

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

NATIONAL OILWELL VARCO, L.P.,
Petitioner,

v.

TECHNICAL INDUSTRIES, INC.,
Patent Owner.

Case IPR2017-00699
Patent 7,401,518 B2

Before BRYAN F. MOORE, MINN CHUNG, and
JACQUELINE T. HARLOW, *Administrative Patent Judges*.

HARLOW, *Administrative Patent Judge*.

FINAL WRITTEN DECISION
35 U.S.C. § 318(a) and 37 C.F.R. § 42.73

I. INTRODUCTION

National Oilwell Varco, L.P. (“Petitioner”) filed a Petition to institute an *inter partes* review of claims 1–20 of U.S. Patent No. 7,401,518 B2 (Ex. 1001, “the ’518 patent”). Paper 5 (“Pet.”).¹ Technical Industries, Inc. (“Patent Owner”) filed a Preliminary Response. Paper 9 (“Prelim. Resp.”).

On July 28, 2017, we instituted an *inter partes* review of every challenged claim on at least one asserted ground of unpatentability, and of every asserted ground of unpatentability for at least one claim, but we did not institute review as to each claim challenged on each ground asserted. Paper 16 (“Inst. Dec.”). On November 30, 2017, Patent Owner filed a Patent Owner Response to the Petition. Paper 21 (“PO Resp.”). On February 12, 2018, Petitioner filed a Reply to the Patent Owner Response. Paper 29 (“Reply”). Pursuant to our authorization, Patent Owner and Petitioner each filed Sur-Replies. Paper 36 (“PO Sur-Reply”); Paper 40 (“Pet. Sur-Reply”).

Petitioner and Patent Owner additionally filed various evidentiary motions. Petitioner filed a Motion to Strike the opinions of Patent Owner’s declarant, Dr. William Emblom (Paper 38), to which Patent Owner filed an Opposition (Paper 42). Patent Owner filed a Motion to Exclude evidence submitted in conjunction with Petitioner’s Reply (Paper 39), to which Petitioner filed a Response (Paper 43).

¹ Petitioner filed its Petition on January 17, 2017 (Paper 2), and subsequently filed a Corrected Petition on February 3, 2017 (Paper 5). All citations are to the Corrected Petition (Paper 5).

On March 27, 2018, the parties presented arguments at an oral hearing. The hearing transcript has been entered in the record. Paper 43 (“Tr.”).

On April 30, 2018, in light of the Supreme Court’s decision in *SAS Institute, Inc. v. Iancu*, 138 S. Ct. 1348 (2018) and the Guidance on the Impact of SAS on AIA Trial Proceedings issued by the USPTO (“Agency Guidance”),² we modified our Decision on Institution to institute trial on all challenges asserted in the Petition. Paper 47, 2. On July 6, 2018, pursuant to our authorization, the parties filed a Joint Motion to Limit the Petition to the originally instituted grounds (Paper 48), which we granted (Paper 50).

In addition, on April 5, Patent Owner filed a Request for Adverse Judgment seeking cancelation of claims 1–3, 5, 7, 8, 10, 12, 13, 15, 17, and 19 of the ’518 patent (Paper 44), which we granted (Paper 50). Claims 4, 6, 9, 11, 14, 16, 18, and 20 of the ’518 patent remain in trial. *Id.*

We issue this Final Written Decision pursuant to 35 U.S.C. § 318(a) and 37 C.F.R. § 42.73. Having considered the record before us, we determine that Petitioner has shown by a preponderance of the evidence that claims 4, 6, 9, 11, 14, 16, 18, and 20 of the ’518 patent are unpatentable. *See* 35 U.S.C. § 316(e). Additionally, we decide the parties’ evidentiary motions below, in Section III.

² Available at <https://www.uspto.gov/patents-application-process/patent-trial-and-appeal-board/trials/guidance-impact-sas-aia-trial>.

A. Related Matters

The '518 patent is asserted in *Technical Industries, Inc. v. National Oilwell Varco, L.P.*, Case No. 6:15-cv-02744 (W.D. La.). Pet. 4; Paper 5, 2.

In addition, we have instituted petitions for *inter partes* review of U.S. Patent No. 7,263,887 (IPR2017-00648), U.S. Patent No. 7,552,640 (IPR2017-00860), U.S. Patent No. 7,997,138 (IPR2017-00910), each of which is related to the '518 patent.

B. The '518 Patent

The '518 patent, titled “Method for Inspection of Metal Tubular Goods,” issued July 22, 2008, from U.S. Patent Application No. 11/849,287, filed September 1, 2007. Ex. 1001, at [54], [45], [21], [22]. The '518 patent is a continuation of U.S. Patent Application No. 10/548,731, filed on March 8, 2004, and now issued as U.S. Patent No. 7,263,887.³ *Id.* at [63]. The '518 patent claims priority to U.S. Provisional Patent Application No. 60/452,907, filed March 7, 2003. *Id.* at [60].

The '518 patent describes a method for evaluating the condition of tubular metal goods by collecting and analyzing data concerning tubular wall thickness. *Id.* at 1:15–20. In particular, the '518 patent discloses the use of ultrasonic technology to acquire wall thickness data, in association with three-dimensional positional data, for discrete sections of the wall of a metal tubular good, “so that the wall of a metal tubular (or portions thereof)

³ U.S. Patent No. 7,263,887 B2 is the subject of IPR2017-00648.

can be displayed, imaged, examined and utilized in simulative/comparative programs as a three-dimensional object.” *Id.* at 1:25–32.

The ’518 patent acknowledges that the use of ultrasonic technology to inspect a metal tubular by determining wall thickness at a position on the tubular was known in the art prior to the time of invention. *Id.* at 2:46–64. The ’518 patent purports to improve upon prior art methods for identifying defects in metal tubular walls by teaching the use of ultrasonic inspection data not only to identify wall defects, but to use “three-dimensional data as to both the defect and the remainder of the tubular” to evaluate, with “mathematical precision,” how such a defect might impact tubular performance. *Id.* at 2:64–3:9. In this regard, the ’518 patent explains that data representing “wall thickness of each incremental section of a tubular and the location of that section can be used in computations which predict the actual effect on the tubular to various stressors, including tensile, bending, collapse and burst forces, aging, etc.” *Id.* at 8:64–9:7. The ’518 patent does not describe how such calculations might be performed, but rather, states that three-dimensional wall thickness data may be “used in mathematical calculations predicting performance of the tubular under certain conditions,” as well as in “engineering calculations and/or programs which predict response of the tubular to various stressors[.]” *Id.* at 3:29–35.

C. Illustrative Claim

Claim 6, which depends from now-canceled claims 1 and 2, is illustrative of the claimed subject matter. Claim 6 and the canceled claims from which it depends, are reproduced below.

1. Method for collection and storage of information representing wall thickness of tubular goods, comprising:
 - a. selecting a section of the wall of a tubular good about which information representing wall thickness is to be acquired and then stored in a format readable by computer means;
 - b. determining number and spacing of discrete portions within said section of the wall of said tubular good which will produce information representing wall thickness of said section of the wall of said tubular good having desired resolution;
 - c. at each of said discrete portions, causing said ultrasonic detection means to determine the thickness of the wall of said tubular good;
 - d. at each of said discrete portions, determining the longitudinal position of said ultrasonic detection means along the axis of said tubular good;
 - e. at each of said discrete portions, determining the circumferential position of said ultrasonic detection means about the circumference of said tubular good; and,
 - f. at each of said discrete portions making a computer readable recording of said wall thickness, longitudinal and circumferential positions in an associated relationship.

Ex. 1001, 9:36–60.

2. The method of claim 1 wherein said number of said discrete portions within said section of the wall of said tubular good is greater than two for each circumference of said tubular good.

Ex. 1001, 9:61–64.

6. The method of claim 2 further comprising the step of causing a computer means to use at least some of the information contained in said computer readable recording to compute the effect of stressors on the wall of said tubular good.

Ex. 1001, 10:13–17. Claims 4, 9, 11, 14, 16, 18, and 20 likewise require the use, by a computer, of “at least some of the information contained in said computer readable recording to compute the effect of stressors on the wall of said tubular good.” *Id.* at 10:3–12:8.

D. Prior Art Relied Upon

Petitioner relies upon the following prior art references (Pet. 5–6):

Kiefer	US 5,641,909	June 24, 1997	(Ex. 1003)
Lam	US 2003/0033880 A1	Feb. 20, 2003	(Ex. 1004)

Assanelli, et al., *Collapse Behavior of Casings: Measurement Techniques, Numerical Analyses and Full Scale Testing*, 1998 SPE/ATW Risk Based Design of Wall Casing and Tubing Conference (1998) (Ex. 1005).

Petitioner also relies on the Declaration of John P. Rodgers, Ph.D. (Ex. 1007) and the Supplemental Declaration of Dr. Rodgers (Ex. 1027).

Patent Owner relies on the Declarations of William J. Emblom, Ph.D. (Ex. 2001), C. Mike Webre (Ex. 2002), and George M. Sfeir (Ex. 2003).

E. The Instituted Grounds of Unpatentability

We initially instituted *inter partes* review of the '518 patent on the following grounds (Inst. Dec. 46):

Claims	Basis	Reference(s)
1–3, 5, 7, 8, 10, 12, 13, 15, 17, 19	§ 102(b)	Kiefer
1, 2	§ 102(b)	Lam
1, 2, 5, 6, 10, 11, 15, 16, 19, 20	§ 102(b)	Assanelli
4, 6, 9, 11, 14, 16, 18, 20	§ 103(a)	Kiefer and Assanelli
5, 6, 19, 20	§ 103(a)	Lam and Assanelli
5, 19	§ 103(a)	Lam and Kiefer

Subsequent to the Supreme Court's decision in *SAS*, and in view of Agency Guidance, we modified our Decision on Institution to include each patentability challenge set forth in the Petition (Paper 47, 2):

Claims	Basis	Reference(s)
1–3, 5, 7, 8, 10, 12, 13, 15, 17, 19	§ 102(b)	Kiefer
1–3, 5, 7, 8, 10, 12, 13, 15, 17, 19	§ 102(b)	Lam
1, 2, 5, 6, 10, 11, 15, 16, 19, 20	§ 102(b)	Assanelli
4, 6, 9, 11, 14, 16, 18, 20	§ 103(a)	Kiefer and Assanelli
4–6, 9–11, 14–16, 18–20	§ 103(a)	Lam and Assanelli
5, 10, 15, 19	§ 103(a)	Lam and Kiefer

On April 5, 2018, Patent Owner filed a Request for Adverse Judgment, disclaiming and canceling claims 1–3, 5, 7, 8, 10, 12, 13, 15, 17, and 19 of the '518 patent. Paper 44. In addition, on July 6, 2018, the parties filed a Joint Motion to Limit the Petition to the grounds on which we originally instituted the proceeding. Paper 48. We granted each of these motions on July 11, 2018 (Paper 50). Accordingly, this Final Written

Decision addresses only the following claims and grounds of unpatentability, which remain for trial:

Claims	Basis	Reference(s)
6, 11, 16, 20	§ 102(b)	Assanelli
4, 6, 9, 11, 14, 16, 18, 20	§ 103(a)	Kiefer and Assanelli
6, 20	§ 103(a)	Lam and Assanelli

II. ANALYSIS

A. *Level of Ordinary Skill in the Art*

The level of skill in the art is a factual determination that provides a primary guarantee of objectivity in an obviousness analysis. *Al-Site Corp. v. VSI Int’l Inc.*, 174 F.3d 1308, 1324 (Fed. Cir. 1999) (citing *Graham v. John Deere Co.*, 383 U.S. 1, 17–18 (1966); *Ryko Mfg. Co. v. Nu-Star, Inc.*, 950 F.2d 714, 718 (Fed. Cir. 1991)). “The person of ordinary skill in the art is a hypothetical person who is presumed to know the relevant prior art.” *In re GPAC Inc.*, 57 F.3d 1573, 1579 (Fed. Cir. 1995). In defining the person of ordinary skill, the Board may consider various factors, including, the “type of problems encountered in the art; prior art solutions to those problems; rapidity with which innovations are made; sophistication of the technology; and educational level of active workers in the field.” *Id.* (quoting *Custom Accessories, Inc. v. Jeffrey-Allan Indus., Inc.*, 807 F.2d 955, 962–963 (Fed. Cir. 1986)). “These factors are not exhaustive but are merely a guide to determining the level of ordinary skill in the art.” *Daiichi Sankyo Co. v. Apotex, Inc.*, 501 F.3d 1254, 1256 (Fed. Cir. 2007). In addition, the applied prior art reflects the appropriate level of skill at the time of the claimed invention. *See Okajima v. Bourdeau*, 261 F.3d 1350, 1355 (Fed. Cir. 2001).

Petitioner asserts that a person of ordinary skill in the art at the time of the invention of the '518 patent would have had “at least a Bachelor of Science degree in mechanical, petroleum, or chemical engineering and at least 2–3 years of experience with pipe testing technology.” Pet. 9; Ex. 1007 ¶ 16. Petitioner further asserts that such an artisan would have been familiar with ultrasonic pipe inspection methods, would have recognized that such methods could be used to scan either the inside or outside of a tubular to yield the same results, and would have known how to use commercially available software to create three-dimensional models of a tubular, as well as to perform finite element analysis of a tubular. Pet. 9–11; Ex. 1007 ¶¶ 17–24.

Patent Owner responds that Petitioner “substantially overstates the qualifications” of an ordinarily skilled artisan “in the field of pipe testing.” PO Resp. 34. Patent Owner does not endeavor to specifically define the relevant artisan, but appears to contend that such an artisan would not necessarily have had a college degree, and would not have been capable of developing the computational algorithms purportedly required to perform the claimed methods of stress analysis. See PO Resp. 35–36 (describing Mr. Webre’s and Mr. Sfeir’s opinions regarding the level of ordinary skill in the field). Patent Owner supports its contentions with the Declaration of C. Mike Webre (Ex. 2002), proffered as an expert witness concerning the level of skill in the field at the time of invention of the '518 patent, and the Declaration of George M. Sfeir (Ex. 2003), the President of Patent Owner.

The contours and effect of Patent Owner’s contentions concerning the level of ordinary skill in the field are somewhat unclear, as Patent Owner’s

declarant concerning the patentability of the '518 patent, Dr. Emblom, accepts Petitioner's definition of a relevant skilled artisan in his declaration. Ex. 2001, 3. Nevertheless, because arguments concerning the level of ordinary skill in the field feature prominently in Patent Owner's Response to Petitioner's obviousness challenges (*see, e.g.*, PO Resp. 34–38), we address the level of ordinary skill in the field in detail.

Resolution of the level of ordinary skill in the field requires identification of the attributes of “the person of ordinary skill in the art to which the invention pertains, not those who may use the invention.” *In re Grout*, 377 F.2d 1019, 1022 (C.C.P.A. 1967) (“It is alleged that a problem existed in the support of honeycomb foundations which appellant solved. While this problem would be encountered by a beekeeper, we think the problem naturally calls for the talents of one skilled in the art of fasteners.”). The '518 patent is addressed to improved methods for the non-destructive inspection of metal tubular goods. Ex. 1001, 1:15–16. As such, a relevant ordinarily skilled artisan would have had the educational and experiential background necessary to develop methods of tubular inspection, not simply to use known tubular testing procedures, as Patent Owner (PO Resp. 35) and its declarants, Mr. Webre (Ex. 2002 ¶¶ 11–12) and Mr. Sfeir (Ex. 2003, 3), suggest. *See DyStar Textilfarben GmbH & Co. Deutschland KG v. C.H. Patrick Co.*, 464 F.3d 1356, 1363 (Fed. Cir. 2006) (“Because, for this patent, the only finding supported by substantial evidence is that an ordinary artisan is not a dyer but a person designing an optimal dyeing process, the jury's implicit finding of a mere dyer cannot withstand scrutiny on JMOL.”).

Furthermore, we agree with Petitioner and Dr. Rodgers that the sophistication of the technology, as well as the problem of, and solutions for, developing more efficient and reliable methods of tubular inspection disclosed in the prior art, reflect a level of ordinary skill consistent with that advanced by Petitioner. Pet. 9–11; Ex. 1007 ¶¶ 15–25. In this regard, we credit Dr. Rodgers’ testimony that the cited prior art “shows that pipe inspection methods and systems were well-known in the field at the time of the earliest priority date of the ‘518 patent so a POSITA would have been exposed to one or more commercially available options and would like have had hands-on experience as well.” Ex. 1007 ¶ 16; Pet. 10–11. For example, as Dr. Rodgers testifies, “Assanelli discloses a methodology for accurately predicting the collapse pressure of subsea pipeline tubulars using three-dimensional models that incorporate measured imperfections in the pipe. The methodology provides for more accurate predictions than prior methods that did not account for measured imperfections in the pipe geometry.” Ex. 1007 ¶ 147 (internal citation omitted). Indeed, Assanelli expressly teaches that although the “bidimensional representation of tube geometry” attainable from two-dimensional finite element models “is not enough for determining the external collapse pressure of casings,” the three-dimensional models disclosed by Assanelli permit “further investigat[ion of] the effects of the casing geometry on its external collapse pressure.” Ex. 1005, 1.

In addition, the ‘518 patent itself illustrates the sophistication of the technology at issue, and supports Petitioner’s and Dr. Rodgers’ definition of the level of ordinary skill in the field. As Dr. Rodgers explains, the

'518 patent “describes the use of commercially available ‘simulative/comparative programs’ to create a three-dimensional object,” but does not explain “how to use these programs, which is evidence that the Patent Owner thought this would already be known to a POSITA and would not need to be explained in the patent.” Ex. 1007 ¶ 18 (quoting Ex. 1001, 1:28–32; Pet. 10–11. We agree with Dr. Rodgers that the paucity of explanation in the '518 patent suggests that an ordinarily skilled artisan would have known that such programs existed and understood how to use them.

In view of the evidence described above, including the sophistication of the technology at issue, and the problems encountered and solutions disclosed in the prior art, we do not find persuasive either Mr. Webre's or Mr. Sfeir's opinions concerning the level of ordinary skill in the field. Mr. Webre's opinion that a relevant skilled artisan would have been “a person that was exposed to tubular inspection methods and equipment that was in commercial use by providers of tubular inspection services or as a user of pipe inspection services” (Ex. 2002 ¶ 11) is based on the faulty premise that an ordinarily skilled artisan would have been one who uses tubular inspection techniques, rather than one who develops them. Furthermore, Dr. Webre's opinion does not comport with the level of sophistication of the '518 patent or the prior art, each of which addresses the development of improved methods of pipe inspection, not the rote use of commercially available products. Mr. Webre's reference to the purported educational criteria for obtaining nondestructive testing certification does not cure the defects in his opinion, as Mr. Webre does not explain what such certification entails, or whether one so certified would be an artisan of

ordinary skill in the relevant field, i.e., the development of tubular inspection techniques. In addition, Mr. Webre’s unsupported, conclusory testimony that Assanelli was “inconsistent” with the “then-current industry standard” screening (Ex. 2002 ¶ 16) is unpersuasive, entitled to little weight (37 C.F.R. § 42.65(a)), and seemingly beyond the scope of his engagement to testify regarding the level of ordinary skill in the art at the time of invention of the ’518 patent (Ex. 2002 ¶¶ 1–2).

Mr. Sfeir’s opinion, which expressly excludes those with “the education, training, experience or motivation to attempt to develop a new, allegedly better, way to calculate pipe collapse pressure” as ordinarily skilled artisans (Ex. 2003, 3) suffers from the same shortcomings as Mr. Webre’s opinions, in that it ignores the level of sophistication of the technology and prior art at issue. In addition, Mr. Sfeir does not provide evidentiary support for his opinions; as such, we give them little weight (37 C.F.R. § 42.65(a)).

Accordingly, we find that Petitioner’s description of a relevant skilled artisan as possessing at least a Bachelor of Science degree in mechanical, petroleum, or chemical engineering, and having at least 2–3 years of experience with pipe testing technology is supported by the record as a whole, and adopt that portion of Petitioner’s description of the level of ordinary skill in the field for purposes of this Decision. Pet. 9–11; Ex. 1007 ¶¶ 15–25. We also agree with Petitioner that a relevant artisan of ordinary skill would have been exposed to, and had experience with, known tubular inspection systems and methods, as well as the use of existing computer software to perform stress analyses. Ex. 1007 ¶¶ 16–18; Pet. 10–11. We

further note that the applied prior art reflects the appropriate level of skill at the time of the claimed invention. *See Okajima*, 261 F.3d at 1355.

We recognize each of Petitioner’s and Patent Owner’s declarants as qualified to provide the proffered opinions on the level of skill and the knowledge of a person of ordinary skill in the art at the time of the invention. The relative weight that we assign such testimony, however, is subject to additional factors. *See, e.g.*, 37 C.F.R. § 42.65(a) (“Expert testimony that does not disclose the underlying facts or data on which the opinion is based is entitled to little or no weight.”); Office Patent Trial Practice Guide, 77 Fed. Reg. 48,756, 48,763 (Aug. 14, 2012) (same).

Petitioner does not challenge the expertise of any of Patent Owner’s declarants in its Reply or Sur-Reply.⁴ Patent Owner, however, asserts that Petitioner’s declarant, Dr. Rodgers is unqualified to opine in this matter because “Dr. Rodgers has never been a POSITA” “in the field of art pertaining to inspection of tubular members” (PO Resp. 36). Patent Owner acknowledges that Dr. Rodgers “has a great deal of education, training and experience in many fields,” but nevertheless asserts that because none of Dr. Rodgers’ patents or publications is specifically addressed to the “inspection of pipe by the ultrasonic means found in the ’518 Patent (let alone Kiefer, Lam or Assanelli)” (*id.*), Dr. Rodgers’ testimony should be discounted, and he should be rejected as an ordinarily skilled artisan (*id.* at 37–38). Patent Owner additionally contends that Dr. Rodgers’ opinions

⁴ As discussed in Section III, below, Petitioner filed an unauthorized Motion to Strike Dr. Emblom’s testimony (Paper 35), which we deny.

should be called into question because he does not identify a single artisan of ordinary skill “who, in 2003, was using, was working on using, or had even conceived of using data, collected by ultrasonic means, which was stored in computer readable format to manually or by computer [] calculate strength of pipe proposed to be used in a particular application.” *Id.* at 38.

Dr. Rodgers is a licensed engineer with fifteen years of experience, the bulk of which relates to work in the oil industry, and includes experience developing “ultrasonic casing inspection tools that operate downhole to interrogate the pipe embedded in the wellbore.” Ex. 1007 ¶ 9. Dr. Rodgers is a named inventor on 29 U.S. patents, and has authored more than 15 publications relating to the oil industry. *Id.* ¶¶ 10–11. Although not specifically addressed to the inspection of tubulars prior to their insertion down-hole, Dr. Rodgers is a named inventor on at least one patent concerning the use of ultrasonic transducer inspection technology in oilfield tubulars. *Id.* ¶ 11; see PO Resp. 36 (acknowledging that Dr. Rodgers’ patents describe the use of an ultrasonic transducer to “detect[] when down-hole pipe or drilling bits are developing problems during use in a wellbore”). In addition, Dr. Rodgers holds Ph.D. and M.S. degrees from the Massachusetts Institute of Technology, where his research focused on the “development and application of ultrasonic transducer materials applied to structural vibration control” (Ex. 1007 ¶ 8), as well a B.S. degree in mechanical engineering with a second major in mathematics from Duke University (*id.* ¶ 7).

Based on Dr. Rodgers’ substantial credentials and experience, including specific experience in the development of ultrasonic tubular

inspection tools, we determine that Dr. Rodgers is qualified to provide expert testimony in this matter. *See Endress + Hauser, Inc. v. Hawk Measurement Sys. Pty. Ltd.*, 122 F.3d 1040, 1042 (Fed. Cir. 1997) (finding witness proffered as an expert in field of ultrasonic level-measuring equipment was qualified to testify in view of “substantial credentials as an electrical engineer”); *Norgren Inc. v. Int’l Trade Comm’n*, 699 F.3d 1317, 1325 (Fed. Cir. 2012) (“Because the person having ordinary skill in the art is a ‘theoretical construct’ and is ‘not descriptive of some particular individual,’ ‘a person of *exceptional* skill in the art’ should not be disqualified because he or she is ‘not ordinary enough.’” (internal citations omitted)).

B. Claim Construction

In an *inter partes* review, the Board interprets claim terms in an unexpired patent according to the broadest reasonable construction in light of the specification of the patent in which they appear. 37 C.F.R. § 42.100(b); *Cuozzo Speed Techs., LLC v. Lee*, 136 S. Ct. 2131, 2142 (2016) (affirming applicability of broadest reasonable construction standard to *inter partes* review proceedings). Under that standard, and absent any special definitions, we give claim terms their ordinary and customary meaning, as would be understood by one of ordinary skill in the art at the time of the invention. *In re Translogic Tech., Inc.*, 504 F.3d 1249, 1257 (Fed. Cir. 2007). Additionally, any special definitions for claim terms must be set forth with reasonable clarity, deliberateness, and precision. *In re Paulsen*, 30 F.3d 1475, 1480 (Fed. Cir. 1994).

Petitioner and Patent Owner propose constructions for certain claim terms. Pet. 15–22; PO Resp. 12–13. As relevant to this Decision, we address the following claim terms.

1. *“causing a computer means to . . .
compute the effect of stressors”*

In the Decision on Institution, we concluded that the broadest reasonable interpretation of the claim phrase “causing a computer means to use at least some of the information contained in said computer readable recording to compute the effect of stressors on the wall of said tubular good,” recited in each of the challenged claims, is “causing a computer to use at least some of the information contained in the computer readable recording to compute the effect, on the strength of the tubular, of stressors applied to the tubular.” Inst. Dec. 8.

Although the parties do not directly challenge our prior construction, Patent Owner emphasizes that “the term ‘computer’ should be interpreted in accordance with the plain, ordinary and commonly understood meaning of the word — that is, a device that is capable of and is used to perform mathematical calculations from properly formatted data input to it.” PO Resp. 13.

The challenged claims expressly require the use of a “computer means to . . . compute the effect of stressors on the wall of said tubular good” (Ex. 1001, 10:4–7), and that requirement is captured by our construction of that claim phrase to mean “causing a computer to use at least some of the information contained in the computer readable recording to compute the effect, on the strength of the tubular, of stressors applied to the tubular”

(Inst. Dec. 8). To the extent Patent Owner contends that the term “computer” should be understood in accordance with its plain and ordinary meaning, i.e., as referring to a device for performing calculations on data, we agree, and observe that such understanding is captured by our original construction. Accordingly, for the reasons above, as well as those set forth in the Decision to Institute (*id.*), we construe the phrase “causing a computer means to use at least some of the information contained in said computer readable recording to compute the effect of stressors on the wall of said tubular good” to mean “causing a computer to use at least some of the information contained in the computer readable recording to compute the effect, on the strength of the tubular, of stressors applied to the tubular.”

We further note that there is no meaningful dispute between the parties concerning the interpretation of “computer,” as Petitioner contends that Assanelli discloses the use of a computer to perform calculations, i.e., finite element analysis (“FEA”) or finite element modeling (“FEM”),⁵ using data obtained from inspection of a tubular good in order to model the effect of various stresses on that tubular good. *See, e.g.*, Pet. 39–40 (describing the data acquisition and FEA modeling steps disclosed by Assanelli).

2. Other Claim Terms

In view of our analysis, we determine that no additional claim terms require construction for the purpose of this Decision. *See Nidec Motor Corp. v. Zhongshan Broad Ocean Motor Co. Ltd.*, 868 F.3d 1013, 1017

⁵ FEA and FEM are used interchangeably in the prior art and throughout this Decision.

(Fed. Cir. 2017) (“[W]e need only construe terms ‘that are in controversy, and only to the extent necessary to resolve the controversy.’” (quoting *Vivid Techs., Inc. v. Am. Sci. & Eng’g, Inc.*, 200 F.3d 795, 803 (Fed. Cir. 1999))).

C. Prior Art Relied Upon

1. Assanelli

Assanelli discloses the use of three-dimensional modeling to predict the effects of casing (i.e., tubular) geometry—including wall thickness—on the external collapse pressure for that casing. Ex. 1005, 1. Assanelli explains that wall thickness contributes to many of the factors that influence the external pressure at which a steel pipe will collapse, including: the ratio of outside pipe diameter to wall thickness; the yield stress of the pipe; the shape of pipe sections (outside diameter shape and thickness distribution); the residual stresses locked in the pipe steel; and the localized imperfections introduced in production or handling, or due to localized wear. *Id.* at 1, 4. Assanelli also observes that it is normal for wall thickness to change along the length of a pipe. *Id.* at 1.

Assanelli describes the acquisition of geometrical information from test pipes with an “imperfection measuring system” (“IMS”), and the use of that information as input data for three-dimensional finite element models to predict pipe collapse pressure. Ex. 1005, 1. Assanelli discloses the performance of “in-depth pipe outside diameter (OD) and thickness mappings,” and explains that pipe wall “thickness is measured manually at 272 locations, using an ultrasonic gauge (**Fig. 5**). An enhancement of the device is planned, which will allow [it] to measure the wall thickness on-line

with the outside diameter.” *Id.* at 2. Assanelli further discloses that the information of the full scale test, including wall thickness measurement data, is stored in a database. *Id.*

Assanelli discloses that angular and longitudinal position information is collected and associated with pipe wall thickness measurements. Figure 5 of Assanelli is reproduced below.

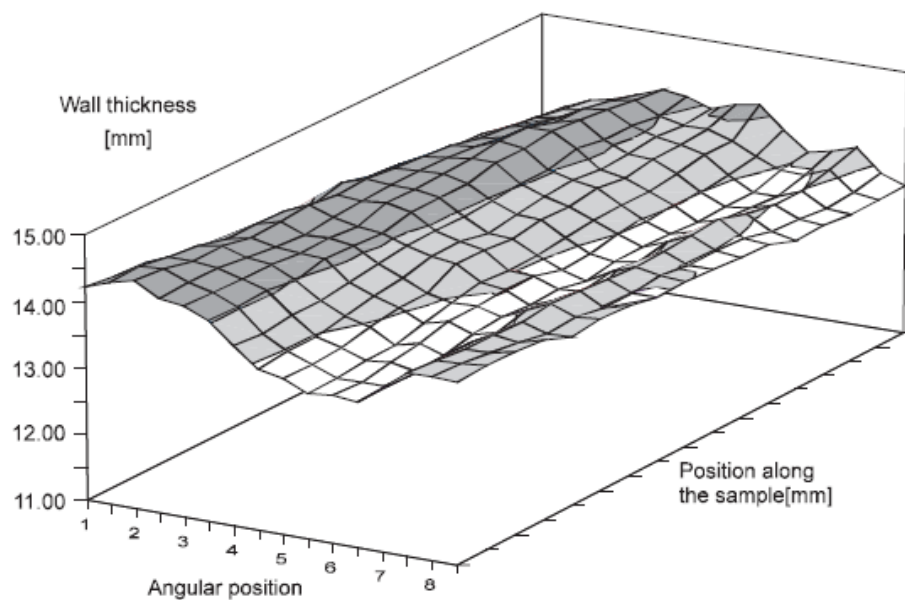


Fig. 5—Wall thickness distribution

Figure 5 plots wall thickness data for various angular and longitudinal positions on a test pipe to depict the wall thickness distribution for that pipe. Ex. 1005, Fig. 5.

Assanelli additionally teaches the use of wall thickness data from different positions on a test pipe to create a three-dimensional finite element model of that pipe. Ex. 1005, 3. Figure 8 of Assanelli is reproduced below.

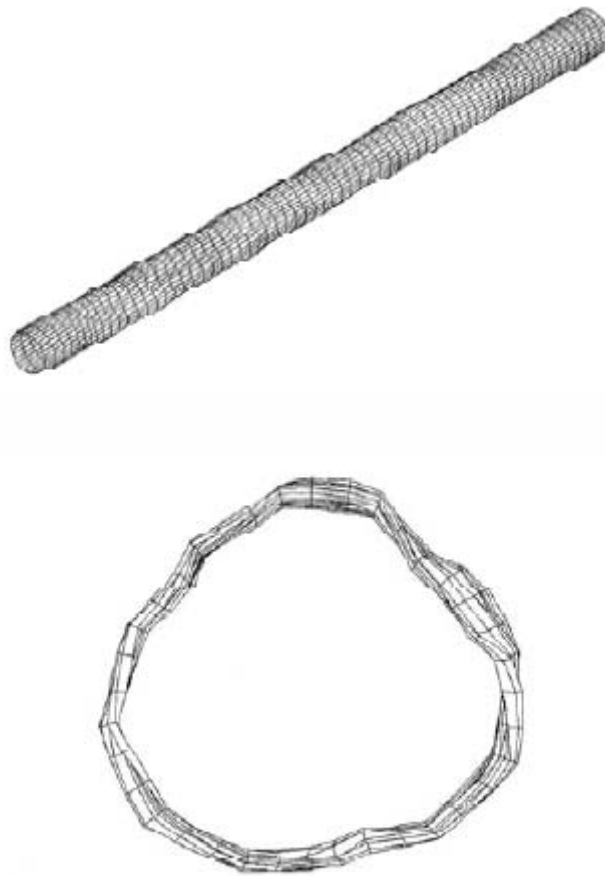


Fig. 8—Three dimensional finite element model (imperfections amplified 50 x)

Figure 8 depicts a three-dimensional model showing wall thickness in lengthwise as well as cross-sectional views. *Id.* at 3, Fig. 8.

Assanelli further teaches that three-dimensional models can be used in finite element models to predict how a pipe will respond to stressors.

Figure 9 of Assanelli is reproduced below.

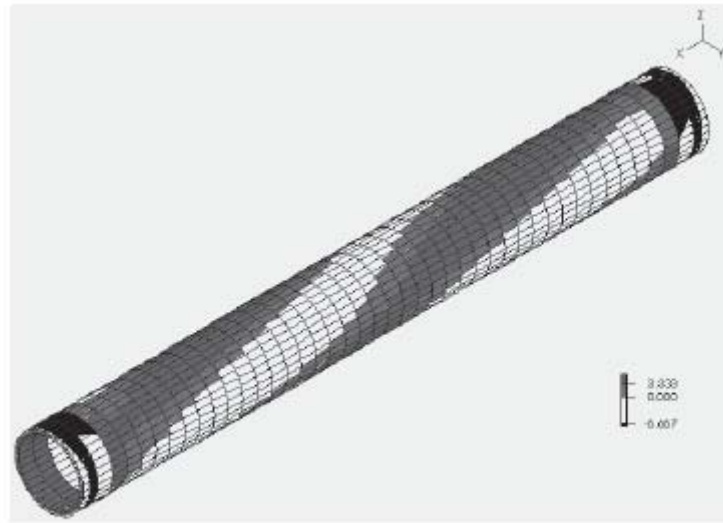


Fig. 9—Finite element model of a pipe with helical ovality.
Distribution of axial stresses at the external surface

Figure 9 depicts a three-dimensional finite element model of a pipe, and “shows the distribution of axial stresses (on the external surface) at impending collapse.” Ex. 1005, 3.

2. Kiefer

Kiefer discloses an apparatus that “provides one hundred percent inspection of the walls of gas mains under operating flow conditions through the use of a unique scanning unit which is inserted into working gas mains to collect [data] for production of graphic images of the wall forming the gas main.” Ex. 1003, 1:46–51. Kiefer teaches that the inspection apparatus “contains an ultrasonic transducer which directs an interrogating pulse into the wall of the gas main at a pre-determined angularly spaced-apart interval” such that “[t]he interrogating pulses form a helical scan pattern.” *Id.* at 1:64–2:4.

Kiefer further explains that

[t]he return pulses (reflective pulses) from the surfaces defining the inner diameter and outer diameter of the gas main and any imperfections or flaws within the wall of the main are received by the transducer, converted into digital form, and are subsequently transmitted to a surface unit which produces a tomograph of the wall of the gas main. In essence, a model of the condition of the surfaces defining the inner diameter and outer diameter of the gas main and a cross-sectional view of the wall of the gas main is generated over the length of the main.

Ex. 1003, 2:4–14; *see also id.* at 5:26–45 (describing the process for generating a computer model of the wall of a gas main including wall thickness and imperfections).

Figure 8 of Kiefer is reproduced below.

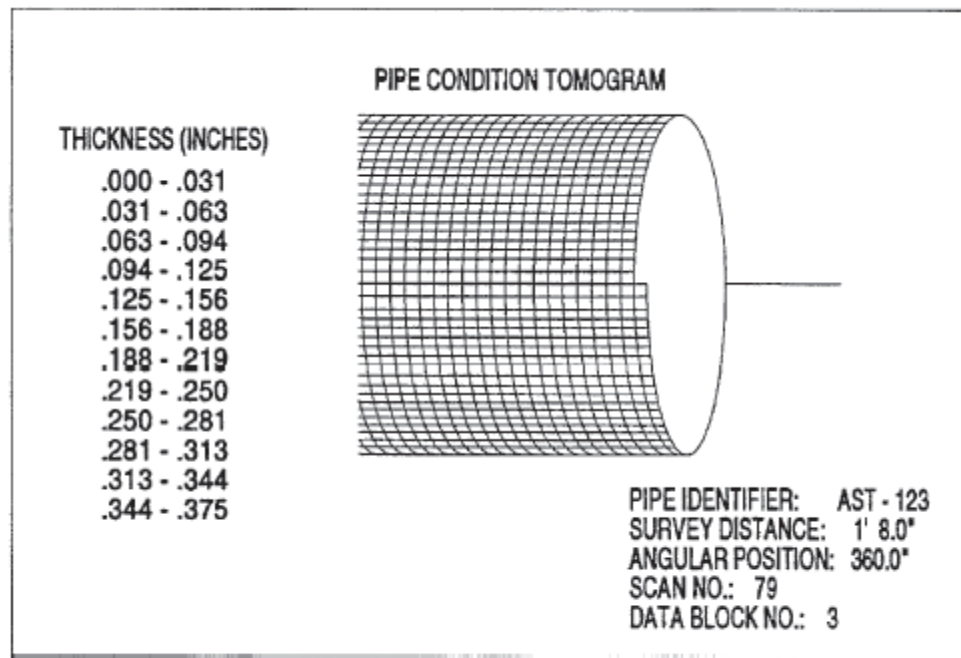


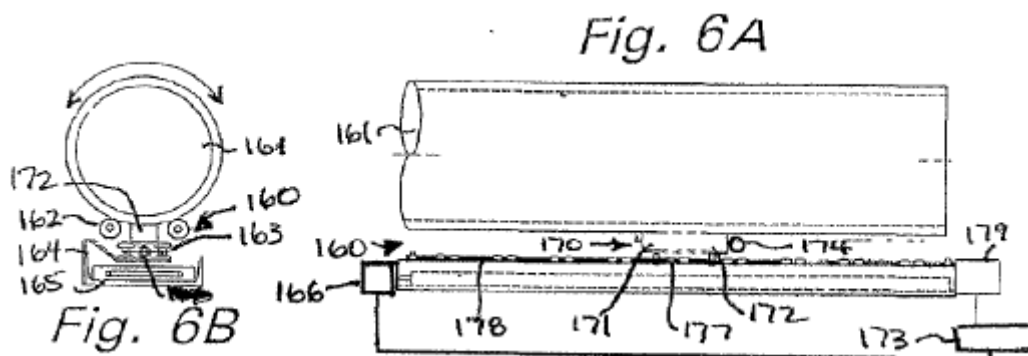
FIG. 8

Figure 8 is a tomograph of a gas main produced by the scan unit assembly of Kiefer. Ex. 1003, 2:55–57. Kiefer explains that “[f]rom such a tomographic image, the surfaces defining the inner and outer diameters of the wall of the gas main and any imperfections or flaws within the wall of the gas main can be examined and accurate physical dimensions of same can be determined.” *Id.* at 5:41–45.

3. Lam

Lam discloses “[a] method for ultrasonically inspecting a tubular member.” Ex. 1004, Abstract. Lam teaches the use of ultrasonic electronic instrumentation to “indicate[,] locate, and measure I.D. flaws, O.D. flaws, wall thickness, and time of flight to the end of a tubular member.” *Id.* ¶ 54. Lam further explains that the disclosed method “is capable of examining almost all of the entire length of the tubular; and, in certain aspects, [] can accurately detect flaws including inner surface defects in substantially all of a tubular’s length and near or at its ends.” *Id.* ¶ 14.

Figures 6A and 6B of Lam are reproduced below.



Figures 6A and 6B are, respectively, schematic lengthwise and end views of the tubular inspection system disclosed by Lam. Ex. 1004 ¶ 35. Transducer

system 171 is pulled longitudinally down the length of pipe 161 by motor 179. *Id.* ¶ 48. Pipe 161 is simultaneously rotated radially by pipe rotation system 162. *Id.*

Lam teaches that the transducer system produces data “indicative of tubular wall thickness (‘wall thickness’) which is transmitted to the computer 156 (as digital information from the ultrasonic instrumentation) for wall thickness determination, alarm if necessary, and/or display.” Ex. 1004 ¶ 56. Lam further discloses that the tubular inspection system includes a programmable logic controller that is interconnected electronically with a computer, and that provides information to the computer concerning circumferential and longitudinal location of the transducer system. *Id.* ¶ 60; *see also id.* ¶ 72 (explaining that such data is in digital form). Lam also explains that the tubular inspection system may include “a graphical representation of a tubular being examined,” and describes various information that might be displayed to an operator. *Id.* ¶ 58.

D. Anticipation by Assanelli

Petitioner asserts that claims 6, 11, 16, and 20 are anticipated under § 102(b) by Assanelli. Pet. 39–45. Patent Owner disagrees. PO Resp. 14–24.

To establish anticipation, each and every element in a claim, arranged as recited in the claim, must be found in a single prior art reference. *Net MoneyIN, Inc. v. VeriSign, Inc.*, 545 F.3d 1359, 1369 (Fed. Cir. 2008). “A reference anticipates a claim if it discloses the claimed invention ‘such that a skilled artisan could take its teachings in combination with his own

knowledge of the particular art and be in possession of the invention.””
In re Graves, 69 F.3d 1147, 1152 (Fed. Cir. 1995) (emphasis omitted)
(quoting *In re LeGrice*, 301 F.2d 929, 936 (CCPA 1962)). The dispositive
question is “whether one skilled in the art would reasonably understand or
infer” that a reference teaches or discloses all of the elements of the claimed
invention. *In re Baxter Travenol Labs.*, 952 F.2d 388, 390 (Fed. Cir. 1991);
Continental Can Co. v. Monsanto Co., 948 F.2d 1264, 1268–69 (Fed. Cir.
1991) (to anticipate, every element of the claims must appear in a single
prior art reference, or if not expressly shown, then demonstrated to be
known to persons experienced in the field of technology).⁶

In support of its contention that Assanelli anticipates claims 6, 11, 16,
and 20 of the ’518 patent, Petitioner asserts that “Assanelli discloses a
method for inspecting and gathering ultrasonic data on oilfield tubulars
using three-dimensional models that incorporate measured variations in the
tubular wall thickness.” Pet. 39; Ex. 1005, 1–4; Ex. 1007 ¶¶ 147, 149. In
particular, Petitioner asserts that Assanelli teaches a method for recording
and storing information representing wall thickness for a section of a tubular
good, including performing in-depth wall thickness mappings, using an
ultrasonic gauge to manually measure wall thickness at 272 locations, and

⁶ Patent Owner states in its Response that Petitioner bears the burden of
establishing anticipation by “clear and convincing evidence.” PO Resp. 13–
14. For clarity, we note that in an *inter partes* review, a petitioner bears the
burden of proving unpatentability by a preponderance of the evidence.
35 U.S.C. § 316(e).

recording wall thickness measurements in a database. Pet. 41–42; Ex. 1005, 2–3; Ex. 1007 ¶¶ 149, 153.

Petitioner also asserts that “Assanelli discloses determining the number of spacing of discrete portions within a selected section of the tubular wall to produce information representing wall thickness (which will create a desired resolution).” Pet. 41; Ex. 1005, 2; Ex. 1007 ¶ 152.

Petitioner explains that this “pre-determined decision by the tubular inspector about the number and spacing of wall thickness measurements” is depicted graphically in Figure 5 of Assanelli. Pet. 41; Ex. 1005, Fig. 5; Ex. 1007 ¶ 152.

Petitioner contends further that Assanelli teaches recording wall thickness, and circumferential and longitudinal position information, for each location measured in an associated relationship, as depicted, for example, in Figure 5, which plots wall thickness as a function of angular and longitudinal position. Pet. 42; Ex. 1005, 2, Fig. 5; Ex. 1007 ¶¶ 153–156; *see also* Ex. 1005, Figs. 8–9 (depicting three-dimensional finite element models for test pipes).

Petitioner additionally asserts that Assanelli “describes positioning the ultrasonic detection means to take wall thickness measurements in at least two discrete portions per circumference.” Pet. 42; Ex. 1005, 2, Fig. 5; Ex. 1007 ¶ 157. In support of this contention, Dr. Rodgers testifies that

Assanelli describes the IMS as a system in which “in-depth pipe outside diameter (OD) and thickness mappings are performed.” Ex. 1005 at 2. In order to perform an “in-depth” mapping, many measurement points will be necessary. *Id.* Further, Assanelli states that “the [wall] thickness is measured manually at 272

locations using an ultrasonic gauge.” *Id.* A POSITA would clearly understand that the wall thickness measurements are being made at many points distributed around the outer surface of the pipe, which would include at least two points per circumference. *The helical scan pattern created by the Assanelli IMS requires at least two points per circumference to adequately define (or create) the helical pattern. See Figure 5.*

Ex. 1007 ¶ 157 (emphasis added).

Having reviewed the cited evidence, and the record as a whole, we find that Petitioner has accurately described the above-stated disclosures of Assanelli, which we adopt as our own. Indeed, Patent Owner does not challenge these assertions. Instead, the parties’ dispute centers upon whether the database that stores the gathered geometric measurement data disclosed by Assanelli constitutes a computer readable recording of that data, and whether the FEM of the effect of stressors on the wall of a tubular taught by Assanelli is performed using a computer. Thus, our following analysis focuses on those issues, which relate to the patentability of each of challenged claims 6, 11, 16, and 20. We also address the sufficiency of the record support for Petitioner’s contention that Assanelli discloses the number of wall thickness measurements required by claims 11 and 16.

1. “*making a computer readable recording*”

Each of the challenged claims requires “making a computer readable recording of said wall thickness, longitudinal and circumferential positions in an associated relationship,” as recited in canceled independent claim 1. Ex. 1001, 9:57–60, 9:61–64, 10:13–17, 10:18–21, 10:37–41, 10:42–45, 10:61–65, 12:4–8. Petitioner contends, relying on the testimony of Dr. Rodgers, that Assanelli discloses making a computer readable recording

of wall thickness, as well as circumferential and longitudinal position data, and using that recording to create the FEM shown in Figure 9 of Assanelli. Pet. 40, 42; *see* Ex. 1005, 2; Ex. 1007 ¶¶ 147, 150, 154–156. In support of Petitioner’s position, Dr. Rodgers testifies that Assanelli discloses gathering a “dataset, which incorporates longitudinal and angular position, wall thickness, and other measurements, [that] is recorded on a computer (pictured and labeled ‘data acquisition’). The dataset is then used to generate a three-dimensional model of the tubular with accurately represented geometry.” Ex. 1007 ¶ 147; *see also id.* ¶ 149 (“The measurements are recorded on a computer data acquisition system.”), ¶ 150 (“Assanelli discloses selecting a section of the wall of a tubular about which information representing wall thickness is to be acquired and then stored in a format readable by a computer.”). Dr. Rodgers additionally testifies that an ordinarily skilled artisan would have understood Assanelli’s disclosure that “[t]he axial position of the ultrasonic transducer is ‘sent to the acquisition system’” indicates that a “longitudinal position sensor is being used to track the location of the cross slide, and that the computer data acquisition system is recording the data.” *Id.* ¶ 154. Dr. Rodgers further explains that an ordinarily skilled artisan would have appreciated that

in order for “information of the full scale test” to have be “stored in a database,” including “[g]eometric measurement fields,” and in order for a complete wall “thickness mapping” to have been generated, [as taught by Assanelli,] a sensor to monitor longitudinal position has been implemented and connected to the data acquisition computer for storage.

Id. Dr. Rodgers also testifies that an ordinarily skilled artisan would have recognized that a “computer was used to generate the three-dimensional

images shown [in Assanelli,] and that [those images are] a representation of the measured data stored using the IMS.” *Id.* ¶ 158.

Patent Owner does not dispute that Assanelli discloses a database having over 100 fields, including wall thickness, and circumferential and longitudinal position data. PO Resp. 23. Nevertheless, Patent Owner argues that “Assanelli does not say how the database is formed, how the information is input to it, what format the information is contained in or how the information contained therein is to be read, by human or some machine means.” PO Resp. 21; *see also id.* at 23 (“Assanelli does not say the database was formatted to be read by a digital computer, was read by digital computer, or was used by a computer to conduct analysis by ‘finite element method’.”). In this vein, Patent Owner asserts that “information representing ‘wall thickness’, measured by ultrasonic (‘time of flight’ detection means) is not fed into the ‘data acquisition’ device of FIG. 1.” *Id.* at 20. Instead, Patent Owner contends that “[g]iven the fact that Assanelli expressly states that ‘the thickness is measured manually at 272 locations, using an ultrasonic gauge,’ one can and should reasonably infer that ‘data’ obtained ‘manually’ (probably with some hand-held ultrasonic gauge which displays a ‘reading’ only momentarily) is manually entered in the ‘database’.” *Id.* at 21.

Although Patent Owner does not cite to Dr. Embloom’s declaration in support of its arguments, we note that Dr. Embloom opines that because the ultrasonic wall thickness measurements of Assanelli are manually performed, “[t]he most reasonable conclusion that one can come to” is that such data is manually entered into the disclosed database. Ex. 2001, 6–7.

Dr. Emblom further testifies that Assanelli “does not indicate what format the information contained in a database is stored [in] or the media which contains it. *Id.* at 7.

On Reply, Petitioner represents that Assanelli expressly states that its IMS is based on the system disclosed in Yeh OTC,⁷ which “specifically taught to use a digital computer to record and store wall thickness data for further analysis.” Reply 5.

Based on our review of the record as a whole, we determine that the preponderance of the evidence supports Petitioner’s contention that Assanelli discloses “making a computer readable recording” of wall thickness, longitudinal position, and circumferential position information “in an associated relationship” (Ex. 1001, 9:57–60). As an initial matter, to the extent Patent Owner contends that Assanelli does not anticipate this claim step because it does not specifically disclose that these properties of a tubular are recorded by a computer, we do not find Patent Owner’s position persuasive, as the challenged claims include no such requirement. Rather, the claims require only that the recordings be computer readable. *Id.*

Furthermore, we find that a preponderance of the evidence supports Petitioner’s contention that Assanelli discloses making the recited wall thickness, circumferential, and longitudinal position data recordings in a computer readable format. Patent Owner’s (and Dr. Emblom’s) assertion that Assanelli does not explicitly discuss how the recited recordings are

⁷ Yeh, M.-K. and S. Kyriakides, *Collapse of Deepwater Pipelines*, OTC Paper 5215 (1986) (“Yeh OTC”) (Ex. 1015).

stored or subsequently read, and, thus, “[o]ne is left ‘speculating’ as to all these matters” (PO Resp. 21) ignores the teachings of Assanelli itself, as well as the inferences an ordinarily skilled artisan would have drawn from those teachings.

Assanelli expressly discloses that geometric measurement fields, including wall thickness, and circumferential and longitudinal position, are among the more than 100 “recorded fields” from the “full scale test” that are “stored in a database.” Ex. 1005, 2. Furthermore, as Dr. Rodgers explains, Assanelli teaches the use of a computer during data acquisition (*see, e.g.*, Ex. 1005, 2, Fig. 1), which indicates that much, if not all, of the data was recorded on a computer and stored digitally in the first instance. Ex. 1007 ¶¶ 147, 150, 154–156. In addition, Assanelli discloses the application of a complex algorithm “to transform the acquired data into the actual mapping of the pipe surface and its Fourier series decomposition” as shown in computer-generated Figures 3 and 4 (Ex. 1005, 2), further evidencing that the data acquired using the IMS was in fact recorded in digital format, stored in an electronic database, and read by a computer. Assanelli likewise draws a direct connection between the manually triggered wall thickness measurements and the computer generated wall thickness distribution shown in Figure 5 (*id.*), and discloses the use of the wall thickness mapping “as input data for our 3D finite element models” (*id.* at 1), suggesting that the data obtained from the thickness measurements is recorded in digital format that is read by a computer.

Moreover, we credit Dr. Rodgers’ testimony that in view of the large volume of data gathered, stored in Assanelli’s database, and subsequently

used in three-dimensional modeling and FEM, an ordinarily skilled artisan would have understood that the data must have been recorded in a computer readable format. Ex. 1007 ¶¶ 154, 158. That an ordinarily skilled artisan would have had this understanding is also illustrated by the disclosure of Yeh OTC that “[d]ue to the large number of data required for suitably detailed mapping of the tube imperfections, a computer based data acquisition system is used for recording, manipulating, reducing, and plotting the data” (Ex. 1015, 2).⁸

Accordingly, for the reasons set forth above, we find that the preponderance of the evidence supports Petitioner’s contention that Assanelli discloses that the recited geometric measurement recordings are made in a computer readable format.

⁸ Petitioner appears to assert, and Patent Owner does not dispute, that Yeh OTC is the same reference as Yeh, M.K. and S. Kyriakides, S., *Collapse of deepwater pipelines*, 110 ASME J. ENERGY RES. TECH. 1 (1988) (“Yeh ASME”), which is cited by Assanelli but not of record in this proceeding. See, e.g., Ex. 2007, 99:15–100:1 (testimony by Dr. Emblom, Patent Owner’s declarant, that Yeh OTC (Ex. 1015) is referenced in Assanelli). Despite the apparent agreement between the parties, because Yeh ASME is not of record, and, thus, cannot be compared to Yeh OTC, which is of record, but is not cited by Assanelli, we do not assume Yeh ASME and Yeh OTC are identical. We rely on Yeh OTC only to the extent it is indicative of how an ordinarily skilled artisan would have understood Assanelli. See, e.g., *Baxter Travenol*, 952 F.2d at 390 (“[E]xtrinsic evidence may be considered when it is used to explain, but not expand, the meaning of a reference.”).

2. *“causing a computer means . . . to compute the effect of stressors on the wall of said tubular good”*

Petitioner also asserts that Assanelli discloses using geometric data recordings to compute, with a computer, the effect of stressors on the wall of the tubular. Pet. 40, 43–44; Ex. 1005, 3; Ex. 1007 ¶ 159. In particular, Petitioner contends that Assanelli discloses performing FEA using the above-described digitally recorded data to “simulate the effect of external collapse pressure” on a tubular wall, and thereby “identify the pressure load at which collapse failure occurs.” Pet. 40 (citing Ex. 1007 ¶ 147).

In support of Petitioner’s position, Dr. Rodgers testifies that

Assanelli’s primary objective in developing an accurate three-dimensional representation of a pipe based on ultrasonic wall thickness measurements is to use the data to perform a stress analysis. See Ex. 1005 at 1, 3, 4, and Figure 9. The stress analysis is performed using “3D finite element models” with the pipe loaded with hydrostatic pressure on the outer surface. *Id.* at 1. This simulates operation in a deepwater pipeline application in which the pressure of the water column is loading on the outside of the pipe. The three-dimensional finite element analysis predicts the resulting stresses in the pipe wall.

Ex. 1007 ¶ 159. With regard to Figure 9 of Assanelli, which depicts a “[f]inite element model of a pipe” and shows “the distribution of axial stresses (on the external surface) at impending collapse” (Ex. 1005, 3), Dr. Rodgers testifies that an ordinarily skilled artisan would have understood “this to be a calculation of the resulting stresses from an applied load” (Ex. 1007 ¶ 159).

Patent Owner recognizes that Assanelli discloses application of the “finite element method” to the above-described database, in order to

calculate tubular “collapse pressure.” PO Resp. 23–24. Patent Owner disputes, however, that Assanelli disclosing performing such analysis on a computer. *Id.* In this vein, Patent Owner asserts that “the word ‘computer’ does not appear anywhere in the text of Assanelli” (*id.* at 17),⁹ and that the “Data Acquisition” device depicted in Figure 1 of Assanelli is “not a computer” capable of performing finite element analysis (*id.* at 17–18). Patent Owner similarly argues that Assanelli fails to disclose a “machine that was capable of making, and actually made, complex mathematical computations from data.” *Id.* at 22.

According to Patent Owner,

[j]ust because Assanelli contains a graphical illustration in FIG. 1 which at first blush may arguably resemble a computer (but tellingly without keyboard, mouse or other human interface device) and/or uses a “database” (which could well be formed by human entry and access of the data contained therein) it does not necessarily follow that Assanelli discloses the express limitation of “causing a digital computer to use at least some of the information which has been recorded in a digital, computer readable format to compute the effect of stressors on the wall of said tubular good”.

PO Resp. 24.

Even though Patent Owner declines to cite to Dr. Emblom’s declaration in support of its arguments, we note that Dr. Emblom testifies that an ordinarily skilled artisan would not have deduced from Figures 6, 8, and 9 of Assanelli that the disclosed collapse pressure calculations were

⁹ Patent Owner appears to acknowledge that at least one of the references cited by Assanelli includes the word “computer” in its title (PO Resp. 16 (quoting Ex. 2004, 27:15–19)).

performed using a computer, because Assanelli does not provide sufficient detail concerning the FEM. Ex. 2001, 14. Dr. Emblom also testifies, however, that FEA software was commercially available for “high end” desktop computers as early as the mid-1980s (Ex. 2001, 10), and that “the FEA software used [by Assanelli] was likely ADINA” (*id.* at 11).

On Reply, Petitioner points out that Dr. Emblom testified at deposition that Figures 8–10 of Assanelli were made using FEA software. Reply 12–13 (citing Ex. 1029, 64:14–17, 76:6–16). Petitioner also asserts that Dr. Emblom admitted during deposition that many papers published prior to Assanelli, including at least two published in the 1970s, disclosed performing FEA on computers (Reply, 3–7 (citing Ex. 1029, 80:7–84:14, 107:18–108:8, 109:23–110:21, 114:13–115:12)).

Turning to Assanelli itself, Petitioner contends that one of the references cited in that paper, Assanelli II,¹⁰ describes work by the same group and provides further detail concerning the FEA procedures used in Assanelli. Reply, 7. Specifically, as Petitioner observes, Assanelli II explains that “[w]e carry out the finite element analyses using a special version of the general purpose finite element code ADINA that incorporates the quadrilateral QMITC element.” *Id.* (quoting Ex. 1013, 8).

Relying on Dr. Rodgers, Petitioner additionally argues that an ordinarily skilled artisan would have recognized that manually performing

¹⁰ Assanelli, A.P., et al., *Analysis of the Collapse of Steel Tubes under External Pressure*, Computational Mechanics, new trends and applications, E. Oñate and S. Idelshon, Eds., CIMNE, Barcelona, (1998) (“Assanelli II”) (Ex. 1013).

the FEA disclosed by Assanelli would not have been feasible, as it would have taken many years to perform the necessary calculations in that fashion. *Id.* at 13–14. Lastly, Petitioner asserts that because it was well-known in the art to perform FEA using a computer, an ordinarily skilled artisan would have recognized that the FEA disclosed in Assanelli was necessarily performed using a computer. *Id.* at 15.

Patent Owner counters in its Sur-Reply that “Dr. Rodgers squarely acknowledges that a POSITA would *not* have looked to any of the *new* [FEA] references cited in his Supplemental Declaration” (PO Sur-Reply, 2–3) because those references were not applicable to the field of art to which the invention pertains, “using ultrasonic means to non-destructively test joints of pipe . . . and use that data to determine the strength of pipe” (*id.* at 1 n.2 (quoting Ex. 2006, 13:20–25)). Therefore, concludes Patent Owner, “Petitioner’s assertion that these *new* references somehow undermine the testimony of Patent Owner’s witnesses is wholly and completely refuted by Dr. Rodgers’ sworn testimony under cross examination.” *Id.* at 3.

Patent Owner also contends that neither Assanelli nor Yeh OTC discloses using a computer to perform FEA. PO Sur-Reply 3–4. In support of its position, Patent Owner asserts that Dr. Rodgers testifies that Yeh OTC does not disclose FEA (*id.* at 3 (citing Ex. 2006, 20:5–23)), and that “Assanelli does not disclose what type of computer was allegedly used to perform” FEA (*id.* at 3–4 (citing Ex. 2006, 21:3–11)).

In its Sur-Reply, Petitioner avers that the prior art FEA articles described in Dr. Rodgers’ Supplemental Declaration (Ex. 1027) establish that Dr. Emblom erred in testifying that, prior to 2003, FEA computer

technology did not exist at the University of Louisiana Lafayette, where Dr. Emblom is faculty. Pet. Sur-Reply, 4. Petitioner also asserts that Patent Owner fails to address Petitioner's argument that an ordinarily skilled artisan would have recognized, given Assanelli's citation to Assanelli II, which explicitly identifies the FEA software employed by Assanelli, that Assanelli discloses the use of a computer in performing FEA. *Id.* at 5.

Based on our review of the record as a whole, we determine that a preponderance of the evidence supports Petitioner's contention that a person of ordinary skill in the art would have understood Assanelli to disclose using a computer to perform FEA, and thereby, compute the effect of stresses on the wall of a tubular. *See Wasica Fin. GmbH v. Cont'l Auto. Sys., Inc.*, 853 F.3d 1272, 1284 (Fed. Cir. 2017) ("Anticipation is an inquiry viewed from the perspective of one skilled in the art."). As explained above, Assanelli teaches the use of a computer as a data "acquisition system" (Ex. 1005, 2, Fig. 1), and describes recording and storing geometric measurements, including wall thickness, circumferential position, and longitudinal position, in a "database" (*id.*). Assanelli further discloses using data from the database to develop three-dimensional FEMs, and subsequently using those models to compute the distribution of axial stresses on a pipe at impending collapse. *Id.* at 3. For example, Assanelli explains that a "coupling of the imperfections measuring device along with full three-dimensional finite element models of the collapse test was implemented in order to resolve the above mentioned discrepancies" in the two-dimensional model. *Id.* ("For the development of the finite element model, the data from the IMS is reconstructed using the first 12 modes of the modal decomposition

(**Fig. 8**).”). Assanelli goes on to disclose the use of the three-dimensional FEM to compute the effects of stressors, including pressure, on the tubular. The result of this computation is depicted in Figure 9 of Assanelli, which “shows the distribution of axial stresses (on the external surface) at impending collapse.” *Id.* at 3.

Moreover, Assanelli expressly cites to work done by the same group that was published in Assanelli II as providing “[a] detailed analysis using 2D and 3D finite element models of this [residual stress] test.” Ex. 1005, 2. With regard to three-dimensional FEMs, Assanelli II discloses that “[w]e carry out the finite element analyses using the code ADINA and the MITC4 shell element.” Ex. 1013, 15. In view of Assanelli’s reference to Assanelli II as disclosing further detail concerning Assanelli’s FEA procedure, and Assanelli II’s teaching that ADINA software was used to perform FEM, we agree with Petitioner that an ordinarily skilled artisan would have understood Assanelli as disclosing the use of a computer to carry out FEA. *See Baxter Travenol*, 952 F.2d at 390 (“extrinsic evidence may be considered when it is used to explain, but not expand, the meaning of a reference”).

Although Patent Owner makes much of the absence of the word “computer” from Assanelli’s text, as well as the lack of human interface devices and wired connections in Figure 1, when considered in the full context of Assanelli’s disclosure, it is apparent that these perceived shortcomings constitute, at most, superficial concerns. It is well-settled that “the [prior art] reference need not satisfy an *ipsissimis verbis* test,” i.e., identity of terminology is not required, to disclose a claim limitation. *In re*

Gleave, 560 F.3d 1331, 1334 (Fed. Cir. 2009). Rather, “the dispositive question regarding anticipation is whether one skilled in the art would reasonably understand or infer from the prior art reference’s teaching that every claim element was disclosed in that single reference.” *Dayco Prods., Inc. v. Total Containment, Inc.*, 329 F.3d 1358, 1368 (Fed. Cir. 2003). As explained above, Assanelli describes acquiring a vast dataset using an IMS that includes an electronic “data acquisition” device, recording that data in a database, and using the database in FEM, as depicted in Figure 9. Indeed, Patent Owner’s declarant, Dr. Emblom, testified in his declaration that the “FEA software used [by Assanelli] was likely ADINA” (Ex. 2001, 11), and confirmed during deposition that Figures 8–10 of Assanelli “were created using ADINA software.” Ex. 1029, 64:14–17, 76:6–16; *see also* Ex. 2001, 11. In addition, Dr. Emblom acknowledges that computers were being used to perform FEA as early as the 1970s (Ex. 1029, 80:7–83:10), and that FEA software was commercially available for “high end” desktop computers as early as the mid-1980s (Ex. 2001, 10)—well before Assanelli’s publication date, and the invention of the ’518 patent. In view of the above testimony, not to mention the disclosures of Assanelli itself, any contention that an ordinarily skilled artisan would have failed to appreciate that Assanelli discloses the use of a computer to perform FEM is not credible.¹¹

¹¹ At oral hearing, Patent Owner raises, for the first time, the argument that “[t]here is no thickness in [Assanelli’s] Fourier transform[,] so when he’s creating his 3D model from which he calculates collapse, he’s not using that.” Tr. 28:21–22. Because “[n]o new evidence or arguments may be presented at the oral argument,” this argument is improper, and we do not

Accordingly, we find that Petitioner has established by a preponderance of the evidence that Assanelli discloses “causing a computer means to use at least some of the information contained in said computer readable recording to compute the effect of stressors on the wall of said tubular good” as required by each of challenged claims 6, 11, 16, and 20.

3. “*greater than sixty-four*” and “*at least three hundred and sixty*”
discrete portions for each circumference

Petitioner asserts that Assanelli discloses taking greater than 64 and at least 360 wall thickness measurements per circumference, as successively required by canceled claims 7 and 12, from which challenged claims 11 and 16 respectively depend. Pet. 42–44 (citing Ex. 1005, 2, 5, Fig. 5; Ex. 1007 ¶¶ 157, 160, 163). In support of Petitioner’s position, Dr. Rodgers testifies that

Assanelli references a parameter “M”, defined in his Appendix A as “the number of samples taken in each turn (360 on average).” Ex. 1005 at 5. The definition of the parameter “M” was “360 on average, [w]hich is a disclosure of taking at least 360 wall thickness measurements per circumference. *Id.*

Ex. 1007 ¶ 160. With particular regard to the claim 11 requirement for greater than 64 wall thickness measurements per circumference, Petitioner

consider it. *Office Patent Trial Practice Guide*, 77 Fed. Reg. 48,756, 48,768 (Aug. 14, 2012); *see also Dell Inc. v. Acceleron, LLC*, 884 F.3d 1364, 1369 (Fed. Cir. 2018) (“Unless it chose to exercise its waiver authority under 37 C.F.R. § 42.5(b), the Board was obligated to dismiss Dell’s untimely argument given that the untimely argument in this case was raised for the first time during oral argument.”). We note, however, that Assanelli discloses the use of tubular thickness data in FEM. Ex. 1005, 1, 3, 4, Table 1, Fig. 8, Fig. 9; Ex. 1007 ¶¶ 158, 159.

additionally asserts, relying on Dr. Rodgers, that Assanelli “inherently” discloses this claim requirement because it references work by Yeh that describes using an IMS to measure wall thickness at 90 locations per circumference. Pet. 43 (citing Ex. 1007 ¶ 160).

We find, however, that the record does not adequately support Petitioner’s contentions. Assanelli expressly discloses that wall thickness is measured in *272 locations total*. Ex. 1005, 2. It, thus, cannot be the case that Assanelli describes performing at least 360 such measurements *per circumference* as Dr. Rodgers testifies.

Moreover, Petitioner’s inherency argument is incomplete. Although Assanelli identifies its IMS as being based on Yeh AMSE¹² (Ex. 1007 ¶ 160; Ex. 1005, 2, 4 n.10), Yeh ASME is not of record in this case, and it, therefore, cannot be determined whether Assanelli necessarily discloses taking geometric measurements at 90 locations per circumference based on the teachings of Yeh ASME. We recognize that Yeh OTC is of record in this case, and that the parties do not appear to dispute that Yeh ASME and Yeh OTC include the same disclosures. *See, e.g.*, Ex. 2007, 99:15–100:1 (testimony by Dr. Emblom, Patent Owner’s declarant, that Yeh OTC is referenced in Assanelli). Absent the opportunity to review Yeh ASME, or evidence sufficient to establish that Yeh ASME and Yeh OTC are indeed the same, however, we cannot determine whether Yeh ASME discloses making 90 geometric measurements per circumference, much less decide that

¹² Yeh, M.K. and S. Kyriakides, S., *Collapse of deepwater pipelines*, 110 ASME J. ENERGY RES. TECH. 1 (1988) (“Yeh ASME”) (not of record).

Assanelli's citation to Yeh ASME adequately supports Petitioner's inherency argument.

In addition, even were there adequate record support for the contention that Yeh OTC and Yeh ASME include the same disclosures, Petitioner does not adequately explain how Assanelli's representation that its IMS mapping procedure is "based on the one presented by Yeh and Kyriakides, among others" (Ex. 1005, 2) supports a determination that the mapping procedure employed by Assanelli *necessarily* involves taking 90 wall thickness measurements per circumference.

Accordingly, we find that Petitioner has not established by a preponderance of the evidence that Assanelli discloses "wherein said number of said discrete portions within said section of the wall of said tubular good is greater than sixty-four for each circumference of said tubular good," as required by claim 11 (Ex. 1001, 10:18–21, 10:37–41), or "wherein said number of said discrete portions within said section of the wall of said tubular good is at least three hundred and sixty for each circumference of said tubular good," as required by claim 16 (*id.* at 10:42–45, 10:61–65).

4. Conclusion

For the foregoing reasons, we find that Petitioner has established by a preponderance of the evidence that Assanelli anticipates claims 6 and 20 of the '518 patent. We additionally find, however, that Petitioner has not demonstrated by a preponderance of the evidence that Assanelli anticipates claims 11 and 16 of the '518 patent.

E. Obviousness over Kiefer and Assanelli

Petitioner asserts that claims 4, 6, 9, 11, 14, 16, 18, and 20 are unpatentable under § 103(a) as obvious in view of Kiefer and Assanelli. Pet. 45–48. Patent Owner disagrees. PO Resp. 25–50.

A patent claim is unpatentable under 35 U.S.C. § 103(a) if the differences between the claimed subject matter and the prior art are such that the subject matter, as a whole, would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. *KSR Int’l Co. v. Teleflex Inc.*, 550 U.S. 398, 406 (2007). The question of obviousness is resolved on the basis of underlying factual determinations including: (1) the scope and content of the prior art; (2) any differences between the claimed subject matter and the prior art; (3) the level of ordinary skill in the art; and (4) objective evidence of nonobviousness. *Graham v. John Deere Co.*, 383 U.S. 1, 17–18 (1966).^{13,14}

Petitioner contends that the combination of Kiefer and Assanelli discloses each step of claims 4, 6, 9, 11, 14, 16, 18, and 20. With regard to Kiefer, Petitioner asserts that the reference teaches “every element of the

¹³ Neither party introduces objective evidence of non-obviousness or argues that the existence of secondary considerations impacts this Decision’s obviousness analysis. Accordingly, our analysis is based upon the first three of the four Graham factors.

¹⁴ Patent Owner states in its Response that Petitioner bears the burden of establishing obviousness by “Clear and Convincing Evidence.” PO Resp. 24. For clarity, we note that in an *inter partes* review, a petitioner bears the burden of proving unpatentability by a preponderance of the evidence. 35 U.S.C. § 316(e).

claims on which these [challenged] claims depend.” Pet. 45; Ex. 1007

¶ 169. Specifically, Petitioner asserts that “Kiefer discloses using an ultrasonic detection means to inspect tubulars to receive associated measurements for wall thickness, longitudinal position, and circumferential position” taken along “‘one hundred percent’ of the tubular wall as the ultrasonic detection means is moved axially and rotatably through the tubular.” Pet. 29; *see also* Ex. 1003 Abstract, 1:46–2:25, 5:19–37; Ex. 1007

¶ 94. Petitioner states that Kiefer teaches an assembly that is advanced longitudinally down the length of a tubular, while simultaneously being rotated 360 degrees around the circumference of the tubular such that the assembly is able to scan 100 percent of the tubular wall. Pet. 30; Ex. 1003, 3:11–53; Ex. 1007 ¶ 95. Petitioner also contends that “Kiefer confirms that, for every wall thickness measurement that is taken, there are corresponding ‘polar coordinates’ identifying where exactly (longitudinally and circumferentially) in the wall the thickness measurement was taken.” Pet. 30; Ex. 1003, 5:26–45; Ex. 1007 ¶ 95.

Petitioner further asserts that Kiefer teaches an ultrasonic transducer that converts reflective pulses from surfaces defining the inner and outer diameter of a gas main and any imperfections within the wall of the main into digital form before transmitting that data to a surface unit (i.e., computer) that produces a tomograph of the wall of the gas main. Pet. 34–35; Ex. 1003 2:3–14, 5:62–6:4; Ex. 1007 ¶ 109. Petitioner contends the tomograph in Figure 8 of Kiefer is a three-dimensional virtual image of the tubular wall made by computer-generated images representing the

measurements taken by the ultrasonic transducer. Pet. 35; Ex. 1003, Fig. 8, 5:38–45; Ex. 1007 ¶ 110.

Having reviewed the cited evidence, and the record as a whole, we find that Petitioner has accurately described the above-stated disclosures of Kiefer, which we adopt as our own. Indeed, Patent Owner does not challenge these assertions. Instead, the parties’ dispute centers upon whether the FEM of the effect of stresses on the wall of a tubular taught by Assanelli is performed using a computer, and whether an ordinarily skilled artisan would have had reason to combine Kiefer and Assanelli. Thus, our following analysis focuses on those issues.

1. *“causing a computer means . . . to compute the effect of stressors on the wall of said tubular good”*

Petitioner contends, for the same reasons described above in the discussion of anticipation by Assanelli, that Assanelli teaches “causing a computer means to use at least some of the information contained in said computer readable recording to compute the effect of stressors on the wall of said tubular good” as required by challenged claims 4, 6, 9, 11, 14, 16, 18, and 20 (*see, e.g.*, Ex. 1001, 10:13–17). Pet. 43; Ex. 1007 ¶ 132. Patent Owner responds by reasserting the same arguments concerning the purported deficiencies of Assanelli’s teachings addressed previously. PO Resp. 29–34.

For the reasons detailed in Section II.D., above, we determine that Petitioner has demonstrated by the preponderance of the evidence that Assanelli’s disclosure of using a FEM to show the distribution of axial stresses on a tubular at impending collapse satisfies the claim requirement of “causing a computer means to use at least some of the information contained

in said computer readable recording to compute the effect of stressors on the wall of said tubular good” (see, e.g., Ex. 1001, 10:13–17).

2. Rationale to Combine

Petitioner asserts that an ordinarily skilled artisan would have had reason to combine Kiefer and Assanelli because they disclose interrelated teachings in the same field of endeavor. Pet. 46; Ex. 1007 ¶¶ 171, 172. In particular, Petitioner points out that Kiefer and Assanelli each disclose collecting data relating to wall thickness, circumferential position, and longitudinal position, and using that data to create a three-dimensional display of a tubular. Pet. 46; Ex. 1007 ¶¶ 171, 172. Petitioner further explains that Kiefer teaches recording wall thickness and positional data “for future reference and analysis.” Pet. 46 (quoting Ex. 1003, 1:39–41); Ex. 1007 ¶ 171. Petitioner, therefore, contends that a relevant skilled artisan would have had reason to use the wall thickness and positional data described by Kiefer in the three-dimensional finite element model taught by Assanelli to determine the effect of various stresses on the wall of a tubular. Pet. 46; Ex. 1007 ¶ 172.

Petitioner likewise asserts that the combination of Kiefer and Assanelli would simply have been a combination of known methods to yield predictable results. Pet. 46–47; Ex. 1007 ¶¶ 172–176. Specifically, Petitioner argues that an ordinarily skilled artisan would have sought to use the data collected as described in Kiefer to perform the finite element analysis described by Assanelli because Kiefer and Assanelli each disclose

collecting the same data, and Assanelli teaches using such data in finite element analysis. Pet. 46–47; Ex. 1007 ¶¶ 172–176.

Petitioner also contends that market forces would have driven the combination of Kiefer and Assanelli because “[t]he industry wanted to conduct stress analyses so that it could minimize the risks associated with using thinner walled casing for the first time, which was cheaper and more efficient to use.” Pet. 58; Ex. 1007 ¶ 197.

Patent Owner responds that, even applying the level of ordinary skill in the field proffered by Petitioner, such an artisan

would not look to Assanelli as a reference, would not be able to perform the complicated mathematical finite element analysis mentioned (but not fully disclosed) by Assanelli, would not have understood from Assanelli that a digital computer should be used to perform such finite element analysis, and would not be motivated to combine Assanelli with any of the other cited references (Kiefer or Lam).

PO Resp. 44. Rather, according to Patent Owner, a relevant skilled artisan “would only be concerned with confirming compliance with published [American Petroleum Institute] guidelines. A POSITA would not be concerned with using measured data from intense ultrasonic testing in pipe strength calculations performed with a digital computer.” *Id.* at 45.

In support of its position, relying on, but not providing citations to, Dr. Emblom’s testimony, Patent Owner reiterates its contention that an ordinarily skilled artisan “would not have understood in 2003 that Assanelli by stating it used ‘finite elements method’ was teaching the use of a computer running FEA/FEM software.” PO Resp. 42. Patent Owner additionally asserts, again referring to unspecified portions of Dr. Emblom’s

testimony, that due to the expense of obtaining FEA software, and the extent of training required to use it properly, the application of FEM to compute the effect of stresses on a tubular was beyond the grasp of an ordinarily skilled artisan. *Id.* at 41–43.

Patent Owner also contends that Assanelli and Kiefer were directed to inspecting tubulars of different thickness, for different types of defects, under different conditions and, thus, an ordinarily skilled artisan would not have had reason to combine those references. PO Resp. 45–46. According to Patent Owner “Assanelli itself suggest[s] such combination would be unnecessary, because thin-walled pipe [as described by Kiefer] ‘is governed by classical elastic buckling formulas’ (i.e., does not need to utilize finite element method).” *Id.* at 46.

In addition, Patent Owner argues that Petitioner has not adequately established either that a computer available to an ordinarily skilled artisan at the time of invention could have processed the “hundreds of thousands of data sets” acquired during a “‘robust’ inspection of a tubular” by FEM, or that such an artisan “would even know that” such powerful computers existed. PO Resp. 46–47.

On Reply, Petitioner responds that the cited references teach each step of the claimed method (Reply 15–16), and observes that Patent Owner did not directly address the rationale for combining Kiefer and Assanelli set forth in the Petition (*id.* at 18).

Patent Owner and Petitioner each reiterate, in their respective sur-replies, the same arguments described above concerning the teachings of

Assanelli, and the FEA references identified by Petitioner in its Reply. PO Sur-Reply 1–5; Pet. Sur-Reply 1–5.

Based on our review of the record as a whole, we determine that a preponderance of the evidence supports Petitioner’s contention that an ordinarily skilled artisan would have had reason for, and a reasonable expectation of success in, combining Kiefer and Assanelli to arrive at the claimed invention. Kiefer and Assanelli each disclose gathering data representing wall thickness, circumferential position, and longitudinal position data from a tubular, and using that data to create a three-dimensional display of the tubular wall. *See, e.g.*, Ex. 1005, 2–4, Figs. 8–9; Ex. 1003, Fig. 8. In addition, Kiefer expressly states that the geometric measurement data can be recorded “for future reference and analysis” (Ex. 1003, 1:39–41), and, as explained previously, Assanelli teaches that FEM can be used to calculate tubular collapse pressure from wall thickness, circumferential position, and longitudinal position data (*see, e.g.*, Ex. 1005, Fig. 9). The use of Kiefer’s tubular measurement data in Assanelli’s FEM in order to calculate tubular collapse pressure, thus, amounts to the combination of known elements to yield a predictable result. *See KSR*, 550 U.S. at 416 (“The combination of familiar elements according to known methods is likely to be obvious when it does no more than yield predictable results.”).

Furthermore, we find that design incentives and market forces would have prompted an ordinarily skilled artisan to gather and record tubular inspection data, as taught by Kiefer, from tubulars slated for use in high pressure activities, and apply FEM, as taught by Assanelli, in order to

determine the collapse pressure for those tubulars and thereby ensure that the tubulars will be able to withstand operating pressures prior to putting them into use. *See id.* at 417 (“When a work is available in one field of endeavor, design incentives and other market forces can prompt variations of it, either in the same field or a different one. If a person of ordinary skill can implement a predictable variation, § 103 likely bars its patentability.”). In this regard, we credit Dr. Rodgers’ testimony that an ordinarily skilled artisan would have sought to combine Kiefer and Assanelli in order to “mitigate the risks” of failure presented by evolving tubular designs and “ensur[e], to a much greater extent, that a given joint of pipe could handle the operating loads.” Ex. 1007 ¶ 179. We likewise credit Dr. Rodgers’ testimony that the proposed combination of Kiefer and Assanelli would have worked because the “digital data gathered by Kiefer would have been capable of being interpreted and analyzed by many commercial available computer programs at the time (e.g. MATLAB and AutoCAD). Once the model was created, FEA software (e.g. ANSYS, LS-DYNA, ADINA, NASTRAN) could then be used to determine the effect of stresses.” *Id.* ¶ 180.

Patent Owner’s re-visitation of its earlier addressed arguments concerning the level of skill in the field, and the capacity of an ordinarily skilled artisan to have understood and applied Assanelli do not persuade us otherwise. As set forth above, we find that an ordinarily skilled artisan at the time of invention of the ’518 patent would have had the educational and experiential background necessary to develop methods of tubular inspection, not simply to use known tubular testing procedures. For example, such an

artisan would have been exposed to, and had experience with, known tubular inspection systems and methods, as well as the use of existing computer software to perform stress analyses. Accordingly, we do not agree with Patent Owner that the above-defined ordinarily skilled artisan would not have looked to, or grasped, Assanelli. Nor do we agree with Patent Owner that a relevant skilled artisan seeking to develop improved tubular inspection methods “would only be concerned with confirming compliance with published [] guidelines,” not “using measured data from intense ultrasonic testing in pipe strength calculations performed with a digital computer” (PO Resp. 45). To the contrary, as explained above, such an artisan would have been a developer, not simply a user, of tubular inspection technology.

Similarly, we are not persuaded by Patent Owner’s arguments that an ordinarily skilled artisan would not have understood Assanelli to teach using a computer for FEM, and would not have had access to, or sufficient training to use, FEA software. For the reasons explained in Section II.A., above, we find that an ordinarily skilled artisan would have been exposed to, and had experience with, software tools for performing stress analyses. In addition, for the reasons described in Section II.D., above, we find that a person of ordinary skill in the art would have understood Assanelli to disclose the use of a computer to perform FEM. Moreover, to the extent Patent Owner relies on Dr. Emblom’s testimony that an ordinarily skilled artisan would not have had access to, or been familiar with, FEA software, we do not find Patent Owner’s position persuasive. Dr. Emblom acknowledges that FEA software was: (1) in use at his own university as early as the 1970s (Ex. 1029, 83:7–83:10); (2) commercially available for high-end desktop computers by the

mid-1980s (Ex. 2001, 10); (3) used to perform stress analysis on tubulars by the mid-1990s (Ex. 1029, 107:18–108:8, 109:23–110:21); (4) used at his own university to do the same by the late-1990s (*id.* at 114:13–115:12); and (5) used to create Figures 8–10 of Assanelli (*id.* at 64:14–17, 76:6–16). Accordingly, we agree with Petitioner that an ordinarily skilled artisan would have had reason for, and a reasonable expectation of success in applying Assanelli’s FEA methodology to Kiefer’s geometric measurement data.

Patent Owner’s assertion that Petitioner has not adequately established that computers could process, or would have been recognized as being capable of processing the volume of data collected during a “robust” inspection of a tubular fares no better. First, Patent Owner does not identify any record support for this assertion, or the contention that “[a] ‘robust’ inspection of a tubular member generates hundreds of thousands of data sets” (PO Resp. 46–47), on which its argument is premised. Second, Dr. Rodgers testifies that an ordinarily skilled artisan would have recognized that the only feasible way to store and use the large dataset used in FEM of tubular collapse pressure would be on a computer. Ex. 1027 ¶ 159. Dr. Rodgers further presents calculations showing that it would have taken “about 40 minutes” to complete a FEA of 700,000 data points using a Pentium 4 computer processor (Ex. 1027 ¶ 159), a “typical consumer-grade processor” available at the time of invention of the ’518 patent (*id.* at ¶ 159, n.1). We credit this testimony, which directly refutes Patent Owner’s unsupported attorney argument. Third, Dr. Emblom, Patent Owner’s declarant, recognizes that “in the 1980s, 1990s, and early 2000s there was

dramatic increase in ‘computing power.’” Ex. 2001, 15. Notably, Dr. Emblom does not testify that computers lacked the capacity to perform FEM on large datasets, but only that such calculations could be “quickly” performed. *Id.* Moreover, in addition to being unsupported, and, thus, entitled to little weight (37 C.F.R. § 42.65(a)), Dr. Emblom’s testimony that “[w]hat I would take issue with is the thought that just because computer system speed, capacity and reliability increase every possible application of that increased computing power is known in every possible field of human endeavor” (Ex. 2001, 15) is insufficient to rebut Petitioner’s evidence that an ordinarily skilled artisan would have recognized that the large datasets associated with tubular inspection could be used for FEA.

Neither do we find persuasive Patent Owner’s contention that an ordinarily skilled artisan would not have sought to combine Kiefer and Assanelli because those references disclose methods for inspecting tubulars of different thickness, for different defects, and at different times. “When a work is available in one field of endeavor, design incentives and other market forces can prompt variations of it, either in the same field or a different one.” *KSR*, 550 U.S. at 417. Further, a reference is analogous art to the claimed invention if: (1) the reference is from the same field of endeavor as the claimed invention (even if it addresses a different problem); or (2) the reference is reasonably pertinent to the problem faced by the inventor (even if it is not in the same field of endeavor as the claimed invention). *In re Bigio*, 381 F.3d 1320, 1325 (Fed. Cir. 2004).

As explained above, we agree with Petitioner that market forces would have motivated an ordinarily skilled artisan to use the digital data

recordings of Kiefer in the FEM of Assanelli in order to mitigate the risks of tubular failure and ensure that tubulars could function at operational load. In addition, we find that Kiefer and Assanelli are addressed to the same field of endeavor as the claimed invention, namely, methods for inspecting metal tubulars used in extractive industries. *See* Ex. 1005, 1; Ex. 1003, Abstract. With particular regard Patent Owner's contention that Kiefer is directed to a different field of endeavor than Assanelli and the '518 patent, we observe that Kiefer and the '518 patent identify overlapping fields of search.

Ex. 1001, [58] (identifying 73/622 as a field of search); Ex. 1003, [58] (same). Furthermore, because Kiefer and Assanelli each describe methods for inspecting metal tubular goods, these references would logically have commended themselves to an inventor's attention in considering the problem of developing improved methods of inspection for metal tubular goods used in extractive industries. *See In re ICON Health & Fitness, Inc.*, 496 F.3d 1374, 1379–80 (Fed. Cir. 2007). Accordingly, we determine that Kiefer and Assanelli qualify as analogous art.

To the extent Patent Owner contends that an ordinarily skilled artisan would not have sought to employ Assanelli's FEM to assess the strength of Kiefer's tubulars, we observe that the test for obviousness concerns "what the combined teachings of [the cited] references would have suggested to those of ordinary skill in the art," not whether such an artisan would literally graft together the methods they disclose. *In re Keller*, 642 F.2d 413, 425, (CCPA 1981). We also note that Petitioner does not propose performing FEM to analyze Kiefer's tubulars, but rather, employing Kiefer's method for obtaining and recording geometric parameter measurements to measure a

relevant tubular, and perform FEA to calculate the collapse pressure of that tubular. Pet. 45–46.

3. Conclusion

For the foregoing reasons, we determine that Petitioner has established by a preponderance of the evidence that claims 4, 6, 9, 11, 14, 16, 18, and 20 of the '518 patent are unpatentable over the combination of Kiefer and Assanelli.

F. Obviousness over Lam and Assanelli

Petitioner asserts that claims 6 and 20 are unpatentable under § 103(a) as obvious in view of Kiefer and Assanelli. Pet. 49–54. Patent Owner disagrees. PO Resp. 25–50.

In support of its position that the combination of Lam and Assanelli renders obvious claims 6 and 20 of the '518 patent, Petitioner asserts that Lam discloses a method for ultrasonically inspecting, and detecting flaws in a tubular across almost the entire length of a tubular. Pet. 30; Ex. 1004, Abstract, ¶ 13; Ex. 1007 ¶ 119. Petitioner states that “Lam has a transducer system for scanning the entire surface area of the wall of the tubular while recording wall thickness.” Pet. 30; Ex. 1004 ¶¶ 9, 54; Ex. 1007 ¶ 119. Petitioner explains that Lam’s ultrasonic transducer system is moved longitudinally, while the tubular is rotated 360 degrees, “so that the entire surface area of the pipe is inspected.” Pet. 30–31; Ex. 1004 ¶ 61; Ex. 1007 ¶ 120. Petitioner asserts that “[t]hese two ranges of motion (longitudinal and circumferential) allow the assembly to scan 100% of the tubular wall.” Pet. 31; Ex. 1007 ¶ 120.

Petitioner further contends that Lam discloses determining the number and spacing of discrete portions of a tubular wall at which thickness measurements will be acquired by varying the advance speed and rotational speed of the ultrasonic sensors. Pet. 33; Ex. 1004 ¶¶ 11, 60; Ex. 1007 ¶ 126.

Petitioner asserts additionally that the ultrasonic transducer system of Lam produces data “indicative of tubular wall thickness (‘Wall thickness’) which is transmitted to the computer **156** (as digital information from the ultrasonic instrumentation) for wall thickness determination, alarm if necessary, and/or display” (Ex. 1004 ¶ 56). Pet. 33; Ex. 1007 ¶ 125.

Petitioner explains that Lam also discloses that the transducer system provides circumferential and longitudinal location information to a computer, and that such positional data, in combination with wall thickness information, may be used to generate a graphical representation of tubular being examined. Pet. 34–35; Ex. 1004 ¶¶ 58, 60, 72; Ex. 1007 ¶¶ 128–131.

Petitioner also asserts that “Lam discloses recording wall thickness, longitudinal position, and circumferential position at more than two discrete portions of the tubular wall by completing a ‘large percent coverage of the pipe wall’ through inspection” and “completely examin[ing]” the outer surface of a tubular. Pet. 36–38; Ex. 1004 ¶¶ 10, 57; Ex. 1007 ¶ 132.

Having reviewed the cited evidence, and the record as a whole, we find that Petitioner has accurately described the above-stated disclosures of Lam, which we adopt as our own. Indeed, Patent Owner does not challenge these assertions. Instead, the parties’ dispute centers upon whether the FEM of the effect of stresses on the wall of a tubular taught by Assanelli is performed using a computer, and whether an ordinarily skilled artisan would

have had reason to combine Lam and Assanelli. Thus, our following analysis focuses on those issues, which relate to the patentability of each of the challenged claims.

1. *“causing a computer means . . . to compute the effect of stressors on the wall of said tubular good”*

Petitioner contends, for the same reasons described above in the discussion of anticipation by Assanelli, that Assanelli teaches “causing a computer means to use at least some of the information contained in said computer readable recording to compute the effect of stressors on the wall of said tubular good” as required by challenged claims 4, 6, 9, 11, 14, 16, 18, and 20 (*see, e.g.*, Ex. 1001, 10:13–17). Pet. 49; Ex. 1007 ¶ 182. Patent Owner responds by reasserting the same arguments concerning the purported deficiencies of Assanelli’s teachings addressed previously. PO Resp. 29–34.

For the reasons detailed in Section II.D., above, we determine that Petitioner has demonstrated by the preponderance of the evidence that Assanelli’s disclosure of using a FEM to show the distribution of axial stresses on a tubular at impending collapse satisfies the claim requirement of “causing a computer means to use at least some of the information contained in said computer readable recording to compute the effect of stressors on the wall of said tubular good” (*see, e.g.*, Ex. 1007 10:13–17).

2. *Rationale to Combine*

Petitioner asserts that an ordinarily skilled artisan would have had reason to combine Lam and Assanelli because they disclose closely interrelated teachings in the same field of endeavor. Pet. 50; Ex. 1007 ¶ 183.

Petitioner points out that Lam and Assanelli each disclose collecting data relating to wall thickness, circumferential position, and longitudinal position, and sending it to a computer for display and analysis. Pet. 50; Ex. 1007

¶ 183. Petitioner additionally explains that Assanelli teaches using wall thickness and positional data to create a three-dimensional display of a tubular, as well as using such data to perform finite element analysis in order to determine the effect of stressors on the tubular wall. Pet. 50; Ex. 1007

¶ 183. Petitioner, therefore, contends that a relevant skilled artisan would have had reason to use the wall thickness and positional data described by Lam in the three-dimensional display and finite element analysis taught by Assanelli. Pet. 50; Ex. 1007 ¶ 183.

Petitioner also asserts that the combination of Lam and Assanelli would simply have been a combination of known methods to yield predictable results. Pet. 50–54; Ex. 1007 ¶¶ 183–186. Petitioner argues that an ordinarily skilled artisan would have sought to use the data collected as described in Lam to perform the three-dimensional modeling and finite element analysis described by Assanelli because Lam and Assanelli each disclose collecting the same data, and Assanelli teaches using such data in three-dimensional modeling and finite element analysis. Pet. 50–54; Ex. 1007 ¶¶ 183–186.

Petitioner further contends that market forces would have driven the combination of Lam and Assanelli, for the same reasons discussed above with regard to the combination of Kiefer and Assanelli. Pet. 54; Ex. 1007 ¶ 187.

Patent Owner relies on many of the same arguments addressed above regarding the rationale for combining Kiefer and Assanelli to support its position that an ordinarily skilled artisan would not have had reason to combine Lam and Assanelli. For example, Patent Owner reiterates its contention that an ordinarily skilled artisan would not have looked to, or understood, Assanelli, and would not have been concerned with developing improved methods for tubular inspection, but applying old ones. PO Resp. 41–45. Patent Owner also reasserts its argument that Petitioner has not adequately established either that a computer available to an ordinarily skilled artisan at the time of invention of the '518 patent could have processed the “hundreds of thousands of data sets” acquired during a “‘robust’ inspection of a tubular” by FEM, or that such an artisan “would even know that” such powerful computers existed. PO Resp. 46–47.

Focusing specifically on Lam, Patent Owner asserts that the fact that Lam does not itself teach using FEM to calculate collapse pressure suggests that the claimed invention would not have been obvious. PO Resp. 47–48. In addition, because Lam was assigned to an entity that ultimately merged with Petitioner, Patent Owner contends that “as of August 2001 Petitioner *itself* did *not* consider the invention in question to be ‘obvious.’” *Id.* at 48. According to Patent Owner, “Petitioner fails to explain with factual evidence of record an invention that was ‘not obvious’ (even as to Petitioner itself) as of August 2001 somehow become “obvious” in March 2003 (the invention date).” *Id.* at 49.

On Reply, Petitioner responds that the cited references teach each step of the claimed method (Reply 15–16), and observes that Patent Owner does

not directly address the rationale for combining Lam and Assanelli set forth in the Petition (*id.* at 18–19).

Patent Owner and Petitioner each reiterate, in their respective sur-replies, the same arguments described above concerning the teachings of Assanelli, and the FEA references identified by Petitioner in its Reply. PO Sur-Reply 1–5; Pet. Sur-Reply 1–5.

Based on our review of the record as a whole, we determine that a preponderance of the evidence supports Petitioner’s contention that an ordinarily skilled artisan would have had reason for, and a reasonable expectation of success in, combining Lam and Assanelli to arrive at the claimed invention. Lam and Assanelli each disclose gathering data representing wall thickness, circumferential position, and longitudinal position data from a tubular, and using that data to create a graphical display of the tubular wall. *See, e.g.*, Ex. 1005, 2–4, Figs. 8–9; Ex. 1004, ¶¶ 54, 56, 58. In addition, Lam explicitly states that the recorded geometric measurement data can be used to identify “defects” in real time, using a two-dimensional display mapping longitudinal position on one axis, and circumferential position on the other (Ex. 1004 ¶ 58), and, as explained previously, Assanelli teaches that FEM can be used to more accurately assess the impact of defects in a tubular, by calculating tubular collapse pressure from wall thickness, circumferential position, and longitudinal position data (*see, e.g.*, Ex. 1005, Fig. 9). The use of Lam’s tubular measurement data in Assanelli’s FEM in order to calculate tubular collapse pressure, thus, amounts to the combination of known elements to yield a predictable result. *See KSR*, 550 U.S. at 416 (“The combination of familiar

elements according to known methods is likely to be obvious when it does no more than yield predictable results.”).

Furthermore, we find that design incentives and market forces would have prompted an ordinarily skilled artisan to gather and record tubular inspection data, as taught by Lam, from tubulars slated for use in high pressure activities, and apply FEM, as taught by Assanelli, in order to determine the collapse pressure for those tubulars and thereby ensure that the tubulars will be able to withstand operating pressures prior to putting them into use. *See id.* at 417 (“When a work is available in one field of endeavor, design incentives and other market forces can prompt variations of it, either in the same field or a different one. If a person of ordinary skill can implement a predictable variation, § 103 likely bars its patentability.”). In this regard, we credit Dr. Rodgers’ testimony that an ordinarily skilled artisan would have sought to combine Lam and Assanelli in order to “minimize [the] risk of casing failure out on the rig.” Ex. 1007 ¶ 187. We likewise credit Dr. Rodgers’ testimony that the proposed combination of Lam and Assanelli would have worked because

[t]he digital data gathered by Lam would have been capable of being interpreted and analyzed by many commercial[ly] available computer programs at the time (e.g. MATLAB and AutoCAD). Among the abilities of these programs to analyze this data was the ability to create the three-dimensional images discussed above, and to then apply common FEA software tools (e.g. ANSYS, etc.) to compute the effect of stressors on the tubular wall.

Id. ¶ 188.

For the same reasons set forth above in the discussion of obviousness over the combination of Kiefer and Assanelli, we do not find persuasive Patent Owner's contentions regarding the level of skill in the field, the capacity of an ordinarily skilled artisan to have understood and applied Assanelli, the purported lack of sophistication of computers at the time of invention of the '518 patent, or the alleged inability of an ordinarily skilled artisan to have recognized that sophistication.

Neither do we find persuasive Patent Owner's contention that because Lam was filed in 2001 and describes a system for visualizing a pipe wall and automatically triggering a "GO/NO GO" signal, instead of disclosing the claimed invention, the claimed invention must not have been obvious. Taken to its logical conclusion, Patent Owner's contention would foreclose any obviousness challenge predicated on a combination of references in which none of the asserted references individually taught or suggested every element of the challenged claim. Moreover, for purposes of our analysis, it is of no moment that Lam does not describe using FEM for tubular inspection, because we find that Assanelli teaches that aspect of the challenged claim, and that an ordinarily skilled artisan would have sought to combine Assanelli's teachings regarding the use of FEM to calculate tubular collapse pressure with Lam's teachings regarding the acquisition and recording of digital data concerning the geometric properties of a tubular.

Based on the foregoing, therefore, we determine that Petitioner has established by a preponderance of the evidence that an ordinarily skilled artisan would have had reason for, and a reasonable expectation of success

in, combining the teachings of Lam and Assanelli to arrive at the invention set forth in claims 6 and 20 of the '518 patent.

3. Conclusion

For the foregoing reasons, we determine that Petitioner has established by a preponderance of the evidence that claims 6 and 20 of the '518 patent are unpatentable over the combination of Lam and Assanelli.

G. Constitutionality of Inter Partes Review

Patent Owner contends that it is unconstitutional for the United States Patent Office to conclude that issued patent claims are unpatentable. PO Resp. 50–51. Subsequent to the institution of this trial and filing of Patent Owner's Response advancing this argument, the Supreme Court ruled, in *Oil States Energy Services, LLC v. Greene's Energy Group, LLC*, that *inter partes* review does not violate Article III of the Constitution. 138 S. Ct. 1365, 1375 (2018) ("The Constitution does not prohibit the Board from resolving it outside of an Article III court."). Accordingly, we do not find Patent Owner's argument persuasive.

III. EVIDENTIARY MOTIONS

Petitioner and Patent Owner have each filed papers seeking to exclude or strike various evidence. Paper 38; Paper 39; *see also* Paper 41 (objections to evidence not preserved by motion).

A. Petitioner's Motion

Subsequent to Petitioner's filing of an unauthorized Motion to Strike Dr. Emblom's testimony (Paper 30, now expunged), we issued an Order explaining that

to the extent Petitioner intended to move to strike Dr. Emblom's declaration, it was required to seek authorization from the Board before so doing. *See* 37 C.F.R. §42.20(b) ("A motion will not be entered without Board authorization."). . . . [T]o the extent Petitioner intended to move to exclude Dr. Emblom's declaration, an action that would not have required authorization from the Board, a motion to exclude evidence "must identify objections in the record in order and must explain the objections." 37 C.F.R. §42.64(c). Because Petitioner neither requested authorization prior to filing its Motion to Strike, filed timely objections to Dr. Emblom's declaration, nor identified any such objections in the record in its motion, we expunge Petitioner's Motion to Strike from the record.

Paper 32, 3.

On March 19, 2018, Petitioner again filed an unauthorized Motion to Strike Dr. Emblom's testimony (Paper 38), to which Patent Owner filed an Opposition (Paper 42). Because Petitioner's Motion to Strike was not authorized, and because Petitioner did not timely file objections to Dr. Emblom's testimony such that Petitioner's Motion to Strike might be treated as an erroneously captioned motion to exclude, Petitioner's Motion is improper, and the requested relief is, therefore, denied. *See* 37 C.F.R. §§ 42.20(b), 42.64(c).

B. Patent Owner's Motion

Patent Owner's Motion to Exclude (Paper 39), filed subsequent to our Order explaining that a motion to exclude must identify and explain objections already of record (Paper 37, 3), does not identify any underlying objections, nor did Patent Owner file objections to the evidence cited in Petitioner's Reply. In addition, because Patent Owner's Motion to Exclude was filed without first obtaining authorization from the Board, it cannot be considered an erroneously captioned motion to strike. *See* 37 C.F.R. § 42.20(b). Accordingly, Patent Owner's Motion to Exclude is denied. *See* 37 C.F.R. § 42.64(c).

For completeness, we note that although Patent Owner filed Objections to Petitioner's Sur-Reply (Paper 41), those objections were not subsequently preserved with a motion to exclude, and, thus, no relief can be granted concerning those objections. 37 C.F.R. § 42.64(c) ("A motion to exclude evidence must be filed to preserve any objection.").

IV. CONCLUSION

For the foregoing reasons, we conclude that Petitioner has shown by a preponderance of the evidence that claims 4, 6, 9, 11, 14, 16, 18, and 20 of the '518 patent are unpatentable.

V. ORDER

In consideration of the foregoing, it is hereby:

ORDERED that claims 6 and 20 of the '518 patent are unpatentable under 35 U.S.C. § 102(b) as anticipated by Assanelli;

FURTHER ORDERED that claims 4, 6, 9, 11, 14, 16, 18, and 20 of the '518 patent are unpatentable under 35 U.S.C. § 103(a) as obvious over Kiefer and Assanelli;

FURTHER ORDERED that claims 6 and 20 of the '518 patent are unpatentable under 35 U.S.C. § 103(a) as obvious over Lam and Assanelli;

FURTHER ORDERED that Petitioner's Motion to Strike is *denied* as improper;

FURTHER ORDERED that Patent Owner's Motion to Exclude is *denied* as improper; and

FURTHER ORDERED that because this is a Final Written Decision, parties to the proceeding seeking judicial review of the decision must comply with the notice and service requirements of 37 C.F.R. § 90.2.

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Patent 7,401,518 B2

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