

CA on appeal from the High Court, QBD, (His Honour Judge Bradbury) before Judge LJ, Longmore LJ, Sir Swinton Thomas : 5th March 2003.

Judgment of the Court handed down by Lord Justice Longmore:

Introduction

- 1 The Claimants, Leicester Circuits Ltd ("Leicester") manufacture printed circuit boards to the order of their customers. We shall call the printed circuit boards PCBs throughout this judgment. The boards are usually made of a plastic composite with a microscopically rough surface and a copper metal conductor pattern standing just proud of the base plastic material. The boards may and usually will contain a variety of holes, tracks and pads into or onto which customers can attach other parts. The boards, when fully constituted, become electronic elements of a variety of products of which one example is the mobile phone. Within their process Leicester apply a solderable finish to those areas of the circuit where soldered joints need to be made and thus assist their customers when they, the customers, seek to solder on other attachments. Leicester's process has to be of sufficient quality to ensure that the nonsoldered parts of the board remain solder resistant and also to ensure that, where soldering does take place, blistering or breakages do not occur within or next to the soldered areas or, indeed, elsewhere. In order to so prepare the boards, Leicester purchased a special ink from ink manufacturers. After the boards have been cleaned, they are fed into a curtain coating machine, through which the boards pass, and ink is coated over the board except for those areas where soldered joints will be required. The speed of movement through the curtain can be regulated to adjust the weight of the wet ink required for the boards. The intention is to ensure that the parts of the boards where soldering will not take place, are covered by the ink which, in a solidified form, is called a "soldermask" and remains solder resistant. Soldermask should adhere readily to the plastic material but any copper covering the plastic will have a comparatively smooth impervious surface which may not be entirely conducive to good soldermask adhesion. It is important that the flow characteristics of the ink are optimised in order to minimise any tendency of the ink to drain away by force of gravity or be drawn away by surface tension from high spots and edges of features on the board, which must hold an acceptable minimum film thickness in those areas. After the coating, the soldermask material is rendered insoluble, then it is hardened by "postbaking" and a solderable finish is applied.
2. The defendants, Coates Brothers plc ("Coates") manufacture and sell to the PCB industry special inks. Between at least 1992 and 1997 they had a good business relationship with Leicester supplying Leicester with a type of ink for which the trade name is Imagecure. The type of Imagecure supplied to Leicester between 1992 and 1997 was colloquially known as T1. Subsequent inks known as T2 and T3 are not relevant to these proceedings. T1, though essentially considered by Leicester to be fit for its purpose, gave rise to potentially unsatisfactory scuffing and marking difficulties of the PCBs during the assembly process. Leicester also came to consider T1 unsuitable for a particular application of solderable finish, Electroless Nickel Immersion Gold (named "ENIG") although it seems to have been satisfactory for the predominant kind of application known as Hot Air Solder Levelling ("HASL"). By the early to mid 1990s other suppliers of ink within the industry were developing a harder product that minimised any scuffing and marking problem. Coates themselves sought to develop such a product. It became known as T4 and from November 1997 to July 1999 Leicester purchased it in place of T1 as their solder resist ink. It was somewhat harder and more brittle than T1.
3. Leicester maintained at trial that they learned in the summer and autumn of 1998 through complaints from a particular customer (Tyco) that T4 was not providing satisfactory solder resistance on certain types of PCB boards ordered by those customers. Whereas traditional printed circuits might normally contain narrow copper conductors, there are other designs which display wider areas of copper, which have been termed "*ground planes*" or "*ground plane panels*". Some of the ground plane designs, though not as common as traditional designs, had been used within the PCB industry for some years. Some ground planes have narrow channels or gaps running through or next to them. It became clear during the trial that the PCBs, which Leicester alleged were defective as a result of the use of the T4 ink during the important period May-July 1999, were those ground plane

PCBs with narrow channels and the argument necessarily had to focus on whether the ink T4 was fit for the purpose of being used in relation to these boards in particular.

4. Leicester asserted that a blistering problem arose on some of these ground plane boards; this type of board (ground plane with narrow channels) was at that time about ten to fifteen per cent of Leicester's production. The blistering problem, it was said, rendered the PCBs unfit for use so that they were subsequently scrapped or that attempts had to be made to re-work them. Leicester accepted that 85-90 per cent or so of board designs produced and manufactured by them were successfully coated with T4 ink when that ink was used on ordinary PCBs; but Leicester say that they suffered loss of custom in consequence of this unfitness, and thus financial loss. At trial they also complained that Coates negligently misrepresented to Leicester the extent of the testing done by Coates on T4, because Coates made in the summer of 1997 a reference in two faxes to exhaustive testing, thus, say Leicester, inducing them by that misrepresentation to buy the product. That complaint was rejected by the judge and Leicester do not appeal that decision. Leicester's further complaint that Coates were in breach of contract by supplying ink that was not fit for its purpose was, however, upheld by the judge and is now the subject of this appeal by Coates.

5. The critical findings of the judge came towards the end of his judgment and are in the following terms:

"144 *There were many shafts of evidence in this action, some favour Leicester and others Coates. It remains the position that Leicester were able to run their business without real setback until early 1999 and using for a year or so the T4 ink. They then had their setbacks as when they lost the chance of increased orders from Tyco but broadly they were, up to early 1999, a company performing satisfactorily with still expanding turnover. Leicester did have equipment that needed some renovation and improvement but they followed up and carried out the recommendations made to them by a wide range of employees of Coates. Indeed I detect no criticism of Leicester by Coates in the sense that Coates have not suggested any prevarication or delay in complying with Coates's suggestions.*

145 *No one factor is persuasive but the alteration in Leicester's position once they changed ink to Tamura and then to Electra is significant. Their problems did not resolve immediately and some boards blistered using other company's ink. Leicester, too, had a large backlog of work which they were not easily able to eliminate but I do accept the evidence of Leicester's witnesses that once the change of ink was made the level of scrapping reduced to manageable proportions.*

146 *Mr Slater [QC, counsel for Coates] described the evidence of other manufacturers, whether oral or in written form, as anecdotal and I am of course in no way determining whether T4 ink was fit for the purpose of other companies. However, the evidence of those outsiders retained some relevance because it sustains a general picture of Coates in 1998 and 1999 struggling to maintain a stance that their T4 ink was suitable for all forms of standard designs of printed circuit board which were to be curtain coated. I remember the statistical position and am conscious that T4 was successful for Leicester in coating the vast majority of designs and that Coates were manufacturers in selling this ink on a worldwide basis. I remember of course the burden of proof and the standard of proof which Leicester have to adhere to. They have to prove their claim on a balance of probabilities. Nonetheless, it does appear that the inadequacy of T4 ink, for ground plane designs with narrow gaps at the edges of those planes became cruelly apparent in 1999. Leicester have established on a balance of probabilities that there were times in 1999 when the T4 ink manufactured by Coates was not reasonably fit for its purpose. Seemingly, T4 in those times was not able to withstand normal variations in processing conditions to be consistently successful and it could only function within a too narrow and unrealistic operating window. That was in 1999. I emphasise that I do not seek to make any finding about the suitability of that brand of ink today. This head of claim on unfitness for purpose has thus been established by Leicester."*

History of the Dispute

- 6 The judge set out a lengthy and detailed chronology of the events leading up to the dispute between the parties, to which reference can be made. We will summarise the salient features and then make a few additions.
- 7 Between 1992 and 1996 use of ground plane PCBs became gradually more common. When in 1997 Coates developed the harder and more brittle form of ink known as T4, they were aware that these forms of PCB were in

use and the trials, which took place to see whether it was effective, probably included trials on such boards, as Coates' witness Mr Macdonald confirmed in his oral evidence. It was for this reason that, by the time of trial, the question had become whether the ink was suitable for such PCBs and, in particular, those ground plane PCBs which had narrow channels. The T4 ink was launched in June 1997 and by November 1997, Leicester had been persuaded to purchase quantities of it. They acquired a stock from Coates and the usual method of purchasing was that, as they used some of the stock, they would indent for more to replace it. The first complaint received by Coates about adhesion of the ink came from a company called Ryttergaard in March 1998 and seems to have related to the ENIG process rather than the HASL process which, by 1998, was the process being used by Leicester. A further complaint from a company called Classical Circuits in June 1998 was dealt with by a recommendation that the ink should be applied more thickly and may also (like a complaint in March 1999) have related to the ENIG process.

8. The first complaint to emanate from Leicester themselves seem to have occurred on 1st July 1998 and to have been dealt with by Coates likewise recommending that a greater weight of ink should be applied. The problem seems to have been resolved because no further complaint was made by Leicester until 15th September and the complaint was made not on their own account but by passing on a complaint from one of their customers who had been using the PCBs as processed by Leicester. This customer was the Tyco Electronic Product Group ("Tyco"); they returned a sample PCB to Leicester who transmitted it to Coates who, on 30th October, said that the ink film weight was "very low" and that there might be excessive undercut caused by a combination of under exposure and over development. It seems that as many as 112 samples of what may have been blistered Tyco boards were sent by Tyco to Leicester many of which were sent to Coates for analysis on 8th December. Coates replied on 11th December stating that moisture might have remained after cleaning and that the boards may have been insufficiently "post baked". On this occasion Coates said that insufficient thickness of ink was not thought to be a cause of the blistering. Nevertheless Leicester informed Tyco on 21st December that they had caused a greater weight of ink to be applied to similar products to the samples and they showed no blistering. On 22nd December 1998 Tyco wrote to Leicester taking the line that whether the problem was insufficient thickness of ink, excessive undercut, under exposure or over development, the fault lay with Leicester from whom they needed reassurance that the problem had been resolved. Leicester replied to this on 4th January 1999 reiterating that they had now increased the amount of ink applied (thus redressing the main cause for concern as Mr Peter Norris, Leicester's Quality Assurance Field Manager, was to say in a memo of 11th February 1999, a copy of which was sent to Tyco) adding that exposure and development accorded with the requirements of what they called the control plan and questioning whether undercut could really be a contributory factor. The memo also said that the pre-treatment line had been improved. Tyco appear not to have thought that this was satisfactory and, as explained by Mrs Brick in her oral evidence, ceased ordering PCBs from Leicester. Leicester's case against Coates in the action contained (inter alia) a claim for the loss of the Tyco business. This was rejected by the judge who held that the Tyco complaints of 1998 were isolated complaints at a time "when T4 ink was apparently being used satisfactorily on other products including ground plane PCBs sold by Leicester to others". Tyco's decision to reduce their orders could not, therefore, be attributed to his findings of unfitness for purpose arising from the subsequent events of 1999. Leicester cross-appeal from this part of the judge's decision.
9. At Leicester's request, Coates came to their premises at Syston to determine if the processing conditions used by Leicester were within Coates' "recommended parameters". Coates issued an audit report on 8th January 1999 making various recommendations in relation both to processing in general and maintaining the equipment. There was no suggestion then that Leicester's processes were actually inadequate but a further report of 1st March 1999 did suggest that the general condition of the machines used was poor, probably due to lack of maintenance. There was no further recorded complaint by Leicester of a blistering problem until 27th April 1999. By this time Leicester were actively considering replacing the T4 ink manufactured by Coates with an ink made by a company called Tamura. Few Leicester documents have survived from this time so it is impossible to say

whether the desire for change came about from dissatisfaction with T4 or (as Coates' documents tend to indicate) from the fact that Tamura could be more competitive than Coates in relation to pricing.

10. Be that as it may, Coates' response to the complaint of 27th April was to attribute the blistering to poor tin stripping, but that theory was exploded when the Tin Research Institute could find no tin residues on the sample PCB with which they had been provided. Blistering occurred during the following 3 months (May-July 1999) at a rate which, according to Leicester, caused considerably more than the usual number of circuit boards to be scrapped. It was apparently always acceptable if up to 8% of PCBs had to be discarded as useless but Leicester contended that a considerably greater percentage had to be scrapped during May, June and July 1999. This was the time when according to the judge (in para. 146 of his judgment) *"the inadequacy of T4 ink for ground plane designs with narrow gaps at the edge of the planes became cruelly apparent"*. The problem was described by Mr Morgan, one of Coates' managers, on 20th May referring to a visit by himself and Mr Chilcott to Leicester: *"All work seen by myself and Paul Chilcott OK. Boards coming off pre clean look good and line slowed down. After lunch the job that had the problem before had blisters again. The jobs processed directly before and afterwards were OK - no blisters. Problem is job specific."*

Between 11th and 22nd June Tamura ink was substituted for T4 in Leicester's sump but this could not be a permanent arrangement since appropriate underwriting laboratory certificates had not then been obtained. T4 was used again from 22nd June until some time in late July 1999 when Tamura ink was substituted. This itself did not prove entirely satisfactory but not for reasons of blistering and it was itself substituted after a short while with an ink known as Electra ink.

11. Meanwhile Coates personnel had visited Syston again between 22nd and 24th June and on 28th June. They did not accept that there was anything wrong with the ink but concluded that blistering was consistent with staining on the boards and recommended a new and separate unit for acid cleaning. On 9th July they observed that blisters also appeared on the copper edge of very small gaps (said to be 0.25-0.3 as opposed to boards with 0.5 gap and upwards where there was no blistering observed). Mr Chilcott said in his report: *"The problem is mainly job specific at the moment with some random blisters on other ground plane work which is probably down to unreliable pre-clean/staining."*

Although the phrase "job specific" was used by Mr Morgan of Coates in May 1999, this report appears to be the first reference in terms to the problem being mainly related to ground plane PCBs with narrow gaps. We surmise that that is the reason why the problem was called "job specific". On 21st July Leicester wondered whether it might be better to change back to T 1 and Mr Parkinson of Coates said that it might be, as T 1 was not as hard or brittle as T4. The judge said that this was the first suggestion by Coates that a change to another ink might be worthwhile.

12. On 24th July Coates took 75 panels away for coating elsewhere at an entity called CEMCO. For some reason which was not satisfactorily explained (but may have related to the fact that Leicester were now using T1 ink), the panels were coated with T 1 ink and so the results cannot have any relevance to the present dispute about T4. Unknown to Leicester, however, complaints had been received about blistering from one of Coates' other customers and thus a competitor of Leicester. This was Cranford Circuits and, when a test of their boards was done using T4 ink on 19th August, all nine boards passed through a curtain coater failed. This is not mentioned by the judge but, as a fact, was common ground. Its significance was hotly disputed.
13. On 16th August Mr Norris of Leicester wrote a long letter to Coates, summarising the history of the matter and saying that they had reverted to T 1 on 22nd July and had been using Tamura since 30th July. He said that since October 1998 scrap attributed to blistering had cost £200,000 and they wished to seek compensation for that and other losses. A meeting convened for 24th August failed to make any progress in resolving the dispute. Leicester then instructed solicitors, Eversheds, who sent a detailed letter before action on 7th December 1999 in which they quantified Leicester's total loss caused by the use of T4 in the sum of £494,009.12 (including £182,600 from loss of profit due to drop in sales and £79,959 for the value of boards which had to be scrapped and £5,488.64 for the cost

of re-working or repairing other boards). A claim form was then issued on 19th December 2000. By the time Particulars of Claim were served in December 2000 the sum claimed had risen to £631,882.

14. Leicester were asked to state the number of PCBs which had blistered and the date of such blistering and on 22nd March 2001 referred to Appendix 2 to Eversheds' letter before action which had itemised the scrapped circuit boards. This 21 page document itemised job sheets which recorded numbers of scrapped boards by reference to scrap codes J01, J02, H03. It emerged from the report of Leicester's accountancy expert Mr Prior that these codes meant "Poor board cleaning", "Curtain coating faults" and "Tin stripping faults" respectively. Mr Norris explained at trial that at the time when the job sheets were made out and Appendix 2 was compiled there had been no code for "Deficiency of Ink" (which, in any event, was not then suspected as a possible cause) and that the allocation of the codes must, therefore, not be taken as an admission of poor processing. In the body of Mr Prior's report dated 13th September 2001, he stated that he had verified Appendix 2, as attached to the letter before action, by sample testing to the job cards. He then examined all the numbered job cards included in Leicester's scrapped schedule (as he called Appendix 2) where the value of the PCBs scrapped exceeded £100. This was 81 jobs, in 57 of which the total number of PCBs exceeded the acceptable figure of 8%. He set out the data he derived from Leicester's scrapping schedule in Appendix F to his report which was a 3 page document. The first two pages related to the 31,053 boards scrapped in the 57 cases where the total number exceeded 8%. The third page dealt with the 3,913 boards scrapped in the 24 cases where the total number scrapped was less than 8%. He then decided that Leicester's realistic claim under this head was between £23,882 and £28,882 (the wasted cost) rather than the figure of £79,959 (the sales value) claimed in the letter before action and the original particulars of claim.
15. The significance of all this detail lies in the format of the scrapping schedule prepared by Leicester, rather than the detailed amount of the particular claim derived from it. As Mr Slater QC, for Coates, pointed out, the schedule itself (although relied on in support of the claim) said nothing about the type of boards to which it related (ground plane PCBs or ground plane PCBs with narrow channels or otherwise) nor did it indicate on the face of it that the reason for scrapping was blistering of the boards.

The Outline Submissions

16. In broad terms Mr Slater for the appellants' on this appeal submits:
 - (1) No problem of any kind arose with T4 ink until May 1999; it had been in use satisfactorily from November 1997 until that date;
 - (2) That, if the judge concluded that there were problems with T4 ink before May 1999, he was wrong to do so. The only "setback" referred to by the judge was that in relation to Leicester's customer, Tyco. On analysis this was not a problem with the ink but with the fact that it had been applied too thinly. In the part of his judgment dealing with damages, the judge correctly rejected any claim in relation to Tyco as being unconnected with the T4 ink; it was therefore inconsistent of him to find (if he did) that the Tyco history had any relevance;
 - (3) The Joint Expert statement, agreed by the experts after exchange of their original reports, effectively conceded that the process by which the ink was applied to the circuit boards was unsatisfactory;
 - (4) That the judge was wrong to say that such problems as Leicester had were resolved when they changed to Tamura or Electra inks;
 - (5) The judge's reliance on the evidence of "other manufacturers" was misplaced;
 - (6) That the reasons given by the judge in relation to unfitness for purpose can be shown to be wrong; there was no relevant evidence other than the challenged evidence above and Leicester had failed to show that the problems they had were anything to do with the T4 ink supplied by Coates, if a cause had to be found it could only be in Leicester's processes;
 - (7) Leicester themselves had never thought there was anything wrong with the ink until shortly before they decided to sue; their internal records always attributed the difficulties to poorly cleaned circuit boards or faults in the curtain coating process by which the ink was applied;

- (8) That a sporadic failure or an intermittent inability to withstand normal variations in processing is not equivalent to "unfitness for purpose"; indeed the specific nature of the failures indicated that these problems lay elsewhere.
17. In broad terms, Mr Sutcliffe QC for Leicester submits:
- (1) That the question whether T4 ink was suitable for its purpose was a finding of fact; there was evidence to support that conclusion and it should not be disturbed;
 - (2) That the judge should have found more clearly than he did that problems with T4 began as early as March 1998. He had correctly instanced one customer, Tyco, as having encountered ink related problems, which, on a true analysis, began in March 1998. He was thus wrong not to have awarded damages for loss of Tyco's business; and wrong not to rely on evidence from Tyco as evidence of the long standing nature of T4;
 - (3) That the experts had agreed in terms in their joint statement that T4 ink: *"displayed certain technical limitations, particularly when applied by curtain coating and particularly when applied to designs with copper ground planes, where there was a tendency to a particular mode of adhesive failure during soldering processes."*;
 - (4) That, any internal categorisations of circuit board problems, as due to poor board cleaning or curtain coating faults, **only** occurred because Leicester at that time had not appreciated and had no reason to appreciate that there was any ink related problem;
 - (5) That the judge was correct to hold that the problems resolved themselves once Leicester started to use different inks such as Tamura or Electra;
 - (6) That the judge rightly relied on evidence from other manufacturers viz Leicester's competitors, particularly Spemco (Mr Driver and Mr Lloyd), Kemitron (Mr Murphy) and Cranford Circuits in support of his conclusion that there was something wrong with T4;
 - (7) That accordingly Leicester had shown, on the balance of probabilities, that the problem related to the ink and not to anything else such as their own processes.

Finding of Fact?

18. It is, of course, tempting for any appellate court, faced with a complex and largely scientific dispute about the fitness for its purpose of any manufactured article, to say that the judge's conclusion about its unfitness is a matter of fact and, provided that there is some evidence to support the judge's conclusion, to uphold the judgment. That would, however, be a negation of our appellate responsibilities. A conclusion that an article is fit or unfit for its purpose is an inference to be drawn from many other facts. The facts so far set out are not particularly controversial; the question is whether the correct conclusion from all the evidence is whether the ink was fit for its purpose. That is a mixed question of fact and law since the judge has to direct himself correctly as to the law on the topic. Subject to one possible point, there is, however, no substantial criticism of the judge's approach in law and it is certainly fair for Mr Sutcliffe to submit that fitness for purpose is primarily in this case a question of fact. That means that the defendants have, as Potter LJ said in granting leave to appeal, a substantial mountain to climb. But the question at the heart of the appeal is a question of inferential fact and the duty of the appellate court is to decide whether the judge's conclusion that the ink was not fit for its purpose is the correct inference from the substantial amount of evidence in the case.
19. There is, moreover, a particular irony in Mr Sutcliffe's submissions in this case. He cross-appeals against the finding that the loss of Tyco's business was not caused by the unfitness for its purpose of the T4 ink. That is as much a finding of fact as the finding that the T4 ink was unfit for its purpose between May and July 1999. But the irony is greater than merely enabling Mr Slater to say as he does "Tu quoque". Mr Slater submits (1) that the judge was, of course, correct to hold that the incidents of blistering in relation to Tyco's PCBs were isolated and not explicable by the quality of the T4 ink supplied by Coates but (2) that the judge has not properly followed through this conclusion because he nowhere faces properly up to the fact (which he says is established) that the ink worked perfectly well from November 1997, when it was first purchased, until May 1999. It is, no doubt, because of the significance of this that Mr Sutcliffe is so anxious to overturn the findings of the judge in relation to

Tyco. If he can do so, he can then say that the ink was only fit for its purpose from November 1997 to March 1998 and can be demonstrated to have been unfit thereafter. On any view, therefore, it is inevitable that this court has to engage with the facts and it is convenient to deal with the cross-appeal in relation to Tyco straight away.

20. The judge set out the basic facts in paragraphs 61 - 66 of his judgment and we have repeated most of them in paragraph 8 of this judgment. The judge put the date of the first complaint from Tyco in the autumn of 1998; this seems to be a reference to 15th September 1998. Mr Sutcliffe said that the problems with Tyco's own customer surfaced in March 1998 but we are not ourselves satisfied that this was the case. It is, in any event, impossible to associate any pre-September problem with blistering. The judge made the important point that none of the sample damaged boards sent by Tyco to Leicester or by Leicester to Coates were retained by the parties; so no expert witness had had any chance of examining them and it was thus difficult to reach any conclusion about the standard of the ink used on the boards or about the processing of the boards.
21. The judge might also have added (though he did not) that Mr Norris's own view seems to have been that Leicester had resolved the problem by (inter alia) increasing the weight of the ink and improving their pre-treatment line. The experts, moreover, agreed in terms (para. 7.2 of their Joint Statement) that the Tyco problem was resolved by the addition of 25% increase in coating weight. Mr Sutcliffe said that there was no evidence to support this but quite apart from the fact that neither expert was orally invited to resile from this agreement, it is in line with Mr Norris's own view of the matter. What the judge did say, however, was that the problem was "an isolated problem in 1998".
22. In the light of his findings, when it came to quantum the judge held that, although Tyco's witness, Mrs Brick, said she transferred about £200,000 of business away from Leicester before December 1998 and September 1999, the Tyco complaints of 1998 were: *"practically isolated complaints when T4 ink was apparently being used satisfactorily on other products including ground plane PCBs sold by Leicester to others."*
23. Mr Sutcliffe attacks both the conclusion that the Tyco PCB problem was not shown to be caused by the T4 ink and the associated decision not to award Leicester loss of profit that would have been made on the Tyco business.
24. This is an impossible task; he has to displace the agreed statement of the joint experts on which the judge relied (para. 128 of the judgment) and the view of his own witness Mr Norris that Tyco's main cause of concern was addressed by increasing the weight of the ink. Without the possibility of examining the relevant circuit boards, there is no material from which this can be done persuasively or at all. The judge was eminently entitled to come to the conclusion that Tyco's problem was an isolated one which had not been shown to have been caused by the ink. On that view, no loss of £ profit in respect of the business taken away from Leicester by Tyco could be awarded. In this respect, therefore, we uphold the judge's judgment.

The Expert evidence

25. It is now necessary to say something about the expert evidence called at the trial. The cause of the blistering on PCBs with ground planes and narrow channels was controversial. The claimants' expert Mr Starkey concluded (9.1.1.3) that the problem was that there was a tendency for the ink to draw away from the edges of copper ground planes, leaving only a very thin coating on the edge of the ground plane area. In the experts' joint statement made after exchange of initial reports he was persuaded (he later claimed he was over-persuaded) to agree that this conclusion could not stand up to scientific scrutiny (para. 6). In his oral evidence he said he did not believe his theory was wrong but he accepted he could not prove it. The judge described it as being expressed in very general terms (para. 134). In his evidence Mr Starkey then orally suggested that the cause might be a change of formulation in the ink but was constrained to agree that, on the evidence, no change in formulation had occurred at the relevant time. (It had been agreed that the changes in formulation were confidential and did not have to be disclosed; but dates of changes were disclosed and set out at para. 5.1.12 of Mr Starkey's original report). Leicester were thus left in the position that they could not prove what caused the blistering on the boards.

26. Dr Wadsworth was equally at a loss. He was inclined to blame the manner of processing of the boards by Leicester and there certainly had been defects in processing before the critical period of complaints between May and July 1999. Leicester had retained a very small number of PCBs (featuring copper ground planes with narrow channels) which showed blistering. Mr Starkey was able to consider them before making his initial report of 7th September 2001 and they were disclosed to Dr Wadsworth on 26th September 2001. In the joint statement, both experts agreed that insufficient evidence was available to determine the definitive cause of blistering in these boards (para. 5.7). Dr Wadsworth also proposed a mechanism for the first time in his oral evidence which came to be known as the solvent vapour hypothesis, but he could never explain why the blistering was confined to narrow gaps adjacent to ground planes and did not extend to narrow gaps which were not adjacent to ground planes. Thus the judge did not accept either of the theories put forward in their oral evidence by the experts and was left with no proved explanation of the blistering phenomenon. He made the point (para. 127) that Leicester did not have to prove the precise cause of the blistering but only had to prove that the cause (whatever it was) was a deficiency in the ink.
27. It is not clear whether or to what extent the judge relied on the evidence of either expert. At the end of his analysis of the evidence he said (para. 135): *"The expert evidence in this action from both witnesses does not have a sufficiently strong foundation to be decisive. I must weigh it in the balance with all the other evidence I have heard"* but that is the last we hear of it before he concludes that Leicester had indeed shown that it was the ink that was to blame. So if any aspect of it had indeed been given weight, there is no indication what that aspect was.
28. Both sides criticised the judge for taking the expert evidence no further. Mr Sutcliffe for Leicester said the judge should have had regard to (and probably did have regard to, even though he did not say so) two particular passages in the agreed statement as follows:
- "2.19 *The assertion made by PS [Mr Starkey] at his paragraph 9.3.3 "It became apparent that although in general they performed to an acceptable standard, XV501 T-4 inks displayed certain technical limitations, particularly when applied by curtain coating and particularly when applied to designs with copper ground planes, where there was a tendency for a particular mode of adhesion failure during soldering processes" is agreed*
- 6.10 *PS's conclusion at his paragraph 10.2 "I believe that the problems which the Claimants encountered with ink type T-4 were caused by factors which were natural characteristics of ink type T-4, and that the effect of these factors was exacerbated by the material used to coat the ink on the printed circuit boards" is agreed with reference to boards with copper ground planes and narrow channels."*
29. It is true that the judge quoted both these passages (as well as many other passages from the expert evidence), but he does not appear to have placed any particular reliance on them. That was probably because they were not singled out in any particular way in Leicester's closing submissions. This was no doubt because a display of "certain technical limitations" (to use the phrase in 2.19) is by no means the same as saying that the ink was unfit for its purpose. If it is reasonably possible to accommodate the technical limitations (and para. 6.10 implies that it may have been), it is difficult to say that ink was not reasonably fit for its purpose, especially if (as seems to have been the case) it was fit for use on all other forms of circuit board used by Leicester and other manufacturers. For this reason, we do not think these two paragraphs of the joint expert statement can carry the day for Leicester; certainly the judge did not expressly or inferentially decide that they did.
30. Mr Slater's attack on the way the judge left the expert evidence was more wide ranging. He also relied on certain paragraphs of the Joint Statement, apart from, as already mentioned, those paragraphs stating that Mr Starkey's preferred mechanism for the blistering did not stand up to scientific analysis (para 5.6) and that the cause of blistering in the samples seen by the experts could not be ascertained (para. 5.7). These were that (1) T4 ink was used for 7 or 8 months by Leicester without complaint after which only 10% of PCBs suffered blistering problems (para. 1.15), (2) batch-to-batch consistency of T4 ink was not an issue (para. 1.18) and (3) the fact that 90% of the board designs were successfully coated with T4 would suggest that the ink was not inherently defective (para. 2.15). It does not seem to us, however, that these agreements can of themselves carry the day for Coates any more than those relied on by Mr Sutcliffe can carry the day for Leicester. Paras. 1.15 and 1.18 are of limited significance

and the agreement relied on in para. 2.15 was only part of a wider agreement that the problem was unlikely to be process-related either.

31. Mr Slater had a more promising line of attack to the effect that the judge had ignored (1) the difficulties which Leicester's scrap schedule posed for the party which had the burden of proof and (2) the evidence which Mr Starkey had been constrained to give in relation to that scrap schedule. It is to this schedule that we now turn.

The Collated Scrap Schedule and the Expert evidence

32. Leicester's scrap schedule attached to their letter before action of 7th December 1999 and Mr Prior's reworking of it (as described in paras. 13 and 14 above) were based on Leicester's available job cards but had some inherent limitations, if anyone wanted to see the pattern of failure on the part of Leicester's PCBs. No attempt was made to do a chronological summary until one of the week-ends during the trial (9/10th or 16/17th February 2002, Day 10, page 80, line 21). Coates' legal team, using information which had long been available, put it into chronological order in the form in which it then came to be known for the rest of the trial, viz. the "Collated Scrap Schedule". It was perhaps a little unfortunate that by that time some of Leicester's witnesses and, in particular, their Quality Assurance Field Manager (Mr Norris) had already given evidence. He had retired from Leicester in April 2000 and retired altogether by the date of the trial when he was living in Devon; he had returned there after giving his evidence. He was the man who had the most intimate knowledge of the failed scrap boards, Leicester's other witnesses being able to give only more general evidence. One advantage, however, of the collated scrap schedule was that it could then be seen at a glance that the period of the highest number of scrapped PCBs was between May and July 1999 rather than at other times. In the light of this, Leicester's Technical Director, Mr Leslie Round was constrained to agree that the schedule showed inconsistency of results (6/67/3-6). One could also now see for the first time how Leicester apportioned the failures as between their 3 categories of JO1 "Poor Board Cleaning", JO2 "Curtain Coating Faults" and H03 "Tin Stripping Faults". (As already said, Mr Norris explained in his evidence that those were the only categories then available as no one then thought that the problems could have been caused by the ink.) Mr Starkey accepted (10/102/12) that he could have done a similar analysis himself before trial.
33. When Mr Starkey came to be cross-examined on the tenth day of the trial the judge forcefully pointed out that he was an important witness who had to take precedence over counsel's holiday arrangements (10/46/10-25). Mr Starkey first had to agree that there had been no change in the ink's formulation during the relevant period (10/49/25) and that, in the light of the world-wide sales figures of T4 ink, it seemed that in practice the ink was reasonably successful and reasonably fit for its purpose (10/51/20 and 53/12). He further agreed that if the ink in the sump did not change but on one day blistered boards were produced and the next day clear (unblistered) boards were produced, any change must be in the condition of the boards at the time of being coated with the ink (10/61/7-12). Mr Slater then took Mr Starkey to some of Leicester's job sheets by reference to his collated scrap schedule and Mr Starkey agreed that:
 - (1) job sheet T6201 of 26th June 1999 showed that only 0.16% of boards processed on that day were rejected due to presumed blistering and such a small percentage could not be attributed to a fault in the ink (10/82/22);
 - (2) job sheet T5964 of 19th May 1999 showed 1% of boards rejected for blistering which was again within an acceptable failure rate (10/86/11);
 - (3) the same applied to job sheets T5970 and T5966 (23rd and 24th May) where the failure rates were 5% and 7% respectively (within Leicester's own acceptable failure rate of 8%) (10/86/20 and 87/3);
 - (4) the same applied to job sheets T6202 of 14th July 1999 where the failure rate was 4% (10/91/18-23); ironically the failures (such as they were) included a greater number of boards processed with Tamura ink than with T4 ink (10/92/20 and 7/196/2322);
 - (5) if there were a 100% failure as with job M5997 on 25th May 1999 that would indicate that something had gone wrong with the job of processing the PCBs (10/87/23);
 - (6) job sheets T6857 and T6825 (both of 23rd July 1999) on which a 100% failure rate had also been recorded related to T 1 ink and did not properly form part of a claim which related only to T4 ink (10/94/17-95/7);
 - (7) job sheet T6755 of 24th July 1999 (which probably, but not certainly, related to T 1 ink) in any event only recorded 5% failure due to blistering which would tend to indicate that the ink for that batch was reasonably fit for its purpose and that, by comparison with the 100% failure rate of the previous day, the problem was with the boards not the ink (10/98/17);
 - (8) when Tamura ink began to be exclusively used in August 1999, the failure rate was 1% just as had been the case with T4 ink in May 1999 on job sheet T5964 (10/101/15).

Mr Starkey ended this part of his cross-examination by saying: *"I think on the basis of the figures that we have seen here there is a very good argument that it's not ink related."*

34. Rather remarkably none of this (to our mind) significant evidence is referred to in the judgment. At paragraphs 117-119, the judge explains how the collated scrap schedule came into existence and how the categories J01, J02 and H03 were formulated well before anyone thought that the T4 ink could be to blame. He then merely says this at paragraph 120: *"Whilst Mr Slater made some hay with the inconsistencies, irregularities and omissions in the scrapping schedule upon which Mr Prior had relied, Mr Sutcliffe made barely a mention of the schedule in his closing submissions. If that document were to be a centrepiece of Leicester's case then I have to say that they would be in real difficulties in proving [to] the requisite standard of proof that T4 ink was unfit for its purpose, but Leicester do rely on much other evidence, some of which I have already recited in the chronology. ..."*

The judge does not here indicate what was the "much other evidence" on which Leicester relied, "some of which" he had already cited in his 74 paragraphs of chronology. Presumably it must be, at any rate mainly, the evidence which he singles out when he comes to his conclusions in paragraphs 145 and 146 of his judgment. But the fact remains that the scrap schedule in the form in which it was attached to the letter before action was, on any view, a vital part of Leicester's case because it was incorporated into the pleading in support of the allegation that, as a result of the unfitness of the ink for its purpose, PCBs had become valueless and had to be scrapped. The scrapping was thus said to be a consequence of the unfitness of the ink and the majority of Leicester's losses were then said to spring from this initial and central breach of contract. When the judge deals with quantum, the scrapping list is relegated to the eighth head of claim in the comparatively small sum, as awarded, of £20,000; but that cannot conceal that other more substantial claims (and, in particular, the loss of profit claim of £256,800) proceed from the alleged fact that the PCBs, as inked with T4, were so unfit for their purpose that a substantial number of PCBs had to be scrapped; of course, other costs were incurred in recycling those not sufficiently damaged to require complete scrapping. The scrap schedule did, therefore, lie at the heart of Leicester's case and Mr Sutcliffe's failure to mention it constituted a remarkably successful finessing of his difficulties. Once, however, Mr Round had agreed that the schedule showed inconsistent results and Leicester's own expert (Mr Starkey) had agreed that, on the basis of the figures in the schedule, there was a good argument that the problem was not ink-related, Leicester's claim should have begun to look decidedly shaky. What then was it that persuaded the judge to conclude that in 1999 the T4 ink was not fit for its purpose? In paragraphs 145 and 146 of his judgment he relies on (1) the change to Tamura and then Electra ink when the level of scrapping reduced to manageable proportions and (2) the evidence of "outsiders" which gave a general picture of Coates struggling to maintain that T4 ink was suitable for all forms of circuit board. To these matters we turn.

Change to Tamura and Electra ink

35. We have already seen (1) that job sheet T6202 of 14th July 1999 included inking with Tamura ink and produced, when combined with T4 ink, an overall failure rate of 4%; this would no doubt be a "manageable proportion" of failure since the accepted failure rate was, in any event, 8% of PCBs; and (2) that once Tamura ink started to be used, there was still a need to scrap 1% of PCBs which were processed in August. In fact the Tamura ink had a different problem since it did not develop as quickly as Leicester would have liked; in the event Leicester did not use Tamura for long and switched to Electra ink which, on the evidence, did work satisfactorily.
36. This amelioration of the situation is, of course, a factor of the case which counts in Leicester's favour as far as it goes, but in the light of the fact that, as shown by the collated scrap schedule, the failures of T4 were, at best, only intermittent, it can hardly be decisive. The judge appears to have thought that the T4 ink malfunctioned for Leicester throughout 1999 but this is a considerable overstatement. He was right to ignore the 1998 position because more than 8% of PCBs were scrapped **on only** 4 occasions. The first such occasion in 1999 was on 12th February, there being 11 scheduled job sheets for that month; there were 11 occasions in March out of 17 job sheets, one in April out of 5 job sheets, 5 out of 13 job sheets for May, 1 out of 3 job sheets for June, and the 8 out of 9 job sheets (dealing at any rate partly with T4 ink) in July. It will be remembered that these scheduled job sheets were job sheets where there had been failures causing more than £100 in value of PCBs to be scrapped.

There were, of course, many more job sheets in respect of which no scrapping at all was recorded or where the value scrapped was not merely less than 8% but less than £100 in all. It can thus be seen at a glance just how intermittent the failures were. Coates can, therefore, justifiably submit that during the 20 months between November 1997 and July 1999, when the change to Tamura ink took place, serious problems occurred in only 4 of those months. If, of course, there had been some change in formulation in 1999, Leicester might have been able to make a case of unfitness for purpose in 1999, but it was established that there was no such change. One is, therefore, left with a picture of intermittent PCB failure in four particular months, only the last three of which were consecutive months. This is not, in our judgment, enough to condemn the T4 ink as unfit for its purpose if other possible causes (such as processing defects) exist, especially if Leicester's own expert is reduced to saying that there is a very good argument that the problem is not ink related.

Experience of "outsiders"

37. By "outsiders" the judge meant either Leicester's own customers or their competitors. We have already considered the position of Tyco, one of Leicester's customers, who did take business away from Leicester. This loss of profit was held by the judge not to have been caused by the unfitness of T4 for its purpose; since the problem seemed to have been resolved by increasing the weight of the ink, it is perhaps not surprising that the judge so found but the main reason for his so holding is that it was a 1998 problem rather than a 1999 one and was thus "truly" an "isolated" incident. (it will be remembered that more than 8% of PCBs were scrapped on only 4 occasions.) It is not likely, therefore, that it was Tyco that the judge had in mind by his reference to outsiders.
38. Mr Sutcliffe, relying on Mr Starkey's view that 34% of Coates' customers made adhesion-related complaints in relation to T4 ink (para. 7.1.3), boldly submitted that many competitors of Leicester had similar problems with curtain coating of T4 ink and that in each case the problem was the ink and not the processes of the relevant PCB manufacturer. He served a respondent's notice of appeal to this effect in support of the judgment in relation to one such manufacturer, Cranford Circuits. We say that this was a bold submission because he invited us to make findings of fact in his favour which the judge declined to make. The judge stated baldly that he was not determining whether T4 ink was fit for the purpose of other companies. Mr Sutcliffe submitted that the judge ought to have made relevant findings in Leicester's favour. No doubt one reason why the judge did not make such findings was that for him to have done so would have involved a sub-trial of the question whether T4 was in fact suitable for the purpose of such other manufacturing companies. He presumably did not consider that he had the material with which to do so; nor do we consider that we do; but since the argument has been raised we will address it.
39. **Cranford Circuits** : The judge recorded that Cranford Circuits ('Cranford') were selected for the main trials of T4 ink between 21st October and 1st November 1996. At this early stage the chief problem was movement of the ink around holes in the circuit boards. Coates considered that that problem could be resolved by the addition of a surface active ingredient. T4 ink was, in due course, purchased and used by Cranford but a complaint about blistering after soldering was received by Coates on 22nd July 1998. No witness from Cranford was called by either side nor were their documents placed before the court; the judge only saw what could be found in Coates' files. This included a report from Mr McDonald, a Coates technical service manager, on a visit made on 9th September 1998, in which he said: *"Despite numerous visits to overcome the problem, it still occurs periodically especially with boards having large copper ground planes . . . investigations of the various process steps have also contributed little to a general lowering of the level of blistering."*

This was at a time when Leicester were not experiencing any problems themselves. Nearly a year later, however, while Leicester was suffering its own problems, Mr Conboy of Coates visited Cranford on 1st July 1999. According to the judge, he reported that Cranford were experiencing "edge lifting on developed features over ground planes, after ni/au". Whether or not edge lifting on developed features is the same complaint as Leicester's complaint of blistering on or around narrow channels, the complaint appears to relate to the ni/au (ENIG) not the HASL process, which was the process used by Leicester. Its relevance is therefore difficult to evaluate. Mr Conboy continues, however, as follows: *"The problem is marginal, so increased surface roughness and*

improved pre-dry may do the trick. If this fails we can always offer one of the new ni/au friendly products with added phoo phoo dust."

Mr Sutcliffe seized on this reference to "phoo phoo" as showing, he said, that Coates were not treating Cranford's difficulties seriously and were intending to fob them off with some palliative which they knew would not change anything. Since Mr Conboy was never called (and in the absence of any pleaded case on this matter it is difficult to criticise Coates for not calling him), it is again difficult to evaluate that submission which, on the evidence that was before the court, is no more than an assertion in relation to use of the ink in a process different from the process actually used by Leicester themselves.

40. Mr Sutcliffe's substantial criticism of the judgment in relation to Cranford is that hereafter the judge omits any reference to what was happening at Cranford until February 2000 and that what happened in summer 1999 was very important. It only emerges in the Coates' documentation. First, Coates made at least 2 further visits in July by their Mr Nick Harris of Technical Support who described the current issues as including "blistering at HASL (mainly on large ground plain (sic) panels)" as well as "edge lifting" and "white staining" at "immersion gold". Mr Harris's record of his visit from 10th-12th July (presumably 1999, though not so stated) when different forms of T4 ink were put through the curtain coating process stated that good results were obtained from all panels that were "HASL'd", that panels that were not Ni/Au plated produced good results but that skipping and poor flow was observed when trying to coat production panels with the relatively fine tracks (100-150u tracks and gaps). A further visit on 18th July did not produce any better results and he concluded further investigation was required. That further investigation took place between 12th-16th August when 9 separate circuit boards were processed with T4 ink by curtain coating and 4 boards processed by the different process of screen printing. All 9 curtain coated boards failed while the screen printed boards passed.
41. Since the judge made a point of referring to Cranford from time to time in his chronology and since Mr Sutcliffe had emphasised these events of July and August 1999, it is indeed surprising that the judge omitted any reference to them. The judge does, however, refer to a further visit of Mr Harris on 31st January and 1st February 2000 made *"as part of the ongoing evaluation of the blistering problems ... on certain types of production jobs"*. A series of inks (including T4) were evaluated under standard processing conditions. Mr Harris's report stated:
*"All of the test panels that were produced, with all ink and final bake combination, passed a single HASL pass (sic) at standard conditions with no visible signs of blistering or removal.
Some further work was being undertaken by Cranford using their standard ink system to establish if the blistering problem was still evident. After testing a couple of 'problem' panels with both types of final cure, no problems were seen."*
The problem thus appeared to have been resolved but it is not clear from any document what had, in fact, been done to resolve the problem. In paragraph 22 of his written statement for the trial, Mr Harris said the cause of Cranford's problems was considered to be their post-bake operation and the use of an infra-red heating unit and that it was also attributed partly to the specific board design which Cranford used.
42. Mr Sutcliffe did not challenge this passage in Mr Harris's written evidence. Instead he tried to obtain an admission that the blistering problem had resurfaced during the HASL process on large ground plane panels in July 2000, after which a change to the ink was made. Mr Harris would not accept that and said that the July changes were to overcome Cranford's poor plating conditions as they eventually did (9/84/6-87/8).
43. The judge finally referred to a visit to Cranford by Mr Conboy and other Coates' personnel on 25th January 2001. Under the heading *"Recent development in soldermask technology"*, Mr Conboy (as the judge recorded) said:
"Blistering. Had problems in the past with previous generations of T4, now totally eliminated after changing pre-clean procedures from pumice to brushing with improved drying to reduce water entrapment between closely spaced channels between ground planes."
44. Although the judge did not expressly say so, it looks as if he omitted any reference to what happened at Cranford in July and August 1999 because he accepted Mr Harris's unchallenged evidence that Cranford's problems with their circuit boards arose from imperfections in their own processing. That is certainly our conclusion from the

available evidence which we have now set out. It seems to us, therefore, that Mr Sutcliffe's reliance on the failure of Cranford's panels in the August curtain coating trials is misplaced. We certainly think that the judge was correct not to make any findings that the T4 ink was unsuitable for Cranford. It must follow that the Cranford experience, such as it was, cannot assist Leicester in their task of proving that the T4 ink was unsuitable for their purposes.

45. The evidence in relation to other PCB manufacturers is no more helpful. In the first place it must be a question whether arguments in relation to other manufacturers are open to Leicester in the absence of any respondents' notice in relation to them. Mr Sutcliffe submitted that the judge had decided that these other manufacturers had had similar problems to those encountered by Leicester and that their experience supported his conclusion as to the unfitness of the ink. The judge, however, merely said that the evidence of the outsiders "*retained some relevance because it sustains a general picture of Coates in 1998 and 1999 struggling to maintain a stance that their T4 ink was suitable for all forms of standard designs of printed circuit boards which were to be curtain coated.*"

We would respectfully doubt whether, when a new type of product is produced and there are problems about its application to all kinds of different circuit boards, it was probative or helpful for the judge to have regard to the experience of those using circuit boards different from the ones used by Leicester which gave rise to problems viz. PCBs with large copper planes and narrow channels. It was recognised by the experts at trial that the Leicester problem was job specific in this sense; the fact that problems might have arisen with other kinds of circuit boards which might need resolution in different ways is irrelevant.

46. On this view, other manufacturers' problems are nothing to the point, unless Mr Sutcliffe can satisfy this court that the problems are the same (or at least very similar) to the problems encountered by Leicester. For this purpose a respondents' notice is required because (1) the submission was not accepted by the judge (he says in terms he is not deciding whether T4 ink was suitable for the purpose of other companies) but constitutes a ground on which (if accepted) the judgment can be supported and (2) the appellants need to know what case they have to meet. Strictly speaking, therefore, Mr Sutcliffe's arguments under this head are not open to him. Mr Slater for Coates, however, made only formal objection to the arguments and we should, therefore, deal with them.
47. **Spemco** : Of the manufacturers, other than Tyco and Cranford, it was the company known as Spemco on which Mr Sutcliffe mainly relied, no doubt largely because he was able to call to give oral evidence both Mr Stephen Driver and Mr Derek Lloyd who were respectively managing directors of Spemco and Argos Electronic who were taken over by Spemco in December 1998. Thereafter Mr Lloyd was Operations Director of Spemco. Spemco found that Argos were already dealing with Coates and decided that Coates should supply and continue to supply the Spemco site in Kent and the Argos site in Portsmouth respectively. Mr Lloyd said in his written evidence that problems with blistering, caused by the solder resist not adhering to the top edges of the upper tracks, started to become troublesome in February 1998 and were "terrible" in 1999. They manifested themselves in particular on PCBs with large ground plane areas (with large areas of copper) and on PCBs with narrow tracks. Mr Driver in his written evidence said that as soon as they started to use Coates' ink in December 1998, there were adhesion problems with PCBs having large areas of copper. He expanded this in his evidence in chief to say that by September 1999 the blistering problem was not the only problem with ground plane boards because once that problem was solved by increasing the thickness of the ink, a different problem of micro bubbling arose. The only documented complaint was made by Spemco telling Mr White of Coates on 27th September 1999 that one of their customers was having blistering problems "*around via holes*". This led to what Mr Driver called "an ultimatum" delivered at a September meeting with Coates.
48. Mr Driver gave evidence on the 4th day of the trial and explained that the "via holes" problem was significant because the via holes connected two ground planes together (4/119/23). It was put to him that that was the only location of Spemco's problems, which did not exist at the channels in the ground planes. He replied that in general there were blisters on the ground planes but not necessarily at points where there were narrow channels (4/119/2-9). He agreed that "*viapad*" blistering could be eliminated by increasing the film weight but he said that,

if that was done, there would be the "old bubbling problem" which was different from blistering. In fact the cause of the problem was not diagnosed and in due course Spemco selected a different supplier while continuing to have a good relationship with Coates (4/120/18-122/8).

49. Mr Lloyd gave oral evidence on the 7th day of the trial and was permitted to expand on his written evidence in a way that impressed the judge. He said that in 1999, the problem was changing every day and Spemco were changing processes every day: "We could not get the product to work. I mean it would work one day and it wouldn't work the next day ... basically the T4 problem is its window of operation, its operating window is too narrow, so ordinary variations in the operating process didn't allow you to run this board with the zero or (?vertical) defect." (7/13-8)

This passage of Mr Lloyd's evidence in chief, unattributed, is adopted almost word for word when the judge comes to his critical conclusion in paragraph 146 of his judgment. After saying that the inadequacy of T4 ink for ground plane designs with narrow gaps at the edge of those planes became cruelly apparent in 1999 and that Leicester had established that there were times in 1999 when the T4 ink was not reasonably fit for its purpose, he says: "Seemingly, T4 in those times was not able to withstand normal variations in processing conditions to be consistently successful and it could only function within a too narrow and unrealistic operating window."

The judge is here adopting the view of a PCB manufacturer who has a separate (even if not entirely dissimilar) problem from Leicester. Like Mr Driver, Mr Lloyd accepted that the problem of blistering caused by the ink not adhering to the shoulder of the copper at the top edges of the copper tracks could be itself cured by increasing the weight of the film. The problem then was that there was micro-bubbling which might or might not be acceptable to their customers (7/19/15-22/8). He agreed he had made no mention of the via hole problem at all which arose in September 1999 when one of Spemco's customers, called Chase, complained but he denied that the concentration in September on that problem meant that the blistering problem, arising before the circuit boards had left the factory, had been resolved.

50. In spite of these two Spemco witnesses being called to give evidence, no Spemco documentation was disclosed or available to the judge. Coates' own records only produced an internal memorandum in relation to the September 1999 meeting. In these circumstances, and on the evidence we have outlined, the judge was, in our view, correct deliberately to refrain from making any finding that T4 ink was unfit for Spemco's purposes. There was just not the material available to him to do that. But that makes it all the more curious that the judge felt able to adopt Mr Lloyd's view about the Spemco problem that T4 ink could not "withstand normal variations in processing and could only function within a too narrow and unrealistic operating window". Even if he were minded to accept Mr Lloyd's evidence in general terms in relation to Spemco's problems, it is not, in our view, justified on the evidence to transpose that acceptance to Leicester's problems which were not the same as Spemco's problems. To put the matter another way if the judge was right not to treat Spemco as a "similar fact" case to the Leicester case, it was wrong for him to rely on Spemco evidence to conclude that Leicester had discharged its burden of persuading the court that the T4 ink was unfit for its purpose.
51. Mr Slater put his case higher than this by saying that the judge had invented a concept of "occasional unfitness for purpose" not known to the law. We would, however, not accept that the facts of this case give rise to any true question of law. "Occasional unfitness" may not be very likely in fact but the only question is whether, as a matter of fact, the ink was reasonably fit for its purpose.
52. The evidence of other manufacturers can be dealt with more briefly. On the second day of Mr Sutcliff's address to us, we asked him on which other manufacturers he relied. Apart from Spemco and Cranford, he instanced Hamlet Circuits Ltd, Classical Circuits Ltd, CST, Mion and Kemitron. We shall take them in that order. His written material referred also to Forward Circuits experience in April 1997 but that was (a) much earlier than any problems of Leicester and (b) inconclusive.
53. **Hamlet** : On 8th February 1999 Hamlet described a problem caused by "solvent or air bubbles erupting through the surface immediately after coating". The next day they asked Coates to send in their teams to get to the bottom of the

problem. The judge referred to this in para. 76 of the judgment but made no findings about whether or how the problem was resolved.

54. **Classical Circuits** : This company reported a problem in June 1998, well before Leicester's problems arose. Coates established that the shoulder of the copper plane had an insufficient weight of film. This problem was thus similar to the Tyco problem. No further trouble seems to have occurred until 17th December 1998 when there was a complaint about blistering but, before the cause of the problem could be established, Classical had changed to a new product. It is not clear what sort of circuit board was having the problems nor whether the HASL application was being used. A later complaint of 10th March 1999 was made in relation to poor adhesion after the ENIG (rather than the HASL) application was being used. A modified product apparently gave more consistent results.
55. **CST** : CST complained of an adhesion problem in October 1999. Coates again professed that they were baffled why a product which worked perfectly well for some months should suddenly become problematic. In an internal e-mail of 17th October 1999 Mr McDonald of Coates accepted that the particular T4 product used by CST, being hard and brittle, was the most prone of all the Imagecure products to this type of problem. The particular HASL application unit was "a very aggressive process". But provided the process was working well, T4 should work; if, however, something went slightly out of spec, poor adhesion would result. Mr McDonald posed the question "*Now either this T4 product has worked well and something at CST has gone out of spec (now the precise cause we may not know yet and may never know for certainty) or the T4 product never really worked well and we have simply only now discovered this.*"
- That poses the CST problem and it may well be that the Leicester problem could be posed in similar terms. But that does not bring one any closer to a resolution of the question whether the T4 ink was reasonably fit for its purpose. The judge (para. 112) called the e-mail illuminating but made no finding of unfitness relating to CST; such light as it sheds may be a light on the question facing the court but is no guide to an answer.
56. **Mion** : Mion was a customer of Leicester; the purchaser from them was a company known as Kostal. In paragraph 74 of his judgment the judge records Kostal complaining about discolouration on the edge of the tracks of PCBs and in paragraph 99 he says that in July 1999 Kostal ceased to do trade with Leicester. A Mion letter of 23rd July 1999 indicates that the problem was that deliveries were not coming through and it is perhaps significant that this is the month when there was apparently 100% scrapping on 4 separate job sheets, although two of them occurred when T1 ink was being used. Again this takes one no further on the question whether the ink was suitable for its purpose.
57. **Kemitron** : Leicester served a statement from Mr Jeffrey Murphy of Kemitron and called him to give oral evidence. He made it clear that he had a problem with Coates' ink but that the problem was one of non-adhesion after they had dispatched the circuit boards to their customers. They had a small problem with blistering which affected 5% of their output but the circuit boards they produced did not have large copper areas and were thus dissimilar to Leicester's problem boards. Mr Murphy also said that the major issue for Kemitron was with the nickel gold application not the HASL application (41105110). Although the judge referred to Kemitron incidentally in his chronology (eg paras 60, 67 and 72) he did not draw any conclusion from those references no doubt because their experience was different from Leicester's in the way described.

Summary of "outsiders"

58. The use that Leicester can make of the experience of "outsiders" can be seen from this analysis to be illusory. Any attempt to use them as "similar fact" evidence was doomed to fail. The judge was, therefore, correct to refrain from holding that T4 ink was unsuitable for any of their purposes. But if sufficient material does not exist to enable such findings to be made, it is illogical and positively dangerous to use it in support of "*a general picture of Coates in 1988 and 1999 struggling to maintain a stance that their T4 ink was suitable for all forms of standard designs of printed circuit boards which were to be curtain coated*" and then to use that general picture as support for a finding that the ink was unsuitable for the particular kinds of circuit boards on which Leicester intended to use the ink.

The reasoning process is far too unparticularised. There is no getting away from the fact that Leicester has a burden of proof to discharge; they have to show that the ink was not reasonably fit for its purpose. We regret to say that the reasoning of the judge in paras. 144-146 of his judgment does not stand up to analysis. Nor, in our judgment, can Mr Sutcliffe succeed in his attempts to show that the judge could have relied on matters other than those mentioned in the judgment.

The witnesses

59. This court must always be conscious that, in a difficult factual case, it may be easy to find fault with some or all of the actual reasons given by a judge for his decision but that, since he has seen and heard the oral witnesses, both of fact and opinion, the decision itself may be correct. Moreover, it is clear in the present case from paragraphs 79 and 140-143 of the judgment that the judge did not form a high opinion of Coates' witnesses, in particular Mr Parkinson whom he condemned as aggressive and Mr McDonald who was unwilling to accept criticism. He held also that each Coates witness knew that it would have been sensible to suggest that a variant to the T4 ink should be tried out.
60. The first of these criticisms relates to the demeanour of the witnesses and the judge's assessment of them in the witness box. That is a view to which he was entitled to come and we would not wish to depart from that assessment. It is for that reason that in this judgment we have not sought to rely on any unsupported but challenged assertion by any Coates' witness but have only sought to answer the question whether Leicester have discharged the onus upon them of showing on the balance of probabilities that the T4 ink was unfit for the purpose of being used for ground plane boards with narrow channels. For the reasons we have given, we are driven to the view that, when all the evidence is taken into account, Leicester have not discharged that burden of proof.
61. The judge's second criticism is more difficult to understand because the concept of a variant to the T4 ink was never an issue at the relevant times in 1999 nor an issue, as such, at the trial. It appears to amount to a veiled allegation of bad faith against Coates' witnesses to the effect that they knew (or at any rate suspected) that the ink was to blame but nevertheless insisted on Leicester checking and altering their processing equipment to no purpose. Although expressed, as we say, in somewhat veiled terms, that must be what it amounts to. We have to say that, having read and considered the evidence, that criticism is, in our judgment, unwarranted. It is not supported by any detailed reasons in the judgment beyond the general references to the demeanour of the witnesses nor do we believe it could be. (The judge himself recorded that Mr Parkinson did suggest trying T1 ink on 21st July in para. 98). Nor do we believe the allegation to have been put in terms by Mr Sutcliffe to the relevant Coates' witnesses. It is not insignificant that Dr Wadsworth, Coates' expert witness, whose integrity was not impugned, himself took the view that Leicester's processes were to blame.

Conclusion

62. It is now time to draw the threads together. First it is important to appreciate that neither the judge nor this court has to make a definitive decision that the cause of the need to scrap or make good defects in the PCBs did (or did not) arise from the manner in which the PCBs were processed. The question is: Have Leicester proved on a balance of probabilities that their various losses were caused by unfitness for its purpose of the T4 ink sold to them by Coates? We do not believe Leicester have so proved because (in summary)
 - (1) T4 ink worked adequately (or was not shown to be unfit for its purpose) between late November 1997 and mid 1999;
 - (2) Even when the need to scrap or make good PCBs arose in mid-1999, the need arose only intermittently and to a surprisingly varying degree;
 - (3) On a fair reading of the evidence as a whole, the experts, while they were unable to identify a positive cause of the need to scrap or repair PCBs in mid-1999, thought the processing by Leicester was more likely to be to blame than the quality of the ink;
 - (4) In the light of the intermittent and varying nature of the problems, the fact that other ink apparently worked for Leicester cannot mean that Coates T4 ink was unfit for its purpose;

- (5) Experience of other manufacturers of PCBs is not probative in the absence of proper allegation and proof that such experience is sufficiently similar to the problems encountered by the claimant in such a manner as to warrant a similar conclusion as to unfitness.

The judge's own conclusions as to unfitness were, therefore, flawed and we are satisfied that he ought to have decided that Leicester had not made out their case as to unfitness for purpose to the required standard of proof. It is for that reason that we will allow this appeal.

Other issues

63. Many other issues arose particularly as to the incorporation of Coates' terms of business and the interpretation of them. No purpose would be served in giving a detailed judgment in relation to these issues. But, in case it is of interest to the parties, our view on those matters is that Coates' terms were part of the contract pursuant to which the ink was supplied since the course of the parties' dealing resulted in their becoming part of that contract. The term relied on, however, in relation to consequential loss was not sufficiently clear to exclude any claim to loss of profit (or, indeed, Leicester's other claims upheld by the judge) since such claims would have been within the reasonable contemplation of the parties if the ink supplied had been unsuitable for its purpose and thus within the first limb of **Hadley v Baxendale** (1854) 9 Exch 341; they were therefore outside the phrase "consequential or incidental damage of any kind whatsoever . . . including without limitation any indirect loss or damage such as operating loss, loss of clientele . . .". The loss of clientele has to be of a kind which is truly "consequential" before it can be excluded. The words "or incidental" are too vague to detract from the requirement that the word "consequential" is to be understood in the sense adopted by this court in **Croudace Construction Ltd v Cawoods Concrete Products Ltd** [1978] 2 Lloyds Rep. 55. In this respect we agree with the judge.

JUDGMENT : LORD JUSTICE JUDGE:

1. We will deal with the issues which now arise in the order in which they were canvassed.
2. Mr Sutcliffe has asked us to order that following the successful appeal by Coates we should order a new trial. In effect he says that on our findings his clients, Leicester, have not really had a sufficient opportunity to present their case to a judge in its full measure.
3. What we have done in our judgment is to accept the judge's findings about the witnesses he heard. We considered their evidence in detail in that context, and then considered the documents relied on by Leicester to establish their case. That case in our judgment, for the reasons given in it, was not established. In those circumstances, we do not think it appropriate to order a new trial.
4. We should say by way of footnote that the question whether a new trial would follow a successful appeal was canvassed in the course of argument before us. We bore those discussions in mind, as well as Mr Sutcliffe's submissions today.
5. The second question is whether we should give permission to appeal to the House of Lords. We do not think that would be justified in this case. If Leicester wish to take the matter further they must seek their Lordships' permission.
6. We now come to the question of costs. The result of this appeal is that Coates have succeeded on the appeal and the cross-appeal. They are therefore entitled to judgment on the counterclaim as well as judgment on the claim. The counterclaim in fact adds very little to all the issues that we have canvassed. But whether that is so or not, in normal circumstances, as Mr Coles submitted to us, the anticipated order would be that Coates should recover their costs from Leicester both here and below.
7. Mr Sutcliffe sought to defeat the application of what I shall describe as the normal rule here in a number of different ways. So far as his written submission was concerned, he developed considerable argument about the impact on the trial of the sudden arrival of a much closer analysis of the document referred to in the judgment as "the scrap schedule". We understand that submission, but in our view that does not affect the appropriate order to be made below. He also asked to us bear in mind in relation to the costs below an important change of case, almost a key point in the litigation. When Mr Slater QC opened his defence before the judge below he agreed that

it was common ground that T4 should have been reasonably fit for the purpose of coating ground planed PCBs, an issue which until that point had been in dispute.

8. Again, we take the view that that is part and parcel of the ordinary stages in litigation and therefore should not affect this particular issue.
9. There is, however, a more substantial feature developed by Mr Sutcliffe in his argument before us today, as well as in his skeleton argument, and that arises from events in late 2001/early 2002, very shortly before the trial of the action which began on 4th February and ended in a judgment on 27th February.
10. In December 1999, way back at the earliest stages of the trouble that arose between Coates and Leicester, there was a Part 36 offer. There was another on 18th September 2001. In the meantime, although we are not clear about the details, steps were being taken, on the face of it by mutual consent, to see whether the issues between the parties could be mediated.
11. On 4th January 2002 the solicitors for Leicester wrote indicating that following "without prejudice" discussions, Leicester had agreed to mediation. It was agreed that Mr Pryor should act as the mediator and that the mediation would take place in Birmingham on 10th January. That, the solicitors said, they understood would be agreeable to Coates. Moreover, they said they had spoken to CEDR about the agreement and that Mr Pryor's availability was confirmed, and that it had been requested that the parties should send their case summaries directly to Mr Pryor.
12. On 7th January the solicitors for Coates wrote in relation to the mediation, confirming that it would take place on 10th January and raising a question about whether Eversheds, the solicitors for Leicester, would charge any fee for the use of the premises as the venue. The only significant further passage in it is that Mr Pryor is described in terms as the mediator and he was asking for an estimate of the parties' costs incurred to date. In other words, at this stage, it is clear that the case would go to mediation.
13. The process did not go on very long. By a letter dated 9th January Mr Pryor wrote to solicitors for both parties in these terms: *"I refer to our various telephone conversations yesterday and today, and to the fax from Plexus last night. I am sorry to learn that Coates are having to withdraw from the mediation. I understand this to be at the insistence of their insurers. Having read the Mediation Statements that you each provided, it seemed clear to me that this was a matter that fell squarely within the category of those ripe for mediation. I still hold the Mediation Statements, so if there should be any change in the position, I would be happy to assist further."*
14. Solicitors acting for Coates faxed the following message to Leicester's solicitors on the same date, 9th January: *"Our client's position has not changed and therefore it will not be proceeding with the Mediation planned for tomorrow."*
The solicitors for Leicester responded, expressing extreme concern at this attitude to the litigation demonstrated by Coates who had, I am paraphrasing, first agreed to mediation and then at the 11th hour refused to proceed with it. These words then appear: *"This is in our view a clear breach of the overriding objective."*
15. There was a separate issue which we need not go into, save to record that we have read the correspondence about it, which arose from the fact that whereas Leicester had supplied their case summary to Coates, Coates had not supplied its case summary to them. At one stage I believe, but perhaps it does not matter, that there was an implied allegation of bad faith.
16. Our understanding of why this mediation failed is summarised in the letter from Mr Pryor. Mr Coles today, when we asked for an explanation, confirmed that the decision was based on the insurance company's instructions. He described this mediation as a form of negotiation which came to nothing. With respect to that argument, we do not agree. The whole point of having mediation, and once you have agreed to it, proceeding with it, is that the most difficult of problems can sometimes, indeed often are, resolved. We note Mr Sutcliffe's argument that, as the litigation was to show, a considerable amount of time and effort had been spent by both sides trying to sort out and resolve their problems.

17. Mr Coles also submitted that there was no realistic prospect of a successful resolution of the issues. He showed us correspondence which he said demonstrated that Leicester had taken an over-robust, perhaps over enthusiastic belief, in the likelihood of a successful outcome from its point of view.
18. Again, we take the view that having agreed to mediation it hardly lies in the mouths of those who agree to it to assert that there was no realistic prospect of success. We do not of course assume that the mediation would have been successful, but we reject the idea that we should treat Coates' decision to withdraw from the process as simply an acknowledgement of the fact that they had agreed to something which was pointless. As I have already said, as far as we know the only reason the mediation was derailed was the insurance company's instructions. The mediator left the position open if there were any attempt to return to him. As far as we can see there was none. There were some further negotiations, but they did not involve the mediator himself.
19. The correspondence starting on 22nd January shows the solicitors for Coates asserting that they believed that their clients would succeed. The offer of a "drop-hands" settlement was rejected by Leicester, and then on 1st February Coates, asserting confidence that the claim would be unsuccessful, made an offer of £150,000 in full and final settlement of the claim inclusive of costs and interest. That, as we understood it, really meant no more than that there would be a contribution to costs. Indeed, that was how Leicester's solicitors viewed it, pointing out the offer was rejected because their client had already spent more than £150,000 on legal and expert fees.
20. So the case proceeded. Before judgment, on 22nd February 2002, this court gave its judgment in **Dunnett v Railtrack Plc** [2002] 1 WLR 2434. The costs in issue in **Dunnett** were the costs of an appeal only. The costs below did not enter into the discussion or judgment. The defendants who were successful in the appeal had refused to participate in alternative dispute resolution. They had not, as here, agreed to mediation and then withdrawn from it without giving any satisfactory explanation.
21. Although the defendants in **Dunnett** had successfully resisted the appeal and drew attention to offers made in settlement, their approach to the alternative dispute resolution was treated by this court as such that no order for costs should be made in their favour.
22. Brooke LJ, giving the only reasoned judgment, at paragraph 12 of the judgment quoted what he described as the helpful notes to the CPR r 1.4 in Civil Procedure, Autumn 2001, vol 1, and in particular this text: "*The encouragement and facilitating of ADR by the court is an aspect of active case management which in turn is an aspect of achieving the overriding objective. The parties have a duty to help the court in furthering that objective and, therefore, they have a duty to consider seriously the possibility of ADR procedures being utilised for the purpose of resolving their claim or particular issues within it when encouraged by the court to do so.*"
Brooke LJ went on: "... the parties themselves have a duty to further the overriding objective. That is said in terms in CPR r 1.3. What is set out in CPR r 1.4 is the duty of the court to further the overriding objective by active case management, ..."
23. When Coates sought permission to appeal there were discussions about the possible settlement of the appeal. It is unnecessary to relate the process by which permission was eventually given.
24. This appeal was listed for hearing on 10th December, and shortly before the hearing of the appeal there was some correspondence which can be fairly summarised as an offer by the solicitors acting for Coates, expressly made without instructions, to see whether a settlement could be achieved. This culminated in an offer, on instructions, which was withdrawn about a quarter of an hour after it had been received.
25. On 10th December, that is to say after the first day of the hearing of the appeal, there was notification to Leicester of a conditional fee agreement entered into between Coates and their solicitors.
26. Mr Sutcliffe relies on the decision in **Dunnett** and the facts which we have endeavoured to summarise in support of the contention that there should be no order for costs of trial and no order for the costs of the appeal. He has suggested in his written argument that somehow Coates took advantage of the process by submitting an over-lengthy and overdeveloped skeleton argument on appeal. But we simply record that as Coates did that without any application for an adjournment, we do not think that criticism should affect the decision.

27. It seems to us that the unexplained withdrawal from an agreed mediation process was of significance to the continuation of this litigation. We do not for one moment assume that the mediation process would have succeeded, but certainly there is a prospect that it would have done if it had been allowed to proceed. That therefore bears on the issue of costs.
28. Trying to achieve a fair balance to reflect the issue of mediation, the outcome of the case, the correspondence which we have looked at and endeavoured to summarise, we have come to this conclusion. As to the costs below, Leicester will pay the costs up to 1 st January 2002 but there will be no order for costs thereafter. As to the costs of the appeal, in our judgment they should follow the event. Therefore Leicester will pay Coates' costs of the appeal.
29. Next we come to a further application by Leicester for judgment debts to be paid by instalments. There are three different classes of debt. First, and perhaps most important, the sums already paid by Coates to Leicester in compliance with the court's order. Then there is Coates' counterclaim which is now successful and, finally, there are the costs which now follow the order that we have just made.
30. According to the latest statement from Mr Williams, a director of Leicester, supported by a letter from his accountants, Leicester is in a parlous financial situation. Plainly this judgment and its consequences will be, to put it neutrally, extremely damaging to its financial position. It is said that Leicester cannot afford to repay the sums now due to Coates and the likelihood is that the company's bank will call in the receiver unless an instalment order is made or agreed.
31. Mr Coles pointed out that this picture of a desperate financial situation is rather at variance with the impression given to this court when considering the application for permission to appeal, and in particular the support derived by Leicester from a letter from its bank. We do not propose to decide a jurisdiction issue. It seems to us that even if there were a discretion in the court to make an order for payment by instalments of the sums paid by Coates to Leicester under a court order, that should be ordered to be repaid in full at once. Coates should not be prejudiced by compliance with and obedience to an order of the court. They are entitled to have their money back forthwith. The question then for Coates, of course, is whether they might see fit to temper the wind to the shorn lamb and come to some agreement of their own with Leicester. That will depend, as has been made clear by Mr Coles, on Coates coming to the conclusion that Leicester's true position is brought clearly to their attention. Having seen exactly where Leicester stand financially, they will make their own decision. It is difficult to argue with that approach.
32. As to the counterclaim, it is not, in practical terms, of significance in this context. We do not propose to make an instalment order. What we shall do in relation to the costs is to say that they will have to be assessed, if not agreed, and during the time while they are being assessed or agreed the parties will have time to disclose in the case of Leicester, to investigate in the case of Coates, what the true financial position is. We shall therefore not make an instalment order in relation to the costs. We shall be open to make that order if an application is made on notice after costs have been assessed, if they are not otherwise agreed. Subject to the consent of the parties, it would be sensible for that decision to be reached by one member of this court rather than for us to try and reconstitute again.

JOHN SLATER Esq QC and STEVEN COLES Esq (instructed by Plexus Law, London WC2B 4JF) for the Appellant
ANDREW SUTCLIFFE Esq QC (instructed by Eversheds, Birmingham B3 3AL) for the Respondent