 12mm level corresponds, according to Mr Smith, with the failure at 13.5mm, the difference in figures being explained by the fact that APD measured from the outside of the unidirectional plank alone, subtracting a

nominal 1.8mm for the outside skin (see paragraph 6.4 of his report). It is suggestive of a problem with the viscosity of the resin. However, he had not referred to the Pierrepoint investigation at all in his report and indeed indicated in cross examination very shortly before referring to the image at **678/660** that he did not consider Ultrasound Scanning to be particularly valuable.

105. Mr Griffiths for the Claimant did not proceed to explore this issue further in cross examination, but in closing submissions, he was particularly critical of this part of Mr Smith's evidence. He pointed out that it was only on the last day of trial and in response to the final question that he was asked in cross examination, that Mr Smith had proffered an explanation that the NDT testing by Pierrepoint and the Electron Microscopy imaging by APD showed a gross manufacturing defect. This point, had not previously been made in his written report, was not referred to in any of the submission, whether written or oral advanced by the Defendant and indeed was not put to Mr Reis.

106. Mr Smith concluded that the shortfalls in local compressive strength and interlaminar shear stress must be due to either material or manufacturing defect. At paragraph 8.3 of his report, he notes that the evidence suggests that the cure of the epoxy matrix was correctly performed, though it is possible that the resin did not spend long enough at a low viscosity stage (a time between the usual working temperature assumed to be 20˚C and the cure temperature of 110˚C), leading to inadequate wetting of the fibres. However, during cross examination, Mr Smith agreed that there was no test result to show that there was a failure properly to cure the laminate.

107. Mr Smith was cross-examined as to various alternative theories as to the possible cause of the failure, in particular relating to the introduction of the camel toe, the altered geometry of the hydrofoil (see 49 above), the increase in length between the V1s and the V2s and the increased load on the bearing plate of the hydrofoil. Mr Smith did not accept that any of these variations was likely to have explained the failure at an unexpectedly low load.

108. Mr Smith was asked about nano particulates. He said that they add strength to the resin by the use of silica. His opinion was, as is set out above, based on the assumption that the Delta product used in the build did not contain such

particulates. However an email of 11 May 2016 at **Supp/36** states that it does. There is no evidence to contradict this and, although the evidence came late in the day, it having been served only shortly before trial, it has not been questioned by the Defendant. I accept that DT124, as used in the hydrofoil, did contain nano particles. In any event, its use was agreed by the designers.

109. As to his opinion of the cause of failure, Mr Reis, under reference ASol 2.3.2 in his report (**531/513**), further explained his opinion as expressed in the joint report. He states that there is no "*sizeable"* manufacturing failure sufficient to explain failure at a relatively low load. There is no evidence of user error. He states that there is inadequate design information to determine whether there may be design error. In particular, he considered that access to hydrodynamic and Finite Element Analysis (FEA) studies was necessary to assess whether the design was a factor in the failure of the plank (see ASol 6.5 at **532/514**).

110. Mr Reis, had, through his company, Optimal Structural Solution, investigated the failure of the hydrofoil at an early point. The report of that investigation is in the bundle at **699/681**. Within the investigation, Mr Reis carried out FEA, which involves in essence computer modelling of the effect of a load on a structure, based on breaking down the structure into notional cubes. This led to the conclusion in section 4 of the report (**741/723**) that "*the solid foils analysis is clear that the notches on the leading edge of foil V2 are sources of stress concentrations … the construction method adopted for the composite foil V2 is creating stress concentrations in the top of the stepped joggle. The noisy results make it hard to say if the failure is real, but from a purely comparative perspective, the stress concentration is evident and is not an existing problem [in] foil V1. The effect is corroborated by both a stress increase on the top of the notched component and a stress concentration on the top of the bond layer unifying this to the main foil. As a matter of fact, the stress concentration on top of the bond failure is high enough to cause its rupture. There is bond failure in the notched areas, even though the laminate thickness on this area is constant and the elements quality is good. This points out* (sic) *to a real failure in this area, although is still tricky to be sure with such noisy results. Is* (sic) *also confirmed that the notched component does not play a crucial role on the strength of the foil, as this should be able to take the load without it. But one could*

speculate whether a failure on the notched component would cause compromising damage on the main foil."

111. Mr Reis made clear in cross examination that his concern as to this element of the design related not the camel toe component itself, but rather to the joggle that accommodates it. He pointed out that, at best the modelling shows damage initiation, not damage propagation, so one could not use the modelling to predict where the ultimate damage in the structure would occur. However, using a load on the upper bearing of 28 tons, one would not have expected failure at the 13.5mm level unless there was some design weakness in the foil. Ultimately, his conclusion in his report is that "*the most likely cause of failure is connected to design rather than manufacture*" (reference ASol 9.1). In particular, he implicates the camel toe feature, on the ground that it may have weakened the mechanical strength of the hydrofoil.

112. Mr Reis does not accept Mr Smith's suggestion that any of the alleged deficiencies in manufacture were capable of causing the failure. On the issue of the compressive strength that was noted to be low (see the answer to question 2.1 in the joint report referred to at paragraph 97 above), Mr Reis commented that, since this strength was measured on pieces taken from the failed board, it is not possible to confirm whether this was indicative of the strength of the component before failure.

113. During cross examination of Mr Reis, counsel for the Defendant raised questions as to his independence. Mr Reis accepted that he had worked at McLaren and that Messrs Easton and Robinson had also worked there. He had worked with them after that time, including with GTR over several years. However he maintained that he was discharging his duty to the court and did not see any conflict of interest.

114. Both Mr Reis and Mr Smith are critical of the lack of proper testing via a "coupon campaign" that is to say the testing parts made specially to be tested to destruction in the same manner (and at the same time) as the foil itself. Whoever is responsible for this, it cannot of course be said to be causative of the failure of the plank since it only would have occurred after the plank had been manufactured.

At best, it has deprived the parties and the court of material from which they might have had a clearer picture of the cause of failure.

Discussion 1: – the Contractual Issues

115. There is no dispute that:

(a) The Defendant contracted to purchase the V2s;

(b) The Claimant manufactured both V2s and delivered the port hydrofoil to the Defendant;

(c) The Defendant is liable to pay the purchase price for the V2s unless it shows that the goods were worthless due to manufacturing error by the Claimant, the burden of proving which relies on the Defendant.

116. Whilst I was referred in skeleton arguments to various authorities on issues as to contractual terms as to quality, I agree with the statement in Mr Land's skeleton argument for the Defendant that the primary issue is "was the quality of the foil built by GTR compliant with the contract?" The Defendant's pleaded case in its Amended Defence and Counterclaim is that it did not and was not obliged to accept the hydrofoils and the pay the balance of the purchase price and moreover that it is entitled to repayment of the sums already paid and consequential losses by reason of the failure of the port hydrofoil (see paragraph 63 at **44/44**). Whilst the Defendant pleads other defects, there is no suggestion that the other defects render the foils non-compliant with the contract, save in so far as they are relied on as evidence that the build quality was poor.

117. Thus, the issue in principle as to the Claimant's entitlement to the balance of the purchase price and as to the Defendant's counterclaim for repayment of sums that it has paid together with consequential losses is a factual issue turning on the expert evidence as to the cause of failure of the port hydrofoil. If that failure was due to manufacturing error, the Defendant has part paid for something of no value. It is not obliged to pay the balance of the purchase price and it is entitled to recover the sums already paid together with consequential losses. On the other hand, if it does not show that the failure was due to some manufacturing error, then it has not formulated a claim for losses based on any of the other criticisms of manufacture of the hydrofoils and does not contend that it is entitled to reject them on any other basis. Accordingly it will be liable to the Claimant for the

balance of the purchase price together with any losses consequential upon its failure to take delivery of the starboard foil.

118. As to the contractual price, I reject the Claimant's case that it is entitled to the original purchase price on the ground that prompt payment was a condition precedent of the agreement to accept the lower price. In reality, the Claimant has provided no sufficient factual evidence for the existence of such a term of the contract. There is no evidence of the express agreement of such a condition precedent. Further, the Claimant is not able to show grounds upon which to imply a term that prompt payment was a condition precedent to the payment of the reduced price nor any relevant trade practice.

119. Turning to the question of the payment of a bonus, there is no evidence that it was ever suggested that the payment of bonus turns upon whether Mr Thomson competed in the 2016-2017 Vendée Globe using the V2 rather than the V1 foils. Such a term could easily have been agreed, but, the Defendant adduces no evidence that it was. Mr Keogh's evidence as to his understanding does not establish any agreement to that effect and is no more than evidence of subjective intent which is not admissible to prove the true contractual interpretation.

120. In fact there is no evidence of any ambiguous contractual term that requires the application of the principles of construction. Even if it had been suggested that the discussion was ambiguous, I can see no basis in commercial common-sense for concluding that it was a pre-condition to the payment of the bonus that the V2 rather than the V1 hydrofoils were used. That was a matter outside of the control of the Claimant and it is by no means obvious that they would have agreed to a contractual term which put the payment of the bonus in the hands of the Defendant. Further, I can see no material from which a term could be implied to the like effect.

121. Accordingly, I am satisfied that the contractual purchase price, for which the Defendant is liable subject to proving that the failure of the hydrofoil was due to a breach of contract on the part of the Claimant, is the balance of the price as varied in September 2016.

122. On the issue of the Claimant's claim for storage charges, I agree with the Defendant's legal analysis. A liability for such charges is not created by the principal contract, since it is silent on the issue.

123. The Claimant has not shown any evidence of trade practice or a course of dealings sufficient to justify the implication of a term to this effect.

124. I have noted above Mr Robinson's assertion that the invoices refer to a liability to pay storage charges. This is incorrect, it only being referred to in delivery notes. Thus the Claimant is left with the sole argument that its delivery notes create such a liability. An example of such a note appears at **1513/1452.** Near the foot, it is stated, "*Patterns and redundant tooling will be stored by GTR for 3 months before storage will be charged unless otherwise agreed."* It is doubtful to my mind that these words, even if incorporated as a term of the contract, would apply to goods that were rejected by the buyer. Even if they did, I see no evidence that such a term was incorporated into the contract as originally executed nor any basis for a finding of variation. In those circumstances I conclude that the sums claimed are not recoverable.

Discussion 2: – the Expert Issues

125. In his closing submissions, Mr Land for the Defendant identified the expert evidence issue as being whether the manufacture by the Claimant of a foil in accordance with design drawings provided to it should have resulted in a foil that could withstand the interlaminar shear loading at 13.5mm that caused the failure of the hydrofoil had it been adequately constructed. This in my judgment is a reasonable way to put the central issue in the case. It might alternatively be put as to whether a failure by the Claimant properly to construct the hydrofoil in accordance with the specification provided to it was the cause of the failure. Either way, the burden of proving the cause of failure lies with the Defendant. This case has at times been put on the basis that the failure must have been caused either by a design failure or a manufacturing failure and they do seem to be the only plausible explanations, the question of "user error" being ruled out on the evidence.

126. On the Defendant's case, the alternative explanation to a manufacturing error, that there was some inadequacy of design, is untenable. It supposes either that the

designer failed to have regard to the degrees of force to which the boat would be subject or that, as designed, the boat was not able to withstand the predicted forces. Both of these, it is said, can be rejected because:

(a) Mr Reis' modelling shows that the foil as designed is strong enough to resist 28 tonnes of force even at its weakest point.

(b) The failure of laminar bonding did not occur in the neutral axis, where shear forces would be at their maximum, but rather on the plane 13.5mm in from the outside of the unidirectional compression plank. This is some way from the neutral axis and therefore the failure would not have occurred here unless this was a weak point. Given that the forces are greatest at the neutral axis, if the failure at the 13.5mm plane was due to overloading, the load on the neutral axis at the time of failure would have been even greater. But since the unidirectional plank was designed to be uniform in construction, failure at a point other than that where the shear force is at its greatest leads overwhelming to the conclusion that the failure was due to a manufacturing or materials error at the point of failure rather than a more generalised design (or indeed construction) error.

127. Whilst Mr Smith is not able conclusively to state the cause of the manufacturing defect that led to failure, his main targets have been the use of DT124 in place of the Gurit product, the presence of contaminants and/or an inadequacy on the manufacturing process affecting the efficacy of the resin.

128. The Claimant's primary position, based on Mr Reis' FEA testing, is that the more probable cause is design error and specifically the assertion that the design of the joggle leads to a risk of interlaminar failure at 13.5mm. But the Claimant puts equal weight on its secondary case that the Defendant cannot prove that the failure was due to manufacturing error and therefore fails to discharge the burden of proof which lies on it.

129. In considering the expert evidence, I found both Mr Smith and Mr Reis to have relevant expertise to consider the complex issues that arose, though neither professed a thorough knowledge of all of the many and varied scientific processes that can be employed in investigating an incident of this nature. I reject any suggestion that Mr Reis gave evidence that was partisan or adversely affected by

his prior relationship with the Claimant. At all times, it appeared to me that he was considering matters carefully on the basis of his expert knowledge rather than acting as a hired gun who simply said what suited the party who engaged him. As to Mr Smith, I found his evidence largely to be carefully given, with appropriate concessions where matters were outside his area of expertise. However, in one respect identified below, I found his evidence not to be reliable. Such unreliability flows in all probability from a firm belief (which may be correct) that something went wrong in the manufacturing process and that the court needs to focus on what the most probable failing in that respect was. However, for reasons set out below, that analysis fails in my judgment to deal with the alternative possibility that in fact the failure was not due to a manufacturing defect at all.

130. I turn to the three possible explanations proffered by Mr Smith as to the manufacturing defect.

131. As to the significance of the change of resin from a Gurit product to a Delta Technologies product, as indicated above, the available evidence indicates that both contained nano particulates. There is no evidence that DT124 performed in any less satisfactory way than the Gurit product. In any event, as the Claimant points out, the designers were consulted on the use of the different product and agreed to it. The Defendant has failed to formulate a case that shows how the use by the manufacturers of a product approved by the designers was a manufacturing defect for which the manufacturers were liable rather than a design defect, the Defendant accepting that design defects are not matter for which the manufacturers are liable.

132. As to contamination, Mr Smith raised the question of the presence of squalene as a contaminant that may have contributed to the failure. As indicated above, he was limited in the extent that he could rely on evidence as to its presence. It was also put to him that squalene occurs naturally in sea water, it being found in fish oil. He said that he had never known of squalene being blamed for the failure of a laminate like this and that in any event he could not deny that, if squalene were present within the damaged part, it may have resulted from that part being dragged through sea water.

133. In my judgment, the alleged presence of squalene cannot be blamed for the failure of the hydrofoil. Whilst its presence (if proved) could be consistent with contamination in the manufacturing process, it could equally be consistent with contamination after the board failed. In any event, the evidence as to its presence is equivocal. I reject this suggested cause of failure.

134. As to any other contamination being the cause of failure, the Defendant raises this as no more than a theoretical possibility. I see no evidence to convince me that it is more likely than not that some form of contamination caused a weakness in the foil.

135. Mr Smith's evidence, as accepted by Mr Reis, shows that it is probable that the shearing failure occurred at around 13.5mm into the compression board and that, since this is not the point at which the forces were greatest, one would not expect to have occurred there absent some design or manufacturing error that led to weakness there. But, when closely analysed, the evidence does not show that the failure was more probably than not due to manufacturing error.

136. In advance of trial, the only explanation for such defects that Mr Smith could proffer were that the weakness was caused by the use of DT124, contamination by squalene and/or some manufacturing weakness due to unidentified contamination or unidentified manufacturing error. Having rejected either the use of DT124 or squalene contamination this leaves only the Defendant with the difficulty of showing that that the weakness was due to a cause that it cannot identify but that must have been caused by or at least during the manufacturing process. In spite of considering a wealth of material, Mr Smith is unable to come up with any clear basis for showing that the weakness at 13.5mm was due to a manufacturing error.

137. The inference of a manufacturing defect comes in significant part from the evidence referred to at paragraph 97 above as to the compressive strength of the board. If reliable, that would be a strong pointer to a manufacturing or product defect. However, I accept Mr Reis' evidence that tests of compressive strength based on parts from the damaged board are potentially unreliable. On any version of the evidence, considerable energy was dissipated on the failure of the laminate

and it is inevitable that this will have caused significant compromise of the structure.

138. Further, I accept Mr Reis' evidence that, at least at a theoretical level, the introduction of the camel toe feature may have compromised the strength of the board. The obvious weakness of this as an explanation for the actual failure of the board is that this compromise of the board supposed a load of 28 tonnes, far in excess of the probable load at the time of failure. Were there some plausible evidence of an identified manufacturing defect at the 13.5mm level, this would probably have been sufficient to persuade me that it was that rather than a design issue that was the cause of failure, since Mr Reis' theory as to the design weakness is dependent on evidence assuming far higher loads and therefore is improbable. But in the absence of any identified defect, the court has to balance the improbable explanation proffered by Mr Reis and the speculative explanations of Mr Smith. Ultimately, that leads to a position where, in my judgment, the Defendant is unable to discharge the burden of proof.

139. Mr Smith's evidence that the Pierrepoint NDT analysis and the electron microscopy performed by APD in fact shows manufacturing defects at this level has caused me to pause for thought in this analysis, even though this theory was first expounded in the witness box. Of course, the Claimant would be understandably concerned if the point on which the Defendant succeeded was one raised for the first time by its expert at the close of cross examination, without the Claimant's expert having had any opportunity to comment on the issue. But that is one of the hazards of litigation - sometimes it is only in the middle of a trial that the true picture emerges. The Claimant cannot (and in fairness does not) expect me to disregard the evidence simply because it had never been raised before.

140. However, I am not satisfied that I can place any weight on this evidence:

(a) Whilst Mr Smith had not seemingly seen the Pierrepoint analysis when he prepared his report, it would be surprising that, if he considered it to be significant, he only mentioned this for the first time in cross examination. Of course this may be because the significance of the analysis only came to him when giving evidence. But if this were so, I would be concerned that he had not fully thought through what he was saying.

(b) Moments before giving the evidence, relating to the Pierrepoint Report, Mr Smith had dismissed this kind of NDT testing as of little help in investigating the cause of the event. At the point that he made that statement, it is difficult to believe that he had in mind that he was about to say that the NDT in fact supported his interpretation of events. This adds to my anxiety about how carefully considered this evidence was.

(c) In any event, I am not clear that the Pierrepoint analysis has the importance that Mr Smith attributes to it. It is correct that the table at **893/875** identifies what may be anomalies in "P1", "P2 and "P3" at a depth of 12mm from the outboard surface. But, on my reading of the report, that is a reference to the points shown on picture 4 (**894/876**) and scans 3 and 4 (**895/877**), not the scan at **889/871**, to which Mr Smith made reference. Without the kind of fuller investigation of this issue which would have occurred if the point had been made in advance in writing, thereby allowing the Claimant's expert to consider and comment upon it, I am not satisfied that Mr Smith is correctly interpreting the Pierrepoint report.

(d) If the APD investigation shows what Mr Smith contended in cross examination, I do not see why he failed to make the point within his original report. Mr Smith noted that report with its reference to failure at the 12mm level, but did not attribute any significance to the photograph which he now says demonstrates that his case is correct. Again, it has not been possible properly to investigate whether the photograph is being correctly interpreted by Mr Smith because the point had not been made earlier.

(e) The matters on which Mr Smith commented were not put to Mr Reis. One might wonder whether this was because Mr Land, for the Defendant, was unaware of the points until Mr Smith gave evidence, but that of course would be speculation. In any event, the fact that they were not put to Mr Reis means that the court is left with little further material by which it might judge the reliability of the evidence given by Mr Smith. Mr Reis was asked in re-examination about the electron microscope image at **678/660** and said that he did not see that the court could draw the

inference of any gross manufacturing defect from that. However, such evidence suffers from the problem that it was being given very much "on the hoof" and may not reflect a considered opinion on the point.

141. Given my rejection of this explanation, I am left unpersuaded by the Defendant's case that the failure was due to manufacturing defect. On balance, it is more probable that Mr Reis' explanation of a weakness associated with the camel toe feature caused this failure than that it was caused by a manufacturing defect which, notwithstanding extensive investigation, remains unidentified.

Discussion 3: – the Claimant's losses

142. The Claimant's recoverable losses are dealt with by my findings on the terms of the contract. It is entitled to the balance of the purchase price in accordance with varied agreement for the sale of the hydrofoils, together with the bonus for Mr Thomson having come second in the 2016-2107 edition of the Vendée Globe. It is not entitled to payment for storage.

Discussion 4: The Defendant's Losses

143. Given my findings on the expert issues, the Defendant does not prove its entitlement to recover any losses. However, for the sake of completeness and if I am wrong on that primary issue, I set out my findings on the Defendant's losses.

144. As the Defendant points out, the Claimant, in the Reply to Amended Defence and Counterclaim, does not raise any issues as to the quantification of the Defendant's losses over and above the denial of liability, although in cross examination, the Claimant raised some questions in particular as to the basis of recovering the cost of replacement foils for the Boat in order to achieve the best sale price.

145. If the Defendant proved breach of contract on the part of the Claimant, it would have a good defence to the claim for the balance of the purchase price and a good case for a counterclaim for the part payment of the purchase price on the ground that the hydrofoils were of no value to it.

146. Further, I would have found that the losses set out at paragraph 55 of the Amended Defence and Counterclaim and dealt with at paragraphs 46 and 47 of the statement of Mr Daniel to be recoverable. The evidence of Mr Taylor adequately supports the attribution of his fees as claimed.

147. However, I would not have held that the Defendant shows the cost of purchasing replacement foils to be recoverable for two reasons:

(a) The Defendant fails to show that the purchase of a further set of foils was a reasonable mitigation of its loss. There is simply no evidential basis for saying that this was money well spent and, for example, the court does not know how much the value of the Boat would have depressed had it been sold without hydrofoils.

(b) More fundamentally, if the Defendant were to recover both the cost of purchasing the V2s and the cost of replacement foils, it achieves double recovery through getting the ultimate foils for free.

Conclusion

148. In conclusion, the Defendant fails to satisfy me that the failure of the foil was due to any breach of contract on the part of the Claimant. The Claimant is therefore entitled to judgment for the balance of the purchase price as varied in September 2016, including the bonus for Mr Thomson's second place in the 2016/2017 Vendée Globe. The Claimant is not however entitled in addition to the cost of storage of the starboard foil.

Permission to Appeal

149. Subsequent to this judgment being sent out in draft, the Defendant sought permission to appeal. Having accepted the factual findings, those four grounds are:

(a) That I failed to bear in mind that, in a "two cause" case such as this, where the court rejects one of the causes, it must accept the other.

(b) That, having found that the design failure was an improbable cause, I should have accepted the other cause, namely manufacturing defect, to be the probable cause

(c) That I erred in finding that the Defendant was obliged to find an identified manufacturing cause; it was enough for the Defendant to succeed to show that a design cause was improbable.

(d) That it is logically unsustainable for me, having found a design cause to be improbable to have found a manufacturing cause to be even more improbable.

150. In my judgment, these are all aspects of the same argument, which is best summarised in the fourth proposition above. However I do not accept that this involves any logical fallacy. It is clear that I used the word "improbable" not in the sense of failing to satisfy the balance of probabilities, but in the more general sense of being unlikely. Even in "two cause cases", both suggested causes may be unlikely. In that context, it is the less unlikely of the two which satisfies the balance of probabilities. As I set out at paragraph 141 of this judgment, I found a design weakness to be the more probable cause.

151. For these reasons I refuse permission to appeal.