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**Datasheet for the decision
of 10 May 2019**

Case Number: T 0815/14 - 3.2.05

Application Number: 07114961.1

Publication Number: 2028403

IPC: F16L15/00, E21B17/042

Language of the proceedings: EN

Title of invention:

Threaded joint with high radial loads and differentially treated surfaces

Patent Proprietor:

Tenaris Connections B.V.

Opponent:

Vallourec Oil and Gas France

Relevant legal provisions:

EPC Art. 83, 56

RPBA Art. 12(4), 13(1), 13(3)

Keyword:

Sufficiency of disclosure (yes)

Allegation of public prior use submitted with the statement of grounds of appeal - abuse of procedure (no) - admitted (yes) - substantiated (no)

Inventive step (yes)

Decisions cited:

T 0017/91, T 0534/89, T 0211/90, T 0508/00, T 1914/08,
T 0443/09



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Case Number: T 0815/14 - 3.2.05

D E C I S I O N
of Technical Board of Appeal 3.2.05
of 10 May 2019

Appellant: Vallourec Oil and Gas France
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Decision under appeal: **Decision of the Opposition Division of the
European Patent Office posted on 5 February 2014
rejecting the opposition filed against European
patent No. 2028403 pursuant to Article 101(2)
EPC.**

Composition of the Board:

Chairman M. Poock
Members: T. Vermeulen
D. Rogers

Summary of Facts and Submissions

- I. The appeal lies from the decision of the opposition division to reject the opposition against European patent No. 2 028 403 (hereinafter: "the patent").
- II. During the opposition proceedings, the opponent raised the grounds for opposition according to Article 100(a) EPC 1973 (lack of novelty and lack of inventive step) and Article 100(b) EPC 1973.
- III. Oral proceedings were held before the board of appeal on 10 May 2019.
- IV. The appellant (opponent) requested to set aside the decision under appeal and to revoke the patent.
- V. The respondent (patent proprietor) requested, as a main request, to dismiss the appeal, or alternatively, to set aside the decision under appeal and to maintain the patent upon the basis of one of the auxiliary requests filed under cover of a letter dated 12 April 2019.
- VI. The documents referred to by the parties in the appeal proceedings include the following:

E2	US 2003/0102669;
E3	EP 1 296 088 A1;
E5	EP 0 713 952 A1;
E6	US 6 174 000 B1;
E7	EP 1 726 861 A1;
E8	"Fatigue resistant threaded and coupled connectors: the new standard for deep water riser applications" by Sches et al, 26th Conference on Offshore Mechanics and Arctic

Engineering held on 10-15 June 2007 in San Diego, California (US);

- E18 "Effects of Over-Torque on Stress Relief in Conical Threaded Connections" by Baragetti and Terranova, Journal of Mechanical Design, Vol. 126, 2004, pages 351-358;
- E25 Excerpt of API Standard 5B, August 1996, and page 2 of addendum 1, March 2004;
- E25a Excerpt of API Standard 5B, pages 26-29;
- E26 Invoice 90000287 of 24 April 2007;
- E27 Delivery confirmation of 6 April 2007;
- E28 Technical drawing ST-D 1001;
- E29 Technical drawing ST-D 1000;
- E30 VAM running book, reprint February 2003, pages 58-61 and 70-71;
- E31 "1.13 Graph Interpretation", page 45-47;
- E32 Tables "New VAM Technical Data" and "New VAM Torque Values";
- E33 Technical drawing ST-D 4201;
- E34 Written statement by Mr Laurent Gillot;
- E35 Liner bill of lading of 13 April 2007.

VII. Claims 1, 4 and 5 of the respondent's main request read (the feature numbering used in the impugned decision is retained and given here in square brackets):

"1. [A1] A threaded joint comprising a male threaded tube (2), defined as pin, and a female threaded tube (3), defined as box, [A2] the pin being provided with a first abutment shoulder (6), the box being provided with a second abutment shoulder (7), said first and second abutment shoulders having complementary shape, the pin (2) being adapted to be made up in the box (3), [A3] wherein an interference is provided between thread roots of either one of pin or box and thread crests of

the other one of pin or box [A4] measured according to the nominal dimensions of the pin and box, [A5] the value of the interference being comprised between 1% and 5% of the average thickness of the joint, [A6] wherein there is provided a root to load flank radius (R) having a value of around 1/4 of the thread height, and [A7] wherein the joint has a surface treatment comprising shot peening [A8] applied to the beginning and end of the threaded zone of the pin (2)."

"4. Make up method for a threaded joint having the features of claim 1, comprising the steps of:
a) [A11] inserting the threaded portion of pin into the threaded portion of box,
b) [A12] applying a torque for making up the pin in the box until first and second abutment shoulders abut,
c) [A13] applying an extra torque until a magnitude between 50% and 90% of the steel's yield strength in the most stressed part of the joint (1) is reached."

"5. Make up method for a threaded joint having the features of claim 1, comprising the steps of:
a) [A11] inserting the threaded portion of pin into the threaded portion of box,
b) [A12] applying a torque for making up the pin in the box until first and second abutment shoulders abut,
c) [A14] applying an extra torque of magnitude between 10% and 50% of the normal make up torque, defined by the manufacturers for each specific joint."

VIII. The arguments of the appellant are essentially as follows:

Sufficiency of Disclosure

(i) Average thickness of the joint

In paragraph [0018] of the patent description the average thickness of the joint was determined as the addition of the average thicknesses of pin and box. The thicknesses must be calculated on the basis of the nominal dimensions of pin and box before making up the joint. The parameters necessary to determine these nominal dimensions were however not available to the skilled person. The patent failed to contain values of the average thickness of the joint, of the external and internal diameters or of any radial or axial dimension of the joint. The pipe diameters given in paragraph [0019] did not suffice to calculate the average thicknesses. No discretisation rule was given on the basis of which the average should be calculated. It was also not clear whether the free, unthreaded ends of pin and box should also be taken into account when calculating the average thicknesses. Furthermore, the data given in paragraphs [0019] and [0028], both of which related to a pipe with an external diameter of 244mm, was contradictory: the average thickness deduced from the interference ratio of 3% and the absolute interference value of 370µm would be smaller than the thickness of 13.84mm. To add to the confusion, paragraph [0012] determined the interference with respect to the average thickness *of the pipe wall*. The skilled person does not know which values of "the other parameters" mentioned in paragraph [0020] would result in a contribution to the fatigue resistance. Similarly, the overlapping points on the graph shown on page 4 of the patent did not allow a conclusion on the benefit of the tests discussed in paragraph [0028] compared to conventional joints. The requirement of claim feature A5 therefore did not allow the skilled person to carry out the invention.

(ii) Abutment of shoulder

In view of the description in paragraph [0050] of the patent, the skilled person would not be able to arrive exactly at the point where the first and second abutment shoulders abut when trying to make up the joint by applying a torque in step b) of claims 4 and 5. Consequently, the claimed methods were not sufficiently disclosed for them to be carried out by a skilled person.

(iii) Most stressed part

According to a third objection in respect of sufficiency of disclosure, the skilled person would not be able to determine the end of step c) of claim 4, i.e. the moment when a magnitude between 50% and 90% of the steel's yield strength was reached in the most stressed part of the joint. As the part of the joint which experienced most stress during making-up changed during the process, it was not feasible to know at which point in time the final make-up position was reached. The feature looped over itself because the determination of the final position would depend on verifying whether the stress was within the limits in a most stressed portion, the location of which could only be established through a finite element calculation in that make-up position.

(iv) Normal make-up torque

The expression "normal make up torque" in feature A14 was objected to because it was not a recognised term in the art. The skilled person could not deduce from his common general knowledge how each manufacturer would proceed in order to calculate and fix the amount of

torque to be applied. As the threaded joint would be operational at the end of step c) of the method according to claim 5, the manufacturer would give the operators a single value for the torque to be applied, rather than a separate indication of the normal make-up torque and the extra torque. Therefore, the skilled person would not be able to determine whether the torque instruction set by the manufacturer already included the extra torque or not. In addition, claim 5 referred back to claim 1, which meant that the normal make-up torque applied to the threaded joint of claim 1. There was no indication that the skilled person could be manufacturer of a joint with the performance characteristics or the details of use of the claimed joint. A joint of this type did not exist on the market at the date of priority. There was also no manual available for such a joint. The description of the subject-matter of claim 5 was therefore insufficiently described.

Alleged Public Prior Use

Documents E26-E30 were submitted as evidence in support of public prior use titled "NEW VAM". They were filed in reaction to the doubts expressed for the first time during the oral proceedings before the opposition division concerning the presence of claim feature A3 in the joint disclosed by document E2. The appellant was taken by surprise by the position of the opposition division and filed the new evidence at the earliest possible opportunity, namely with the grounds of appeal. The prior use was proof that joints of the type shown in document E2 had been on the market for at least twenty years before the priority date.

In response to the communication of the board, further documents E33-E35 were filed to remove any remaining doubt that the NEW VAM joint was made available to the public.

The public prior use was sufficiently substantiated and proven. The NEW VAM joint was developed by the appellant and had been sold and widely distributed since 1985. This was shown by the invoice E26 and the delivery confirmation E27. Proof of the delivery was given by the bill of lading E35, which indicated that 692 parts with a total weight of more than 43 tons were shipped to Abu Dhabi well before the priority date of the patent. From the different order numbers, the number of items and the total weight it was clear that the same order was referred to in documents E26, E27 and E35. Also the link between the invoice and the technical drawings was proven. Drawing E33 differed from drawing E28 in that the interior profile of the tubing was slightly modified. The title "NEW VAM TUBING 2 3/8" of drawing E33 referred to the type and the diameter of the joint. The presence of special drift was also mentioned in the title box. The weight "4.60 lb/ft" was given in the first column of the table included in the drawing E33. Therefore, the drawing E33 corresponded to the tubing referred to on page 2/3 of the invoice E26, where the "L80 Type 1" indicated the type of steel used, the "Special Range (30,00 ft - 31,00 ft)" related to the length of the tubing and the "Special Drift 1,910" corresponded to the drift value of E33. Through the reference to the drawing number "ST-D 1000" in the text above the title box of E33, the link with document E29 was established. The last revision of drawing E33 took place in 1997. In view of the difficulty to realise these types of products, no more changes were carried out after the design was

tested and validated. The written statement E34 certified that the drawings submitted by the appellant corresponded to the tubings sold as per documents E26 and E27. The VAM Running book E30 was a commercial document given by the appellant to its clients. Some of the angles visible in drawings E28 and E29 were also shown in the figures on top of page 58 of document E30. The delivery of a large number of tubings proved that no secrecy agreement existed. The confidentiality clauses on drawings E28, E29 and E33 merely demonstrated that the content of the drawings themselves was confidential and could not be reproduced without permission.

Inventive Step

i) Starting from document E2

The best starting point for assessing the inventive step of claim 1 would be document E2. It concerned the same technical field as the patent and was directed to the same effect as the patent, i.e. to improve resistance to fatigue. Paragraph [0004] of document E2 described a conventional API buttress-type thread following the standard 5B. The comments and dimensions on figures 5 and 6 of document E25 implied that such API threads only have radial interference between the crests and roots, in accordance with claim feature A3. Because of the word "conventional" in paragraph [0005], the joint of the embodiment of figure 2 also comprised such a thread, albeit in combination with an axial abutment. This was confirmed by Table I of document E2, according to which a "trapezoidal thread" was used in the tests, which corresponded exactly to the trapezoidal shape of the buttress-type thread of the API 5B standard. This view was also supported by

document E6, where figure 11 showed a root-to-crest interference and where column 3, lines 22-31 describing the trapezoidal threads of figures 9-11 referred to API standards. Furthermore, according to paragraph [0055] of document E2 the amount of interference was adjusted by varying the effective diameter of the thread. Hence, claim feature A3 followed directly and unambiguously from the disclosure of document E2. A value of the interference of between 1.1% and 2.6% could be deduced from Table II, so that also claim features A4 and A5 were disclosed.

In order to improve the resistance against fatigue of the joint, in particular at the thread bottom, the skilled person would turn to document E7, which dealt with fatigue fracture strength (paragraph [0009]). Document E7 described buttress-type trapezoidal threads of a joint as in document E2 with identical nominal dimensions and with an abutment shoulder (paragraphs [0029], [0030] and [0042]). Hence, the disclosure of document E7 was compatible with that of document E2. In order to improve fatigue resistance, document E7 proposed to apply shot peening along the entire length of the thread (paragraphs [0014], [0015] and [0026]), which covered the beginning and the end thereof. The size of the micro-particles used for shot peening was determined in function of the surfaces that were treated. Paragraphs [0008] and [0009] also indicated that API buttress threaded joints of the type shown in figure 7 should be improved, a particular importance being attributed to the threaded bottom corner curved part. The teaching of document E7 was therefore not only to apply shot peening but also to enlarge the radius of curvature of the standard API joint from the value of 0.2mm in figure 7 to the value of 0.4mm shown in figure 2, the latter corresponding to a ratio of

around 1/4 with respect to the thread height. Although a different radius might change the axial extension of the contact, it would not affect the amount of interference of the thread, which was defined in terms of the nominal dimensions of the joint only. There could be no synergy between the features A3 and A6. In this context, the second paragraph in the right column on page 4 of document E8, which disclosed a joint with root-to-crest interference, merely confirmed that there was no incentive to change the interference when the radius of curvature modified. It was further emphasised that the size of the particles used in the patent fell within the micro-particle range disclosed in document E7. The skilled person would therefore apply the teaching of document E7 to the joint of E2 and implement claim features A6, A7 and A8 without any inventive activity.

ii) Starting from document E6

Figure 4 of document E6 showed a threaded joint with abutment shoulders, as in claim features A1 and A2. Regarding claim features A3-A5, the description of figure 1 in column 4, lines 15-16 of document E6 was referred to, as well as Table 1 and claim 1, from which values of the radial interference could be calculated for different sizes of the tubing. According to figures 8-9 API buttress-type threads were used, which were known to have root-to-crest interference. The root-to-load-flank radius in figure 6 had a value of 21%. This must be around 1/4, as the variation of R with respect to the value of 1/4 was calculated to amount to $\pm 8\%$ based on the absolute values of R given in claim 2 of the patent. Therefore also claim feature A6 was known.

The objective technical problem was to improve the fatigue resistance of the joint. The skilled person would turn to document E7 and opt to apply a surface treatment comprising shot peening on the thread surface of document E6, both to the beginning and to the end of the threaded zone. Hence, claim 1 was not inventive.

iii) Starting from document E7

Based on the disclosure in figure 11 of document E6, it was clear that the API buttress-type thread of example 3 of document E7 had a root-to-crest interference. Example 3 also disclosed an abutment shoulder. In view of the fact that the broad expression "around 1/4" of claim feature A6 in combination with the absolute values for R mentioned in the patent set a range of between 10% and 40% around 1/4, the root-to-load-flank radius shown in figure 7 of document E7 was considered to have a value of around 1/4 of the thread height. This meant that claim features A1-A4, A6 and A7-A8 were all known from document E7.

Apart from the fact that document E25 disclosed that the value of the interference of API buttress-type threads lay within the range of claim feature A5, the skilled person would also arrive at these values based on paragraph [0016] of the patent. Therefore, claim 1 did not involve an inventive step when starting from document E7.

IX. The respondent's arguments may be summarised in the following manner:

Sufficiency of Disclosure

(i) Average thickness of the joint

As the appellant had indicated how the skilled person would calculate the average joint thickness from prior art technical drawings when assessing the inventive merit of claim 1, the invention must be sufficiently clear and complete to be carried out. Paragraphs [0019] and [0028] of the patent referred to different joints so that the data in these paragraphs could not be combined. Proof therefor was given by document E32, an excerpt from the 2001 edition of the VAM running book. The table on page 64 showed the respective wall thicknesses for different nominal weight values associated with the outer diameter of 244mm (9 5/8 inch). The thickness 13.84mm corresponded to the value given in paragraph [0028], but was associated with a different nominal weight (53.50 lb/ft) than the value 36 lb/ft given in paragraph [0019].

(ii) Abutment of shoulder

On the basis of document E31, another excerpt from the 2001 edition of the VAM running book, it was clearly well-known in the technical field of thread joints to interpret make-up graphs and recognise the different points referred to in figure 3 of the patent. The skilled person would therefore be in a position to detect the point where the first and second abutment shoulders abut during the make-up procedure.

(iii) Most stressed part

The person skilled in the art was a joint designer rather than an operator that carried out the make-up operation. As the make-up procedure was defined at the design stage, all values of stress in all points of the

joint were known, as well as the stress values resulting from incremental torque increases. An academic study from an Internet website was cited in support of the argument that the analysis of stress distribution in a joint for a specific load was a common activity of a joint designer, who would therefore be in a position to determine the most stressed part and compare the magnitude of the stress with the yield strength.

(iv) Normal make-up torque

In document E18 the expression "nominal torque" was used. The tables of document E32 were referred to as evidence that for every type of joint an optimal value of torque was known to be applied at make-up. The well-recognised term "nominal torque" was identical to the "normal torque" of the patent. Contrary to what is required by the Guidelines F-III, 1, no substantiated facts were submitted in support of the objection of lack of sufficient disclosure. The search examiner, the examining division and the opponent/appellant were able to judge the relevance of the prior art in view of the claims of the patent.

Alleged Public Prior Use

The documents filed in support of the alleged public prior use should not be admitted into the procedure. They related to activities of the appellant, which the respondent had no possibility of verifying. The actual pipes were inaccessible to anyone and the drawings were confidential. The strict criterion "beyond any reasonable doubt" should therefore be applied by the board. There was no proof that a member of the public had ever seen the pipes and the joints. The submission

at such a late stage should be considered as an abuse of the procedure. The case law cited on pages 828-830 of the Case Law of the Boards of Appeal, edition 2013, IV.C.1, point d) (i) was referred to, in particular decisions T 17/91, T 534/89, T 211/90, T 508/00, T 1914/08 and T 443/09. Furthermore, the prior use did not appear *prima facie* relevant as its content seemed to be of the same importance to the procedure as the content of document E2.

The product name "NEW VAM" in the invoice E26 did not exclude that the product had developed through time. For reasons of brand loyalty it was common to keep the same name despite changes to a product. Document E27 merely indicated that something would be shipped in the future. The bill of lading E35 only proved that some items were on board of the ship, not that they were actually delivered. If a large quantity of items were actually sold, more information about the sale would have been expected. Technical drawings E28, E29 and E33 were confidential and were dated respectively 14, 13 and 10 years before the alleged sale of the NEW VAM pipes. There was no certainty at all that the drawings were related to the sale and that the threads of drawing E29 were actually those machined on the NEW VAM joints that were allegedly shipped to Abu Dhabi. Nor was it clear whether the dimensions of the drawings, which were not available to the clients, were left unchanged in the interim. The publication E30 showed that various different models of the NEW VAM joints existed. The written statement E34 was from the hand of an employee of the appellant. The events discussed therein dated too far back to remember them. It was thus *prima facie* not clear what was disclosed, when it was disclosed and how it was disclosed. A public prior

use based on the sale of NEW VAM joints was therefore not sufficiently demonstrated by the appellant.

Inventive Step

i) Starting from document E2

There was no link in document E2 between the thread type of figure 1 and the threads used in the abutment-type joints shown in figures 2 and 3. The mere mention of "conventional" in paragraph [0005] did not provide such a link. The API standard referred to in paragraph [0004] as well as the joint shown in figure 6 of document E25 related to a joint without a torque shoulder, contrary to the joint of figures 2 and 3 of document E2, which did not necessarily require any interference. A reference to the API standard did not necessarily entail that API STD5B was meant. Figures 8-11 of document E6, for example, merely referred to the API Standards. The presence of an abutment shoulder considerably affected the stress field of the joint. Document E25a was an excerpt of the same API STD 5B and showed different types of conventional threads. From a reading of document E2, in particular paragraphs [0023], [0043] and [0055] the interference T could not be directly and unambiguously understood as acting between thread roots and thread crests. The joints disclosed by documents E5, E3 and E6 had threads with flank-to-flank interference also defined by reference to the pitch lines of the threads. Therefore, the subject-matter of claim 1 differed from document E2 by claim features A3 to A8. The problem of improving fatigue strength was not discussed in document E2.

Document E7 disclosed features A6, A7 and A8 in different contexts and their combination could not be

made without hindsight. The document described three different examples. Example 1 disclosed feature A6 without explaining for which type of joint the pin should be used. Example 2 failed to disclose features A6 and A8. Example 3 dealt with a joint with buttress-type thread and some kind of shoulder, without disclosing feature A6. Nowhere in document E7 was there any teaching that a thread with feature A6 would contribute to the improvement of fatigue life. Nothing was said about the possible importance of the value of the root-to-load-flank radius with respect to the thread height. Figure 2 was not linked to figure 7. Rather, figure 7 was cited to show that conventional shot peening did not reach the critical points of a thread design. As a solution, the document taught that the particles used for shot peening should be smaller. The skilled person would not cherry-pick from different parts of the document. He would not isolate the radius of curvature from figure 2, from which no interference or abutment could be concluded, and apply it to the thread of document E2. This was not necessary as the smaller particles would reach all the critical points anyway, no matter how small the conventional radius of curvature was. In addition, in figure 2 micro-shot peening was applied on one end portion with imperfect threads. This was clear from the mark "X" in figure 1. Hence, claim features A3, A6 and A8 were not disclosed in combination by document E7. A combination of features A3 and A6 would also be far from obvious, as an increased radius of curvature would reduce the area of contact at the thread root, so that the contact pressure would increase and the probability of galling and fatigue microcracks become more probable. For those reasons, claim 1 involved an inventive step over document E2 in view of document E7.

ii) Starting from document E6

The appellant was mistaken in making a correlation between the mention of interference and the mention of a buttress-type thread in document E6. The thread shown in figure 6 of E25 was just one example of a joint without abutment shoulder according to the API standards. The radius of curvature of figure 6 of document E6 differed by 20% from the value corresponding to 1/4 of the thread height. Document E6 failed to disclose claim features A3 to A8. These missing features were not disclosed by document E7 so that the impugned decision was right in concluding that claim 1 had an inventive step over document E6 in view of document E7.

iii) Starting from document E7

As document E2 did not disclose any interference between crests and roots and did not refer to the problem of fatigue life, document E7 was a more appropriate starting point for assessing inventive step. In example 3 a joint with API thread and an abutment shoulder was described in the context of improving the fatigue life. As no other state of the art document at hand hinted to the solution proposed in the patent, claim 1 would be inventive.

Reasons for the Decision

1. *Sufficiency of Disclosure*

The objections raised by the appellant can be divided into four groups.

1.1 Average thickness of the joint (claim feature A5)

According to paragraph [0018] of the description of the patent in suit, the average thickness of the joint is determined as the addition of the average thicknesses of pin and box. The appellant is correct in stating that the pipe diameters and the corresponding interferences given in paragraph [0019] alone are not sufficient to calculate the average thicknesses of pin and box. The board nevertheless judges that the person skilled in the art when designing a threaded joint for a pin and a box cannot have any problems in determining the average thickness of the pin and box and, hence, of the joint. In the absence of a detailed method to determine the average, the skilled person is nevertheless able to calculate the arithmetic mean of the maximum and minimum thickness values.

Furthermore, the board finds the arguments of the respondent relating to the difference in values between paragraphs [0019] and [0028] convincing. From a reading of document E32, it would seem that the wall thickness of paragraph [0028] of the patent, albeit associated with a pipe having the same outer diameter as the one of paragraph [0019], would apply to a joint with a different nominal weight than the joint referred to in paragraph [0019].

The requirement in paragraph [0012] of the patent that the interference is comprised between 1% and 5% of the average thickness *of the pipe wall* is clearly erroneous. The skilled person would have sufficient information in the patent as a whole (paragraphs [0018], [0027] and claim 1) to carry out the invention, namely by fixing the value of the interference on the basis of the average thickness of the joint.

The parameters mentioned in paragraph [0020] are merely contributing factors that help, in addition to the values of interference, in maintaining the stresses in the joint under control. As indicated by the "etc" at the end of the paragraph, the list of parameters is not exhaustive. Neither the lack of concrete values for any of those parameters nor the inconclusive graph on page 4 of the patent would be a hurdle for the person skilled in the art to carry out the invention.

1.2 Abutment of shoulders (claim feature A12)

Curve 11 in figure 3 of the patent illustrates that a sharp increase in resistance is experienced at point "d" during the make-up procedure. This corresponds to the "energisation" of the abutment shoulders 6 and 7, i.e. the conversion of the input torque in elastic energy stored in the joint, cf. paragraphs [0049] and [0050] of the patent. The change in slope leads to a substantially increased resistance and will therefore indicate to the person making up the joint that the abutment shoulders of pin and box have come into contact. In reality, the torque curve will not have the abrupt change in slope shown by the simplified graph of figure 3 but a gradual transition. The abutment of shoulders is then typically determined according to a standardised rule, as explained on page 47 of document E31.

The board is therefore convinced that the skilled person will be able to determine the end of step b) of claims 4 and 5.

1.3 Most stressed part (claim feature A13)

In view of the detailed description in paragraphs [0049] to [0051] of the patent, the board understands the wording "*applying an extra torque until a magnitude ...*" in step c) of claim 4 as referring to the torque that is applied after the completion of step b). This "extra torque" corresponds to the segment d-e-f of curve 11 in figure 3 of the patent, whereby the curve segment d-e represents the customary make-up beyond the point where the first and second abutment shoulders abut until a stress of about 50% of the yield strength is reached and whereby the segment e-f represents an additional make-up beyond the customary make-up.

For establishing whether a patent discloses the invention in a manner sufficiently clear and complete for it to be carried out, the skilled person may use his common general knowledge to supplement the information contained in the patent or to overcome the lack of guidance therein (cf. Case Law of the Boards of Appeal of the European Patent Office, 8th edition 2016, II.C.3.1).

The board concedes that no guidance can be found in the patent about the location of the most stressed portion in the threaded joint nor about the point in time at which the desired result "*...until a magnitude between 50% and 90% of the steel's yield strength in the most stressed part of the joint*" is reached in the make-up process. The appellant argues that the operator in charge of making-up the joint would in theory need to investigate for each incremental increase of the torque which part of the joint experiences the most stress and whether the maximum stress value in that part lies within 50 to 90% of the yield strength, in order to complete the method step c) of claim 4.

In practice, threaded joints in the hydrocarbon industry are made up by means of power tongs controlled by computer programs which are fed with data provided by the joint designer, cf. paragraphs [0027], [0055] and [0056] of the patent. Therefore the skilled person in the present case will be considered as a group of people including not only the operator responsible for assembling the tube string but also the engineer who designs the threaded joint, and possibly also the supplier of the power tong.

As laid out in paragraph [0053] of the patent, the design engineer will pre-estimate, modelize and simulate optimal make-up parameters for each type of commercial joint. In order to carry out the simulation he will have recourse to a finite-element analysing tool that can accurately map the stress field in the entire joint on the basis of the geometrical data of the joint, its material and the estimated operative load conditions. As the design engineer knows that the highest load concentrations for a threaded joint with an interference between thread roots and thread crests tend to occur either near the thread roots or at the torque shoulder, he will take particular care that the results in those parts of the joint are more accurate, for example by locally refining the finite element mesh. By changing the operative load conditions in the simulating environment, the magnitude of the stress can be monitored as a function of the relative positions of pin and box. In doing so, the onset of plastic deformation during make-up can be avoided.

Having established which joint design yields the best results, the design engineer will then test the design in full scale and, where necessary, repeat the numerical analysis in a series of iterative steps, cf.

paragraph [0054] of the patent. With the validation of the optimised threaded joint, also the method of making up the joint will be fixed, so that the power tong can be programmed to carry out a precise number of turns at a certain make-up speed with a predetermined torque value per turn. At the end of the make-up process initiated and supervised by the operator, the action of the power tong is stopped at a position where a stress with a magnitude larger than 50% and smaller than 90% is reached in the most stressed part of the joint, corresponding to the optimal value determined in the design process.

The argument of the appellant that the position of the most stressed portion evolves during make-up is acknowledged by the board. This is nevertheless common in the design stage, where a work model (a threaded joint) with estimated parameters (an estimated final make-up position) undergoes simulation in a first stage and is iteratively adapted in subsequent stages in response to the evaluation of the simulation results of the preceding stage. As soon as the predetermined stress conditions are reached, the iterative process is stopped, the design loop is interrupted and the final make-up position of pin and box is fixed. In practice, this corresponds to an exact number (and fractions) of turns through which the power tong will rotate the pin relative to the box.

1.4 Normal make-up torque (claim feature A14)

According to paragraph [0056] of the patent the "normal torque" or "maximum nominal make up torque" defined by the manufacturers for each joint corresponds to the ordinate of point e of curve 11 in figure 3, i.e. the

final make-up torque applied according to customary practice of known make-up methods.

The design engineer deciding on the method of making up the joint (cf. point 1.3 above) will be guided by the example given in paragraph [0051] of the patent, according to which "customary make up operation achieves a final torque which produces loads of about 50% of the yield strength". Iterative simulations carried out on the threaded joint of claim 1 will reveal at which magnitude of torque loads of about 50% of the yield strength are reached in the joint. Once this normal make-up torque is determined, the magnitude of the extra torque can be calculated as a value between 10% and 50% thereof. By programming the power tong correspondingly, step c) of claim 5 can be carried out.

The board acknowledges that there is some confusion in the use of the term "extra torque" when reading claims 4 and 5 in the light of the description. Paragraphs [0049], [0051] and [0056] define the extra torque as the " Δ -torque" corresponding to the curve segment e-f in figure 3, which is applied at the end of customary make-up. Claims 4 and 5, on the other hand, omit the step of applying the customary make-up and jump from the abutment torque immediately to the extra torque. Nevertheless, these contradictions are a matter related to Article 84 EPC rather than to sufficiency of disclosure.

The skilled person is given a clear guidance in paragraphs [0051] to [0056] of the patent how to carry out the method of claim 5.

1.5 In view of the above, the board judges that the invention is disclosed by the patent in a manner sufficiently clear and complete for it to be carried out by a person skilled in the art (Art. 100(b) EPC 1973).

2. Alleged Public Prior Use

2.1 Admittance of documents E26-E30 and E33-E35

2.1.1 Article 12(4) of the Rules of Procedure of the Boards of Appeal (RPBA, cf. Supplementary Publication 1 to the Official Journal of the EPO 1/2018, 41 ff) requires the board to take into account everything presented by the parties under Article 12(1) RPBA if and to the extent that it relates to the case under appeal and meets the requirements of Article 12(2) RPBA. However, it lies within the discretion of the board to hold inadmissible facts, evidence and requests which could have been presented or were not admitted in the first instance proceedings.

According to the established case law, a filing made with the statement of grounds of appeal should not be considered inadmissible if it is an immediate and appropriate reaction to developments in the previous proceedings. It is legitimate for an appellant who lost the opposition proceedings to try to improve its position and fill the gaps in its arguments by presenting further evidence on appeal (cf. Case Law of the Boards of Appeal of the European Patent Office, 8th edition 2016, IV.C.1.3.6).

2.1.2 In the statement setting out the grounds of appeal, the appellant argued that it was only in the oral proceedings before the opposition division that for the

first time doubts were expressed concerning the presence of claim feature A3 in the joint disclosed by document E2. Hence, documents E26-E30 could not have been filed earlier. The appellant stated it was taken by surprise by the position of the opposition division and filed the new evidence in the form of documents E26-E30 at the earliest possible opportunity, namely with the grounds of appeal.

- 2.1.3 From the submissions made in the opposition proceedings it appears that the respondent had assumed with the appellant that claim feature A3 was at least implicitly disclosed by document E2 (cf. page 10 of the letter dated 20 June 2012). The communication dated 18 September 2013 sent in the annex to the summons for oral proceedings implies that this view was shared by the opposition division. Point 4.1.2.2 on page 7 of the minutes of the oral proceedings before the opposition division reveals that the respondent changed its position regarding claim feature A3 during the oral proceedings, which led the opposition division to conclude that document E2 failed to disclose claim feature A3.

In view thereof, the board sees no reason to doubt the argument of the appellant that it was caught unawares by the change of opinion of the opposition division. The presentation of the late-filed documents E26-E30 with the statement setting out the grounds of appeal, i.e. at the earliest possible moment in the appeal proceedings, therefore represents an immediate reaction to developments in the previous proceedings.

- 2.1.4 The appellant has also argued that the alleged public prior use showed that joints of the type shown in document E2 had been on the market before the priority

date since at least twenty years. By filing documents E26-E30 it is demonstrated that claim feature A3, which is clearly disclosed in technical drawing E28, is implicitly disclosed in document E2. The belated filing is therefore seen as an attempt to counter the newly emphasised reason given in point 4.1.4 of the impugned decision.

Strictly speaking, the evidence in support of a public prior use concerning activities that lie in the sphere of the appellant could have already been filed with the notice of opposition. The appellant has nevertheless credibly argued that it had no reason to file the evidence until the opposition division changed its assessment of document E2.

For those reasons the board considers the filing of these documents to be a reasonable and appropriate response to the reasons given in the decision under appeal.

- 2.1.5 Documents E33, E34 and E35 were filed in response to the communication pursuant to Art. 15(1) RPBA, in which the board raised doubts concerning the alleged public prior use.

According to Article 13(1) RPBA, any amendment to a party's case after it has filed its grounds of appeal or reply may be admitted and considered at the board's discretion. The discretion shall be exercised in view of inter alia the complexity of the new subject-matter submitted, the current state of the proceedings and the need for procedural economy. Article 13(3) RPBA additionally requires that amendments sought to be made after oral proceedings have been arranged shall not be admitted if they raise issues which the board or the

other party or parties cannot reasonably be expected to deal with without adjournment of the oral proceedings. The three documents E33-E35 were advanced as missing links in an attempt to complete the chain of arguments given in support of the alleged public prior use with the statement setting out the grounds of appeal. The board is satisfied that the belated filing is an immediate reaction to the deficiencies identified in point 8.2 of the board's communication. In particular, the technical drawing E33 and the written statement were filed with the aim of corroborating the link between the technical drawing E29 and the invoice E26, whereas the bill of lading E35 was presented as a further proof of the delivery of the products to the client. The documents are short and do not appear to raise any complex substantive questions.

- 2.1.6 The respondent considers the belated filing of the documents in support of the alleged public prior use an abuse of the procedure. In support of this allegation, he cites some of the decisions listed in chapter IV.C. 1.3.17 point a) of the 8th edition (2016) of Case Law of the Boards of Appeal of the European Patent Office.

The following is noted by the board in respect of the cases underlying these decisions:

The deciding board in T 17/91 (26 August 1992, Headword and Reasons 5) found that an assertion of public prior use, based on the opponent's own activities and submitted after the expiry of the opposition period and in the absence of good reasons for the delay, represented an abuse of the proceedings.

Decision T 534/89 (OJ 1994, 464, Reasons 2.5 and 2.7) addressed the allegation of a public prior use filed for the first time with the statement setting out the grounds of appeal. In view of the fact that the information about the prior use was available to the appellant before expiry of the period for opposition and that it was a deliberate choice not to raise this issue in the opposition proceedings, the deciding board found a manifest abuse of procedure and refrained from admitting the evidence.

In T 211/90 of 1 July 1993 (cf. Reasons 1.2) a prior use was alleged for the first time four weeks before the oral proceedings. A change of representative and an interpretation of the claim by a national court during parallel infringement proceedings were not found to be valid reasons for the late filing.

In the case underlying T 508/00 (29 June 2004, Reasons 5.2), a document filed with the notice of appeal in support of a prior use was not admitted. The poor communication with the subsidiary companies in the USA was not found to be a convincing argument for the belated filing.

In reaction to the statement setting out the grounds of appeal in T 1914/08 (13 October 2011, Reasons 2), the respondent had announced that further documents would be filed in support of a prior use submitted before the opposition division and considered proven in the impugned decision. The document in question was filed only two years later shortly before the oral proceedings in appeal,

allegedly on account of financial difficulties in the interim period.

In decision T 443/09 of 16 June 2011 (Reasons 2.3), the appellant argued that a document in support of a prior use presented for the first time in appeal could not have been filed before because of difficulties in retrieving documentation in a large company. The board judged that such difficulties form a self-created situation lying entirely within its own sphere of responsibility, which is not a reason to justify the admission for the late-filed documents purportedly showing a prior use.

Unlike the above cases, the appellant in the present case has credibly laid out sound reasons for filing the evidence at the beginning of the appeal stage, namely a surprising change in opinion of the opposition division at the end of the opposition proceedings. In the present case, nothing indicates that the appellant was deliberately withholding information or postponing the filing for tactical reasons.

The board therefore sees no abuse of the procedure in the submission of documents E26-E30 and E33-E35.

2.1.7 In view of the above, the board exercises its discretion under Article 12(4) RPBA and Article 13 RPBA to admit documents E26-E30 and E33-E35 in the proceedings.

2.2 Substantiation

2.2.1 Where an objection based on an alleged public prior use is disputed and all the evidence lies essentially within the power and knowledge of the opponent, the

applicable standard of proof established by the case law of the boards of appeal is "beyond any reasonable doubt" (cf. decisions cited in Case Law of the Boards of Appeal of the European Patent Office, 8th edition, 2016, III.G.4.3.2).

2.2.2 Turning to the case at hand, the public prior use allegedly concerns the sale by the appellant in 2007 of seamless tubings of the "NEW VAM" type to the company ADCO in Abu Dhabi (UAE). According to the appellant, the proof that the NEW VAM products were made available to the public before the priority date is given by the invoice E26, the delivery slip E27 and the bill of lading E35.

E27 appears to be a document issued by a logistics company SDV on 6 April 2007, providing information on the planned freight shipment from the port of Antwerpen with estimated time of arrival (ETA) at the destination Abu Dhabi on 27 April 2007. Similarly, the bill of lading E33 is dated weeks before the expected arrival of the ship. Also the invoice E26 predates the actual delivery. No proof has been given that the pipes were transported and shipped in such a way that the threaded parts of pins and boxes were open to inspection by third parties. Nor did any of the documents provide evidence that the pipes were actually delivered to the client in Abu Dhabi before the priority date of the patent. In addition, none of the documents E26, E27 and E33 actually disclose the technical features of the products being shipped.

2.2.3 The technical details of the products referred to in the invoice E26 are allegedly shown by technical drawings E29 and E33. Page 2/3 of the invoice E26 describes them as follows:

Seamless Carbon Tubing as per API 5CT
2 3/8 x 4,60 lb/ft L80 type 1 NEW VAM SB 20°-
CHANFREINES 20° Special Range (30,00 ft - 31,00 ft)
Special Drift 1,910 ".

The title NEW VAM TUBING 2 3/8" of drawing E33 suggests that a similar type of tubing is concerned. The presence of special drift is also mentioned in the title box ("Drift Special") of the drawing E33 and the weight 4.60 lb/ft is given in the first column of the table included in the drawing. The explanation given by the appellant regarding the meaning of the specifications "L80 Type 1" (type of steel), "Special Range (30,00 ft - 31,00 ft)" (length) and "Special Drift 1,910" (a detail of the inner wall) seems cogent and is not disputed by the respondent. In view of the reference to the drawing number "ST-D 1000" in the text above the title box of E33, there seems to be no doubt as to the link with technical drawing E29.

However, the documents on file leave open whether the NEW VAM tubing of drawing E33 is identical to or merely similar to the tubing described in the invoice E26. Technical drawings E29 and E33 were produced 22 resp. 14 years before the order of E26 was placed. From the revision block in the title box it follows that the drawings were revised 13 years resp. 10 years before the alleged sale. The question therefore arises whether the drawings underwent any further updates reflecting modifications of the depicted components in the time period up to the manufacture of the tubings that were shipped to Abu Dhabi.

2.2.4 Document E30 is an excerpt of a VAM Running book reprinted in 2003. Whether this commercial document or

a later reprint was handed to the client in Abu Dhabi before the priority date of the patent is unknown. Nor is it clear in how far the excerpt is related to the tubing of technical drawing E33 or to the thread of technical drawing E29. Page 59 of document E30 teaches that different NEW VAM pin and box tubings existed at the time of writing. As the details of the figures on top of page 58 are not clearly recognisable, a link with the technical drawings cannot be established.

The written statement E34 contains a declaration signed by an employee of the appellant responsible for the documentation in the company since 2012, i.e. five years after the alleged sale. Apart from its low probative value, nothing in the statement links the technical drawings E28, E29 and E33 to the sale alleged by documents E26, E27 and E35.

2.2.5 In conclusion, the board judges that it has not been shown beyond any reasonable doubt that the alleged public prior use related to the appellant's own activities had taken place prior to the priority date of the patent.

3. Inventive Step

3.1 Starting from document E2

3.1.1 Figure 3 of document E2 shows a threaded joint consisting of a male threaded pin 11 and a female threaded box 20. A first abutment shoulder 13 formed at an axial end of the pin and a second abutment shoulder 23 on the inner surface of the box have a complementary shape. The threaded joint is made up by inserting the threaded portion 12 of the pin into the threaded portion 22 of the box. Hence, claim features A1 and A2

are known from document E2. This is not disputed by the parties.

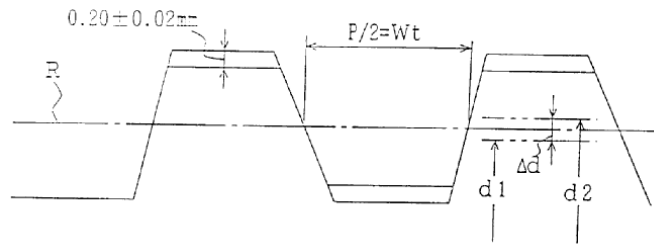
There is also agreement between the parties that claim features A6, A7 and A8 are not disclosed by document E2.

The board does not see any reasons to deviate from these conclusions.

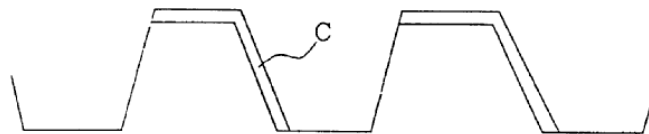
3.1.2 The threaded portions 12 and 22 of the joint have an amount of interference T expressed in mm (cf. paragraphs [0015] and [0035]). In order to determine the effect of the interference on the stress corrosion in the joint, paragraphs [0054] until [0061] of document E2 describe a series of tests that were carried out with interferences varying between 0.219 mm (test sample 1) and 0.519 mm (test sample 8). With an outer diameter $D3$ of 194.33 mm and an inner diameter $D1$ of 154.78 mm taken from Table I and schematically shown in figure 3, the average thickness of the joint must be $(D3-D1)/2 = 19.78\text{mm}$. This means that the interferences of the eight test samples amount to 1.1%, 1.5%, 1.6%, 2.1% and 2.6%, respectively, of the average thickness of the joint. Each of these values lies well inside the range claimed in claim feature A5.

3.1.3 Nonetheless, document E2 fails to disclose which type of interference is present in the threads of the respective test samples, i.e. how the threaded portions 12 and 22 interfere with each other. Table 1 indicates that the threaded joint used in the tests has a trapezoidal thread shape. Trapezoidal threads on a pin can either interfere with trapezoidal threads on a box through contacting flank surfaces or they interfere through mutual contact between the roots of one thread

and the crests of the other thread. The flank-to-flank interference (shown in the figure below) can be found



in figures 1 and 3 of document E3, in figures 3, 4, 6 and 8 of document E5 and in figures 1 and 6 of document E6. Essentially, a clearance is left between the crests and the roots. In the alternative case of root-to-crest interference the axial gap between the flanks of a valley is larger than the width of the teeth so that the crests and the roots come into contact with each other before the flanks do. This is for example shown in figure 10 of document E6 reproduced below.



In both interference types, the degree of interference is typically controlled in the design phase by setting the effective diameter of the thread on the pin with respect to the effective diameter of the thread on the box. Therefore, contrary to the assertion of the appellant, the wording "varying the thread effective diameter" in paragraph [0055] of document E2 does not permit to conclude which type of interference is used.

The board concurs with the respondent that the details of the prior art joint according to figure 1 of document E2, and in particular the mention of "a buttress type having a trapezoidal thread prescribed by STD5B of the API (American Petroleum Institute)

standards" in paragraph [0004], are not automatically transferable to the threaded joints of figures 2 and 3. Unlike figures 2 and 3, figure 1 shows a threaded joint of the type that does not have an abutment shoulder. Its construction and stress field is therefore substantially different compared with the joints of figures 2 and 3, on which the tests of Table 2 were carried out. Therefore, irrespective of the question what kind of interference takes place in conventional API STD5B threads, the information in paragraph [0004] does not imply that the threaded joints of figures 2 and 3 also have a buttress-type thread according to the API standard.

Moreover, the board is not convinced that the specification "thread shape - trapezoidal thread" in Table 1 of document E2 establishes a compelling link between the embodiment of figure 3 and the prior art thread type of figure 1. As established above, a thread with trapezoidal cross-section is common for oil well pipe joints and is completely independent of the type of interference used. Hence, there is no explicit or implicit disclosure of the type of interference used in the threaded joint of figure 3.

In conclusion, the combination of claim features A3, A4 and A5 is not disclosed by the embodiment shown in figure 3 of document E2.

- 3.1.4 Paragraph [0014] of the patent teaches that the fatigue resistance of the threaded joint is improved by a combined action of claim features A3, A6 and A7. According to paragraphs [0019] and [0041] high stress concentration is avoided by claim features A5 and A8. In view thereof, the board agrees with the appellant and the respondent that the objective technical problem

starting from document E2 is to improve the fatigue strength of the joint.

- 3.1.5 As set out in point 1.3 above, the skilled person in the present case will be a group of people including not only the operator responsible for assembling the tube string but also the engineer who designs the threaded joint, and possibly also the supplier of the power tong.
- 3.1.6 Starting from the example shown in figure 3 and described in paragraphs [0054] to [0061] of document E2, the skilled person will have to make some choices regarding the thread on the pin and box portions. The design engineer knows that only limited options are available to build in interference in case of a trapezoidal thread: either the flanks of the protruding trapezoids engage the mating trapezoidal recesses, resulting in a flank-to-flank interference, or the crests of the protruding trapezoids come into contact with the roots of the mating recesses, which produces a root-to-crest interference.

There is no doubt that threads with either type of interference are well known to the skilled person mentioned above. In this respect, the patent confirms in paragraph [0048] that the thread type with root-to-crest interference "is usual in many state of the art joints". As established in point 3.1.3 above, the only information contained in document E2 regarding the thread type can be found in the description of the prior art in paragraph [0004]. A buttress type having a trapezoidal thread prescribed by STD5B of the API is shown in the API specification of document E25 (figure 6) and is also described in document E5 (page 2, lines 39-48 and figure 2). Such a thread type appears to be

characterised by an interference between the crest surfaces and the root surfaces. The board concurs with the appellant that nothing in document E2 would impede the skilled person to realise the interference of the joint shown in figure 3 through a contact between roots and crests. On the contrary, in absence of any further suggestions in document E2 and in view of the information disclosed in documents E25 and E5, the information found in paragraph [0004] of document E2 would actually incite the skilled person to opt for a root-to-crest interference.

The board is not convinced by the argument of the respondent that the absence of a torque shoulder in the STD5B buttress type mentioned in paragraph [0004] implies that it cannot be used for the abutment-type joint of figure 3. There is no doubt that the stress field in a joint is very different without a torque shoulder, but that does not discourage the design engineer from using a thread with root-to-crest interference in combination with a torque shoulder, in particular as examples of such an arrangement are known from the prior art (figures 1 and 2 of document E5).

Thus claim features A3-A5 alone can not lead to a finding that claim 1 involves an inventive step.

3.1.7 The skilled person who has set himself to solve the objective technical problem would learn from paragraphs [0005]-[0008] of document E7 that the treatment of thread surfaces by shot peening will increase the surface hardness and improve the fatigue fracture strength. In particular, using small particles in the range from 30 to 300µm ensures that also geometrically complex parts are reached so that the entire surface is treated uniformly (paragraph [0008], [0009], [0013]-

[0015]). In the light of this disclosure, the skilled person will readily adapt the threaded joint known from document E2 by treating its threaded surface with shot peening using micro-particles.

3.1.8 Nonetheless, to infer from document E7 that a specific value of the root-to-load-flank radius is disclosed as an important feature that would contribute in solving the objective technical problem is at odds with the teaching of the document. The only mention of the radius of curvature of a threaded portion is in paragraph [0008]. With reference to figure 7, this paragraph explains the difficulty in reaching a threaded bottom corner curved part with a radius of 0.2mm when applying conventional shot peening using particles with minimum diameter of about 0.5mm. The solution proposed by document E7 is to use smaller particles that also can be injected into a bending part of such threaded bottom corners (cf. paragraph [0017]). Neither the general description in paragraphs [0010] to [0026] nor the detailed description of the three examples of document E7 imply that the radius of curvature should be increased in order to overcome the drawbacks of conventional shot peening, let alone that the value of 0.4mm of figure 2 should be selected. As a consequence, there is no reason why the skilled person would opt to select the value of the root-to-load-flank radius from figure 2 of document E7 (or its ratio with respect to the thread height) and to apply this teaching to the thread known from document E2.

3.1.9 In this connection it is noted that any change in dimension in the threaded portion of an oil well joint will invariably have an impact on the stress field in the joint. The board concurs with the respondent that an increased radius of curvature at the root of a load

flank will alter the area of contact between the root and the crest that radially interferes therewith. It can be expected that the change in distribution of the normal stress and of the shear stress resulting therefrom produces a stress concentration that will have an effect on the fatigue strength of the joint beyond what would have been envisaged if there were no interference.

The appellant cites the second paragraph in the right column on page 4 of document E8 as evidence that there is no need to adapt the interference when the root-to-load-flank radius increases. Nevertheless, the text passage actually discourages a simple increase of the radius. Instead, a "double radius" is foreseen as a trade-off between reducing the stress concentrations and warranting sufficient length for the load flank. In the improbable case that the skilled person would choose to apply the micro-shot peening of document E7 and to change the root-to-load-flank radius along the lines of document E8, the root-to-load-flank transition of document E2 would be replaced by a first curved part with large radius extending upwards from the root and by a second curved part with small radius joining the first curved part to the load flank. Not only is there no "root-to-load-flank radius" in this case, there would be no hint to fix the value of either radius to around 1/4 of the thread height.

- 3.1.10 The board concludes that the combination of claim features A3-A8 is not disclosed by document E7, nor would it be obvious to derive this combination from document E7 in combination with document E8. In view thereof, claim 1 involves an inventive step when starting from document E2.

3.2 Starting from document E6

The only embodiment of document E6 disclosing a first and second abutment shoulder is shown in figure 4 and described in column 6, lines 10-22. In that example, nothing is known about the type of thread used. The threads shown in the other embodiments of figures 1 and 6 use a flank-to-flank interference to make up the respective joint (see point 3.1.2 above). The buttress-type threads according to figures 9-10 appear to have a root-to-crest interference but they belong to the background art. No link between any of figures 1, 6, 9 and 10 and the abutment shoulders of figure 4 can be derived from the document. Furthermore, the root-to-load flank radius of figure 6 has a value of 20.5%, which is around 1/5 rather than around 1/4 of the thread height.

In conclusion, the embodiments of figures 1 or 6 fail to disclose claim features A2-A8 whereas claim features A3-A8 are missing from the embodiment of figure 4. As the argumentation given in point 3.1 with respect to documents E7 and E8 also applies here, claim 1 cannot involve an inventive step when starting from document E6.

3.3 Starting from document E7

Example 3 of document E7 discloses a threaded joint with a "buttress-type threaded shape with metal seal and shoulder" (paragraph [0042]). In view of paragraph [0016] and claim 3, it may be assumed that the buttress-type thread follows one of the standards of the American Petroleum Institute (API). However, the assertion that the thread of document E7 can be equated with the thread shown in figure 11 of document E6 or

with the thread of document E25 is therefore not supported by any evidence. The dimensions given in figure 7 of document E7 yield the value $0.20/1.575 = 12.6\%$ for the root-to-load-flank radius with respect to the height of the thread, which is around $1/8$ rather than around $1/4$. The subject-matter of claim 1 therefore differs from the threaded joint of document E7 by claim features A3-A6.

For the same reasons as given in points 3.1.7 to 3.1.9 above, the board does not see a teaching in document E7 or in document E8 that would incite the skilled person to adapt the embodiment of figure 7 in line with claim features A3-A6 in an obvious manner.

In particular, there would be no reason to modify the value of the radius (0.20mm) of the curved part between the root and the load flank of the thread. The fact that paragraph [0008] mentions a problem in conjunction with the embodiment of figure 7 of document E7 does not mean that the skilled person would select the value of the radius (0.4mm) shown in figure 2 of document E7 and use this on the thread of figure 7. Even if there were a good reason to do so, the effect of an increased radius of curvature on the area of contact between radially interfering roots and crests would substantially alter the stress field in the joint with a potentially grave impact on the fatigue strength of the joint.

3.4 Conclusion

Having regard to the state of the art, the subject-matter of claim 1 is not obvious to a person skilled in the art. Therefore, the threaded joint according to

claim 1 involves an inventive step (Article 56 EPC 1973).

3.5 Method claim

As each of claims 4 and 5 defines a method for making up "a threaded joint having the features of claim 1" they partially draw their features from claim 1. The limitations on the subject-matter of claim 1 are therefore also imported in the method claims. In view thereof, also the make-up methods of claims 4 and 5 involve an inventive step (Article 56 EPC 1973).

Order

For these reasons it is decided that:

The appeal is dismissed.

The Registrar:

The Chairman:



N. Schneider

M. Poock

Decision electronically authenticated