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UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

CHEVRON ORONITE COMPANY LLC,
Petitioner,

v.

INFINEUM USA L.P.,
Patent Owner.

IPR2018-00922
Patent 6,723,685 B2

Before JON B. TORNQUIST, MICHELLE N. ANKENBRAND, and JULIA HEANEY, *Administrative Patent Judges.*

TORNQUIST, *Administrative Patent Judge*.

JUDGMENT
Final Written Decision
Determining All Challenged Claims Unpatentable
35 U.S.C. § 318(a)

I. INTRODUCTION

Chevron Oronite Company LLC ("Petitioner") filed a Petition (Paper 1, "Pet.") requesting an *inter partes* review of claims 1–20 of U.S. Patent No. 6,723,685 B2 (Ex. 1001, "the '685 patent"). Infineum USA L.P. ("Patent Owner") did not file a Preliminary Response to the Petition.

Upon consideration of the Petition and the evidence of record, we determined that Petitioner demonstrated a reasonable likelihood that it would prevail with respect to at least one claim of the '685 patent. Paper 6, 20 ("Dec."). Thus, consistent with the Supreme Court's decision in *SAS Institute Inc. v. Iancu*, 138 S. Ct. 1348, 1359–60 (2018), and USPTO Guidance,[1] we instituted review of all challenged claims on all challenged grounds.

Following institution of trial, Patent Owner filed a Patent Owner Response (Paper 13, "PO Resp."), Petitioner filed a Reply (Paper 16, "Pet. Reply"), and Patent Owner filed a Sur-reply (Paper 22, "Sur-reply"). In support of their respective positions, Petitioner relies on the testimony of Dr. Donald J. Smolenski (Ex. 1002) and Dr. Syed Q. A. Rizvi (Ex. 1055), and Patent Owner relies on the testimony of Dr. Jai Bansal (Ex. 2003).

An oral hearing was held on August 30, 2019, and a transcript of the hearing is included in the record (Paper 32, "Tr.").

[1] In accordance with USPTO Guidance, "if the PTAB institutes a trial, the PTAB will institute on all challenges raised in the petition." *See* USPTO, Guidance on the Impact of SAS on AIA Trial Proceedings (April 26, 2018) (available at https://www.uspto.gov/patents-application-process/patent-trial-and-appeal-board/trials/guidance-impact-sas-aia-trial) ("USPTO Guidance").

A. Related Proceedings

The parties identify *Infineum USA LP v. Chevron Oronite Company LLC*, Case No. 1-18-cv-00323 (D. Del.), as a related matter. Pet. 2; Paper 4, 1. The '685 patent was also the subject of IPR2018-00923 (institution denied) and IPR2018-00924 (institution denied). Paper 4, 1; Pet. 2.

B. The '685 Patent

The '685 patent is directed to lubricating oil compositions that "exhibit simultaneously improved low temperature valve train wear performance, excellent compatibility with fluoroelastomer materials commonly used for seals in modern internal combustion engines, and improved fuel economy properties." Ex. 1001, 1:4–9.

The '685 patent explains that lubricating oil compositions for combustion engines typically contain a base oil of lubricating viscosity, as well as various additives used "to improve detergency, to reduce engine wear, to provide stability against heat and oxidation, to reduce oil consumption, to inhibit corrosion, to act as a dispersant, and to reduce friction loss." *Id*. at 1:12–19. The '685 patent further explains that "[s]ome additives provide multiple benefits, such as dispersant-viscosity modifiers," whereas other additives improve one characteristic of the lubricating oil while adversely affecting one or more other characteristics. *Id.* at 1:19–22.

The '685 patent discloses that when "small amounts of one or more oil soluble molybdenum compounds," an ashless, organic, nitrogen-free friction modifier, zinc dihydrocarbyl dithiophosphate (ZDDP), and a calcium detergent are added to a base oil having a viscosity of at least 95 and

a Noack volatility[2] of less than 15%, a low-cost lubricating composition with improved fuel economy, excellent wear protection, and reduced adverse effects on fluoroelastomer seals is provided. *Id.* at 2:1–8, 2:47–55.

C. Illustrative Claim

Petitioner challenges claims 1–20 of the '685 patent. Independent claim 1 is illustrative of the challenged claims and is reproduced below:

> 1. A lubricating oil composition comprising:
>
> a) an oil of lubricating viscosity having a viscosity index of at least 95;
>
> b) at least one calcium detergent;
>
> c) at least one oil soluble molybdenum compound;
>
> d) at least one organic ashless nitrogen-free friction modifier; and
>
> e) at least one metal dihydrocarbyl dithiophosphate compound, wherein said composition is substantially free of ashless aminic friction modifiers, has a Noack volatility of about 15 wt. % or less, from about 0.05 to 0.6 wt. % calcium from the calcium detergent, molybdenum in an amount of from about 10 ppm to about 350 ppm from the molybdenum compound, and phosphorus from the metal dihydrocarbyl dithiophosphate compound in an amount up to about 0.1 wt. %.

Ex. 1001, 13:47–63.

D. Asserted Grounds of Unpatentability

Petitioner challenges the patentability of claims 1–20 of the '685 patent on the following grounds (Pet. 3–4):

[2] Noack volatility measures the evaporative loss of lubricant oil at high temperature. Ex. 1001, 2:52–54; Ex. 1002 ¶ 23. A lower Noack volatility is associated with a less volatile oil. Ex. 1002 ¶ 23.

Claim(s) Challenged	35 U.S.C. §	References
1–3, 6–8, 10, 11, 13–15, 18–20	103	Toshikazu[3], Henderson[4]
4	103	Toshikazu, Henderson, Schlicht[5]
9, 16, 17	103	Toshikazu, Henderson, Walker[6]
1–3, 5–8, 10–15, 18–20	103	Toshikazu, Henderson
4	103	Toshikazu, Henderson, Schlicht
9, 16, 17	103	Toshikazu, Henderson, Walker

II. ANALYSIS

A. Claim Construction

In this *inter partes* review, claim terms are construed according to their broadest reasonable interpretation in light of the specification of the patent in which they appear. 37 C.F.R. § 42.100(b) (2017);[7] *Cuozzo Speed*

[3] Japanese Patent Application Publication No. JP H5-279686 A, published Oct. 26, 1993 (Ex. 1005). Exhibit 1005 contains the English-language translation of Toshikazu, the Japanese language version of this reference, and a declaration attesting to the accuracy of the translation. Our citations are to the English-language translation.
[4] H.E. Henderson, et al., *Higher Quality Base Oils for Tomorrow's Engine Oil Performance Categories*, SAE Technical Paper Series 982582, 1–13 (1998) (Ex. 1006).
[5] US 3,365,396, issued Jan. 23, 1968 (Ex. 1011).
[6] WO 99/60080, published Nov. 25, 1999 (Ex. 1007).
[7] A recent amendment to this rule does not apply here, because the Petition was filed before November 13, 2018. *See* Changes to the Claim Construction Standard for Interpreting Claims in Trial Proceedings Before the Patent Trial and Appeal Board, 83 Fed. Reg. 51,340 (Oct. 11, 2018) (amending 37 C.F.R. § 42.100(b) effective November 13, 2018) (codified as amended at 37 C.F.R. § 42.100(b) (2019)).

Techs., LLC v. Lee, 136 S. Ct. 2131, 2144–46 (2016) (upholding the use of the broadest reasonable interpretation standard). In determining the broadest reasonable construction, we presume that claim terms carry their ordinary and customary meaning. *See In re Translogic Tech., Inc.*, 504 F.3d 1249, 1257 (Fed. Cir. 2007). A patentee may define a claim term in a manner that differs from its ordinary meaning; however, any special definitions must be set forth in the specification with reasonable clarity, deliberateness, and precision. *See In re Paulsen*, 30 F.3d 1475, 1480 (Fed. Cir. 1994).

Claims 18–20

Claims 18–20 recite:

> 18. A method for improving the fuel economy and fuel economy retention properties of an internal combustion engine, which comprises: (1) adding to said engine the lubricating oil composition of claim 1; and (2) operating said engine.
>
> 19. A method for improving the anti-wear protection of an internal combustion engine comprising the steps of: (1) adding a lubricating oil composition of claim 1; and (2) operating the engine.
>
> 20. A method for improving the compatibility between a lubricating oil composition and the seals of an internal combustion engine comprising the steps of: (1) adding to said engine a lubricating oil composition of claim 1; and (2) operating the engine.

Ex. 1001, 14:52–65. As shown above, claims 18–20 each include a preamble that identifies the purpose or intended result of the claimed invention and two method steps requiring (1) the addition of the lubricating oil composition of claim 1 to an engine and (2) operating the engine. *Id.* The parties dispute whether the preambles of claims 18–20 are limiting. Pet. 35–40; Pet. Reply 13; Sur-reply 12–13.

"In general, a preamble limits the invention if it recites essential structure or steps, or if it is 'necessary to give life, meaning, and vitality' to the claims. Conversely, a preamble is not limiting 'where a patentee defines a structurally complete invention in the claim body and uses the preamble only to state a purpose or intended use for the invention.'" *Catalina Mkt'g Int'l, Inc. v. Coolsavings.com, Inc.*, 289 F.3d 801, 808 (Fed. Cir. 2002) (internal citations omitted) (quoting *Pitney Bowes, Inc. v. Hewlett-Packard Co.*, 182 F.3d 1298, 1305 (Fed. Cir. 1999), and *Rowe v. Dror*, 112 F.3d 473, 478 (Fed. Cir. 1997)). A preamble is also generally not limiting when "deletion of the preamble phrase does not affect the structure or steps of the claimed invention." *Id.* at 809.

Here, the preambles of claims 18–20 are statements of purpose or intended result and deletion of these preamble phrases would not affect the steps set forth in claims 18–20. This suggests the preambles are not limiting.

Patent Owner contends a finding that the preambles are limiting is "necessitated" by the doctrine of claim differentiation. Sur-reply 12–13. In support of this position, Patent Owner quotes from *Tandon Corp. v. U.S. International Trade Commission*, 831 F.2d 1017, 1023 (Fed. Cir. 1987), which states:

> There is presumed to be a difference in meaning and scope when different words or phrases are used in separate claims. To the extent that the absence of such difference in meaning and scope would make a claim superfluous, the doctrine of claim differentiation states the presumption that the difference between claims is significant.

Although the doctrine of claim differentiation "creates a presumption that each claim in a patent has a different scope," "it is not a 'hard and fast' rule of construction." *Bristol-Myers Squibb Co. v. Ben Venue Labs., Inc.*,

246 F.3d 1368, 1375 (Fed. Cir. 2001); *Seachange Int'l, Inc. v. C-COR Inc.*, 413 F.3d 1361, 1368–69 (Fed. Cir. 2005). Thus, where the preambles of multiple claims provide only a statement of purpose or intended result, and do not result in a manipulative difference in the steps of the methods, the doctrine of claim differentiation, without more,[8] does not require a finding that the preambles are limiting. *Bristol-Meyers Squibb*, 246 F.3d at 1375–1376. This is true even if the result is multiple claims having identical scope. *Id.* at 1376 (finding that independent claims 1 and 5 and independent claims 2 and 8 of the involved patent were of identical scope); *see also Tandon*, 831 F.2d at 1023 (noting that "practice has long recognized that 'claims may be multiplied . . . to define the metes and bounds of the invention in a variety of different ways,'" and "two claims which read differently can cover the same subject matter") (quoting *Bourns, Inc. v. United States*, 537 F.2d 486, 492 (Ct. Cl. 1976)). Thus, we find that the preambles of claims 18–20, which set forth the intended result of the method steps, are not limiting.

[8] Neither party cites to or relies on the written description or prosecution history of the '685 patent to support its proposed construction. *See Allergan Sales, LLC v. Sandoz, Inc.*, 935 F.3d 1370, 1374–75 (Fed. Cir. 2019) (determining that statements of purpose or intended result were limiting where they were relied upon during prosecution to support the patentability of the claims). Moreover, although the preambles of each claim identify the subject of the method as an "internal combustion engine" and the body of each claim refers back to this engine ("said engine" or "the engine"), this is no different than the claims at issue in *Bristol-Meyers Squibb* that were found to be non-limiting, which identified the subject of the method ("a patient" or "a cancer patient") in the preamble and then referred back to this subject in the body of the claims ("said patient"). *Bristol-Meyers Squibb*, 246 F.3d at 1371–72.

B. Principles of Law

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. *See 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) if in the record, objective evidence of nonobviousness. *Graham v. John Deere Co.*, 383 U.S. 1, 17–18 (1966).

C. Level of Ordinary Skill in the Art and Dr. Smolenski's Testimony

The parties dispute the proper level of ordinary skill in the art and whether Dr. Smolenski's testimony should be relied upon in this proceeding.

1. Level of Ordinary Skill in the Art

Petitioner contends a person of ordinary skill in the art

> would have had an undergraduate degree in a relevant field (e.g., Mechanical Engineering, Materials Science Engineering, Chemical Engineering, or Chemistry) with three to five years of experience with formulating and/or testing engine lubricating oil compositions or a graduate degree in a relevant field with one to three years of experience with formulating and/or testing engine lubricating oil compositions.

Pet. 13 (citing Ex. 1002 ¶ 17).

Patent Owner does not set forth a definition of a person of ordinary skill in the art, but Dr. Bansal testifies that

> a person of ordinary skill in the art would have a B.S. degree in Chemistry, Chemical Engineering or an equivalent field as well as at least 5 years of experience directly formulating engine lubricating oil compositions or a graduate degree in Chemistry, Chemical Engineering or an equivalent field as well as at least 3 years of experience directly formulating engine lubricating oil compositions.

Ex. 2003 ¶ 19.

As shown above, both parties generally agree on the amount and type of education, as well as the amount of experience, that would have been possessed by one of ordinary skill in the art, and agree that an individual with experience in directly formulating engine lubricating oil compositions may be one of ordinary skill in the art. Ex. 1002 ¶ 17; Ex. 2003 ¶ 19. The parties' dispute centers around whether an individual with experience in the testing of engine oils may also qualify as one of ordinary skill in the art. PO Resp. 3–5; Pet. Reply 25–27.

Dr. Bansal testifies that, "[i]n view of the '685 Patent, the specification and prosecution history, a deep understanding and hands-on experience formulating engine lubricant oil is . . . a pre-requisite" to be a person of ordinary skill in the art. Ex. 2003 ¶ 23. Dr. Bansal further testifies that in the engine oil additive industry a "formulation scientist," or "formulator," "must possess extensive knowledge of the additive components, inter-component interactions, and additive interactions with the common materials of construction in the engine." *Id.* ¶ 20. Dr. Bansal contends additive companies closely guard this knowledge, which is not available from public sources. *Id.* According to Dr. Bansal, in his "long experience in the additive industry" he has "not come across a single case

where an individual with zero hands-on formulation experience has been tasked with important formulation decision making." *Id.* ¶ 21.

Dr. Rizvi, testifying in support of Petitioner, agrees with Dr. Smolenski's assertion that a person with experience in the testing of engine oils may qualify as one of ordinary skill in the art. Ex. 1055 ¶ 24. Dr. Rizvi further testifies that direct experience formulating an engine oil is not a prerequisite to appreciate that one could combine well-known additive components to achieve the advantages disclosed in the prior art, and notes that he has "interacted with dozens of individuals who understand the intricacies involved in formulating engine oils even though they may not have directly formulated an engine oil." *Id.* ¶ 22.

The '685 patent claims are directed to both a lubricating oil composition and a method of using this lubricating oil composition to improve certain qualities of an internal combustion engine. Ex. 1001, 13:47–63, 14:52–65. The '685 patent specification discloses engine oil additives, formulations of additives in a base oil, and test results for these formulations. *Id.* at 10:42–13:45 (concluding that the disclosed test results demonstrate unexpected results), Tables 1–5. Similar to the '685 patent, the prior art of record discloses both engine oil formulations and testing results for the disclosed compositions. *See* Ex. 1005 ¶ 9, Tables 1, 2 (providing formulation information and testing results for Examples 1–19 and Comparative Examples 1–5). In view of these disclosures, we agree with Petitioner that one of ordinary skill in the art could have experience in either formulating an engine oil or testing such oils in internal combustion engines. Thus, we adopt Petitioner's definition of a person of ordinary skill in the art as more accurately depicting the level of education and experience of one of

ordinary skill in the art, as reflected in the prior art of record and the '685 patent.[9]

2. Dr. Smolenski's Testimony

Patent Owner contends Dr. Smolenski is not a person of ordinary skill in the art and this "automatically impugns his Declaration." PO Resp. 4–5. We are not persuaded by this argument. First, it is undisputed that Dr. Smolenski is one of ordinary skill in the art under the definition we adopt. Tr. 73:16–18. Second, there is no requirement that an expert's education and experience perfectly match that of one of ordinary skill in the art in order to provide testimony. *SEB S.A. v. Montgomery Ward & Co.*, 594 F.3d 1360, 1373 (Fed. Cir. 2010); *Sundance, Inc. v. DeMonte Fabricating Ltd.*, 550 F.3d 1356, 1363–64 (Fed. Cir. 2008). An expert must instead have sufficient knowledge, skill, training, experience or education of a "specialized" nature to assist the trier of fact in understanding the evidence of record. *SEB*, 594 F.3d at 1373.

On this record, we are persuaded that Dr. Smolenski has sufficient education and experience of a specialized nature to assist the Board in understanding the evidence of record. Ex. 1003 (Dr. Smolenski's CV); Ex. 2005, 141:4–143:8 (Dr. Smolenski testifying that despite the fact that he has never worked as a formulator, he has had "extensive exposure to engine oil formulations" and has a "broad understanding of how engine oil

[9] We have adopted the lower level of skill in the art Petitioner has advocated. To the extent a higher level of skill in the art were applicable, we note that "[a] less sophisticated level of skill generally favors a determination of nonobviousness, and thus the patentee, while a higher level of skill favors the reverse." *Innovention Toys, LLC v. MGA Entm't, Inc.*, 637 F.3d 1314, 1324 (Fed. Cir. 2011).

formulations affected results"), 292:2–13 (Dr. Smolenski testifying that he has evaluated hundreds of engine oil formulations and their performance data during his career). Thus, we will consider his testimony in this proceeding.

Although we decline to exclude or ignore Dr. Smolenski's testimony as a whole, we recognize that Dr. Smolenski lacks significant experience in benchtop formulation of engine oils. PO Resp. 4; Ex. 2005, 140:22–141:12 ("No, I don't indicate that I'm an expert formulator."). Accordingly, where relevant, we take Dr. Smolenski's lack of benchtop formulating experience into account when determining the weight to give his testimony, especially where Dr. Rizvi did not confirm this testimony[10] in his declaration and Dr. Bansal did not confirm this testimony during his cross-examination.

D. Obviousness of Claims 1–3, 6–8, 10, 11, 13–15, and 18–20 over Toshikazu (Example 16) and Henderson

Petitioner contends the subject matter of claims 1–3, 6–8, 10, 11, 13–15, and 18–20 would have been obvious over the combined disclosures of Toshikazu (Example 16) and Henderson. Pet. 18–40.

1. Toshikazu

Toshikazu discloses lubricating oils for internal combustion engines that have "excellent wear resistance and friction characteristics." Ex. 1005, Abstract, ¶ 1. Toshikazu explains that anti-wear agents, such as zinc dithiophosphate (ZnDTP) and zinc dithiocarbamate (ZnDTC), prevent wear

[10] There is no dispute that Dr. Rizvi is one of ordinary skill in the art under either party's definition, and Dr. Rizvi testifies that the opinions set forth in his declaration would be the same under either party's definition of one of ordinary skill in the art. Ex. 1055 ¶ 24.

by creating protective films on metal surfaces. *Id.* ¶ 6. When anti-wear and friction reducing agents are used together in a lubricating composition, however, the function of both components may be inhibited due to competitive adsorption at metal surfaces. *Id*. In addition, ZnDTP and ZnDTC may interact with certain detergent/dispersant additives, further impairing their wear resistance. *Id.* ¶ 7. In view of these interactions, Toshikazu reports that it had not previously been possible to achieve satisfactory wear resistance, friction reduction, cleaning, and dispersion using ZnDTP or ZnDTC in combination with known lubricant additives. *Id.* ¶ 8.

> Toshikazu reports that the above limitations can be overcome by using the combination of an organic molybdenum compound and an aliphatic acid ester as a friction reducing agent, by using calcium or magnesium sulfonate, or calcium or magnesium phenate, as a metal detergent, by using benzylamine, alkenyl succinimides, or boron derivatives of alkenyl succinimides, as [an] ashless detergent/dispersant, and by using ZnDTP or ZnDTC as an antiwear additive.

Id. ¶ 10.

Tables 1 and 2 of Toshikazu are reproduced below:

[Table 1]

		Example											
		1	2	3	4	5	6	7	8	9	10	11	12
Friction Reducing Agent	MoDTC	0.225	0.075	0.15	1.50	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15
	MoDTP	---	---	---	---	---	---	---	---	---	---	---	---
	Aliphatic Acid Glyceride	0.075	0.225	0.075	1.50	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075
	Oleamide	---	---	---	---	---	---	---	---	---	---	---	---
Metal Detergent	Ca-S (Overbased)	0.72	0.72	0.72	0.72	0.72	0.72	0.72	0.72	---	---	0.72	0.72
	Ca-S (Neutral)	---	---	---	---	---	---	---	---	---	---	0.40	---
	Ca-P (Overbased)	---	---	---	---	---	---	---	---	0.92	---	---	---
	Mg-S (Overbased)	---	---	---	---	---	---	---	---	---	0.92	---	---
Ashless Detergent/Dispersant	Boron-based Alkenyl Succinimide	2.4	2.4	2.4	2.4	0.4	4.0	---	---	2.4	2.4	2.4	2.4
	Alkenyl Succinimide	---	---	---	---	---	---	---	1.56	---	---	---	---
	Benzylamine	---	---	---	---	---	---	2.92	---	---	---	---	---
Antiwear Additive	*sec*-$C_{3\text{-}6}$ZnDTP	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	---
	pr-$C_{3\text{-}6}$ZnDTP	---	---	---	---	---	---	---	---	---	---	---	0.96
	sec-$C_{3\text{-}6}$ZnDTC	---	---	---	---	---	---	---	---	---	---	---	---
Base Oil		Mineral Oil	Mineral Oil	Mineral Oil	Mineral Oil	Mineral Oil	Mineral Oil	Mineral Oil	Mineral Oil	Mineral Oil	Mineral Oil	Mineral Oil	Mineral Oil
Friction and Wear Characteristics	Friction Coefficient	0.044	0.045	0.041	0.046	0.041	0.043	0.039	0.052	0.048	0.046	0.044	0.043
	Wear Track Diameter (mm)	0.43	0.44	0.41	0.48	0.41	0.45	0.41	0.39	0.44	0.40	0.46	0.4

[0053] [Table 2]

		Example							Comparative Example				
		13	14	15	16	17	18	19	1	2	3	4	5
Friction Reducing Agent	MoDTC	0.15	---	0.15	0.15	0.15	0.15	0.15	---	0.3	---	0.15	0.15
	MoDTP	---	0.15	---	---	---	---	---	---	---	---	---	---
	Aliphatic Acid Glyceride	0.075	0.075	0.075	0.075	0.075	0.075	---	---	---	0.3	0.075	0.075
	Oleamide	---	---	---	---	---	---	0.3	---	---	---	---	---
Metal Detergent	Ca-S (Overbased)	0.72	0.72	0.72	0.72	0.72	0.72	0.72	0.72	0.72	0.72	0.72	---
	Ca-S (Neutral)	---	---	---	---	---	---	---	---	---	---	---	---
	Ca-P (Overbased)	---	---	---	---	---	---	---	---	---	---	---	---
	Mg-S (Overbased)	---	---	---	---	---	---	---	---	---	---	---	---
Ashless Detergent/Dispersant	Boron-based Alkenyl Succinimide	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4	1.6	2.4
	Alkenyl Succinimide	---	---	---	---	---	---	---	---	---	---	---	---
	Benzylamine	---	---	---	---	---	---	---	---	---	---	---	---
Antiwear Additive	*sec*-C_{3-6}ZnDTP	0.48	0.96	0.96	0.96	0.96	---	0.96	0.96	0.96	0.96	0.96	0.96
	pr-C_{3-6}ZnDTP	0.48	---	---	---	---	---	---	---	---	---	---	---
	sec-C_{3-6}ZnDTC	---	---	---	---	---	0.96	---	---	---	---	---	---
Base Oil		Mineral Oil	Mineral Oil	High Pressure Hydro-genated Oil	Synthetic Oil	Mineral Oil / High Pressure Hydro-genated Oil	Mineral Oil	Mineral Oil	Mineral Oil	Mineral Oil	Mineral Oil	Mineral Oil	Mineral Oil
Friction and Wear Characteristics	Friction Coefficient	0.042	0.045	0.044	0.045	0.044	0.046	0.045	0.123	0.088	0.103	0.097	0.101
	Wear Track Diameter (mm)	0.45	0.44	0.42	0.43	0.45	0.42	0.42	0.54	0.56	0.43	0.59	0.52

Tables 1 and 2 provide the compositions of the nineteen Example lubricants and five Comparative Example lubricants of Toshikazu. As shown in Tables 1 and 2 above, the lubricants of Examples 2 and 16 each contain MoDTC (an organic molybdenum compound), an aliphatic acid glyceride friction reducing agent, an overbased calcium sulfonate detergent, a boron-based alkenyl succinimide ashless detergent/dispersant, an *sec*-C_{3-6}-ZnDTP anti-wear additive, and a base oil comprised of either mineral oil (Example 2) or synthetic oil (Example 16). *Id.* at Tables 1, 2; *see also id.* ¶¶ 49–51 (identifying the specific type of additives used in the Example lubricants).

2. Henderson

Henderson discusses the changing requirements in the art for engine oils. Ex. 1006, Abstract. Henderson reports that previous improvements in engine oils had focused on additive technology, but "with the current shift in automotive oil requirements, the need for improved base oils to complement

the additives has led to significant refinery investments." *Id.* at 1.[11] Henderson reports that one of the improvements in the art was a shift toward higher quality base oils with viscosity indices of 100 and above and Noack volatility levels of less than 15%. *Id.* at 1–2 ("However, this change is considered minor compared to the proposed 15% maximum Noack limit as a secondary mandatory volatility specification.").

By using higher quality base oils, Henderson reports that an oil with enhanced features may be obtained. *Id.* at 4. These enhanced features include "improved fuel economy and retention, oxidation stability, lower volatility for improved oil consumption control, high temperature deposit control and exceptional low temperature pumpability." *Id.*

3. Analysis—Independent Claim 1

Petitioner persuasively demonstrates that the lubricating composition of Example 16 of Toshikazu contains an oil of lubricating viscosity, at least one calcium detergent (overbased calcium sulfonate), at least one oil soluble molybdenum compound (MoDTC), at least one organic ashless nitrogen-free friction modifier (aliphatic acid glyceride), and at least one metal dihydrocarbyl dithiophosphate compound (*sec*-C_{3-6}ZnDTP). Pet. 19–24; Ex. 1005 ¶¶ 20–23, 49–51, Table 2. Petitioner also persuasively demonstrates that the composition of Example 16 is substantially free of ashless aminic friction modifiers. Pet. 24.

With respect to the amounts of the recited additive components, Petitioner persuasively demonstrates that the composition of Example 16 contains between 300 to 320 ppm of molybdenum and has a phosphorus

[11] We refer to the original page numbers of Henderson, as opposed to the page numbers added in the lower left corner by Petitioner.

content from the metal dihydrocarbyl dithiophosphate compound (*sec*-C_{3-6}ZnDTP) that is between 0.09 and 0.12 wt. %, a range that overlaps the claimed range of "up to about 0.1 wt. %." *Id.* at 28–29 (quoting *In re Peterson*, 315 F.3d 1325, 1329 (Fed. Cir. 2003) ("In cases involving overlapping ranges, we and our predecessor court have consistently held that even a slight overlap in range establishes a *prima facie* case of obviousness.")).

Although Toshikazu reports that Example 16 contains 0.72 wt. % overbased calcium sulfonate detergent, it does not report the total amount of calcium imparted by this detergent. Petitioner argues, however, that typical overbased calcium sulfonate detergents in the art had a calcium content between 11 and 16%, and calculates that the use of these typical detergents in Example 16 of Toshikazu would result in a calcium content from the calcium detergent that is between 0.08 and 0.12%, a range that the claimed range of 0.05 to 0.6 wt. % fully encompasses. *Id.* at 27–28.

Toshikazu also does not report the viscosity index or Noack volatility of its synthetic base oil, but Petitioner contends one of ordinary skill in the art would have ensured that the base oil of Example 16 had a viscosity index above 95 and a Noack volatility below 15%, in view of Henderson's disclosure that the industry was rapidly shifting toward such oils due to their improved performance and in order to meet the then-applicable GF-3 standard. *Id.* at 20–21, 25–27 (citing Ex. 1006, 1–2, 4, 5, 8, Table 5).

In its response, Patent Owner disputes (1) whether one of ordinary skill in the art would have selected a base oil with a viscosity index above 95 for use in Example 16 of Toshikazu; (2) whether one of ordinary skill in the art would have selected a base oil with a Noack volatility less than 15% for

use in Example 16 of Toshikazu; (3) whether one of ordinary skill in the art would have selected an overbased calcium sulfonate detergent for use in Example 16 of Toshikazu that would provide a calcium content between 0.05 to 0.6 wt. %; and (4) whether one of ordinary skill in the art would have selected the lubricant of Example 16 of Toshikazu for further development and modification. PO Resp. 5–9, 24–35. Patent Owner also asserts that unexpected results reported in the '685 patent for the claimed composition support a finding of nonobviousness. *Id.* at 8–9, 55–58. We address these points below.

a. "an oil of lubricating viscosity having a viscosity index of at least 95"

The base oil of Example 16 is composed of 80 wt. % poly-α-olefins and 20 wt. % diisodecyl adipate (a diester). Pet. 19; Ex. 1005 ¶ 49; Ex. 1002 ¶ 60. Petitioner presents uncontested testimony that the predominant viscosity grades for synthetic base stocks in engine oils were 4 and 6 centistoke ("cSt"). Pet. 20 (citing Ex. 1009, 449; Ex. 1002 ¶ 61); *see also* Ex. 1005 ¶ 12 (Toshikazu disclosing that the base oil preferably has a kinematic viscosity within the range of 3 to 20 cSt). At a viscosity grade of 4 cSt, PAO-4 (poly-α-olefin) has a viscosity index of 123, polyol ester has a viscosity index of 130, and dibasic acid ester (i.e., a diester) has a viscosity index of 161. Pet. 20 (citing Ex. 1009, 450, Fig. 4). At a viscosity grade of 6 cSt, PAO-6 has a viscosity index of 135, polyol ester has a viscosity index of 114, and a diester has a viscosity index of 145. *Id*. (citing Ex. 1009, 450, Fig. 5). Applying these values to the lubricating oil of Example 16, Petitioner contends one of ordinary skill in the art would have understood that this lubricating oil had a viscosity index above 95. *Id.* (citing Ex. 1002

¶ 62 (Dr. Smolenski testifying that the mixture of two synthetic base oils having a viscosity index above 95 would result in a combined base oil with a viscosity index above 95)).

To the extent one of ordinary skill in the art would have had any question regarding the viscosity index of Example 16, Petitioner contends they would have sought to achieve a viscosity index above 95 in view of Henderson's disclosure that base oils having a viscosity index of 100 or above provided several improved features, including "improved fuel economy and retention, oxidation stability, lower volatility for improved oil consumption control, high temperature deposit control, and exceptional low temperature pumpability." *Id.* at 20–21 (citing Ex. 1006, 1–2, 4).

Patent Owner contends one of ordinary skill in the art would not have simply presumed that the PAO of Example 16 was either 4 cSt or 6 cSt, or that the viscosity index of Example 16 is greater than 95. PO Resp. 28. Patent Owner further contends that one of ordinary skill in the art would not have had a reasonable expectation of success in using a base oil with a viscosity index exceeding 95 in Example 16 due to Henderson's and Lakes'[12] disclosures that additive packages used with one type of oil may not be compatible with, and may not necessarily give the same performance in, another type of base oil. *Id.* at 29–30 (citing Ex. 2003 ¶ 102; Ex. 1006, 2; Ex. 1009, 17).

Upon review of the parties' arguments and evidence as a whole, we find that Toshikazu's synthetic oil composed of 80 wt. % poly-α-olefins and 20% diisodecyl adipate (a diester) could have been formulated to have a

[12] Stephen C. Lakes, *Automotive Crankcase Oils*, Marcel Dekker, Inc. (1999) (Ex. 1009, "Lakes").

viscosity index of 100 or greater simply by using the predominant viscosity grades for PAOs known in the art. Pet. 19–20; Ex. 1055 ¶¶ 42–44 (noting that diisodecyl adipate has a viscosity index of 136) (citing Ex. 1038, 145 (Table 1)). We further find that one of ordinary skill in the art would have sought to achieve this viscosity index in view of Henderson's disclosure that the art was rapidly shifting towards such oils due to their improved performance. Ex. 1006, 2, 4.

Although Lakes and Henderson disclose respectively that certain additive packages designed for petroleum-based engine oils may not be suitable for use with synthetic oils (Ex. 1009, 449), and additive solubility must be investigated when new types of base oils are used (Ex. 1006, 2), Petitioner's proposed combination does not require a change from the 80 wt% poly-α-olefins and 20% diisodecyl adipate base oil used in Example 16. Instead, one of ordinary skill in the art would only have needed to select a PAO having one of the predominant viscosity grades used in the art (4 cSt or 6 cSt). Thus, it is not evident why Henderson's and Lakes' concerns with respect to *changing* the type of base oil in a lubricating composition would have been applicable to the selection of an appropriate viscosity grade for the PAO and diisodecyl adipate in Example 16 of Toshikazu.

Moreover, as Dr. Rizvi testifies, Toshikazu expressly indicates that "[t]here is no particular limitation on the base oil used in the present invention, and it is possible to use various types of mineral oils, synthetic oils, and so on that are known in the art."[13] Ex. 1005 ¶ 12; Ex. 1055 ¶¶ 46–

[13] Toshikazu's disclosures are consistent with those of the '685 patent, which indicate that any of Group I–V base stocks, either alone or in combination, may be used in the claimed invention. Ex. 1001, 2:47–3:22.

49. Consistent with this disclosure, Toshikazu reports essentially identical results when the additive package of Example 16 is used with a mineral base oil, a synthetic base oil, or a mineral oil/high pressure hydrogenated base oil. Ex. 1005, Tables 1, 2 (Examples 3, 16, 17). These disclosures suggest that the additive packages of Toshikazu are not susceptible to solubility issues when a new base oil is used. Ex. 1055 ¶ 49. Thus, we credit the testimony of Dr. Smolenski and Dr. Rizvi and find that one of ordinary skill in the art would have had a reasonable expectation of success in using a synthetic base oil that imparts an overall viscosity index of 95 or above to the lubricating composition of Example 16 of Toshikazu. Ex. 1002 ¶ 64; Ex. 1055 ¶¶ 46–49; *see In re O'Farrell*, 853 F.2d 894, 904 (Fed. Cir. 1988) ("For obviousness under § 103, all that is required is a reasonable expectation of success.").

In view of the foregoing, we find that one of ordinary skill in the art would have formulated the lubricating composition of Example 16 of Toshikazu to have a viscosity index greater than 95 and that such an ordinarily skilled artisan would have had a reasonable expectation of success in so doing. Ex. 1055 ¶ 47.

b. "the composition having a Noack volatility of about 15 wt. % or less"

Petitioner contends that at 4 cSt and 6 cSt the base oil of Example 16 would have a Noack volatility of less than 15%. Pet. 25–27. And to the extent Example 16's Noack volatility is unclear, Petitioner contends one of ordinary skill in the art would have ensured that Example 16 had a Noack volatility of less than 15% in order to comply with the then-applicable GF-3 standard (as discussed in Henderson). *Id.*; Pet. Reply 10; Ex. 1006, 2.

In response, Patent Owner repeats its argument set forth above regarding potential compatibility or solubility issues with additive packages when a base oil is changed. PO Resp. 33 (citing Ex. 2003 ¶¶ 115–118) (asserting that any formulation changes could necessitate modifications "of the relative amounts of additive components and the engine oil"); Sur-reply 10.

At the time the '685 patent was filed, the GF-3 standard set a maximum Noack volatility level of 15%. Ex. 1002 ¶ 76; Ex. 1006, 1–2; Ex. 1016, 591, 596. This requirement, as disclosed in Henderson, essentially mandated that any base oil used in Example 16 be formulated with a Noack volatility of 15% or less. Pet. 26; Pet. Reply 10; Ex. 1002 ¶¶ 76, 80; Ex. 1053, 96:22–97:10 (Dr. Bansal testifying that, "[b]y 2002, if you were meeting GF-3 standard, then you would have had to meet 15 percent NOACK"). Thus, we find that one of ordinary skill in the art would have sought to formulate the lubricating composition of Example 16 to have a Noack volatility level of 15% or less prior to the earliest effective filing date of the '685 patent.

With respect to the question of reasonable expectation of success, Petitioner persuasively demonstrates that one of ordinary skill in the art could have formulated the 80 wt. % poly-α-olefins and 20% diisodecyl adipate synthetic oil of Toshikazu to have a Noack volatility level of 15% or less by simply choosing the predominant grades of PAOs used in the art, and Toshikazu indicates there is no particular limitation on the type of synthetic oil used. Pet. 25–27; Ex. 1005 ¶ 12 ("There is no particular limitation on the base oil used in the present invention, and it is possible to use various types of mineral oils, synthetic oils and so on that are known in the art."); Ex.

1055 ¶¶ 48–50; Ex. 1053, 57:21–58:3 (Dr. Bansal agreeing that one of ordinary skill in the art had the necessary skills to select an appropriate base stock for compliance with the GF-3 standard). Thus, we find that one of ordinary skill in the art would have had a reasonable expectation of success in formulating Example 16 of Toshikazu to have a Noack volatility of less than 15%.

c. "0.05 to 0.6 wt. % calcium from the calcium detergent"

Toshikazu discloses that Example 16 contains 0.72 wt. % overbased calcium sulfonate, but does not report the Total Base Number (TBN) or the calcium concentration of this overbased calcium sulfonate. Ex. 1005 ¶ 50, Table 2; PO Resp. 33–34.

In formulating Example 16 of Toshikazu, Petitioner contends one of ordinary skill in the art would have sought to use "a typical overbased calcium sulfonate" known in the art, which Dr. Smolenski testifies would have a calcium content between "about 11 and 16%." Pet. 27 (citing Ex. 1002 ¶¶ 82–85; Ex. 1011, 2:43–50); Pet. Reply 11 (citing Ex. 1055 ¶¶ 55–60). Dr. Smolenski testifies that this level of calcium content is consistent with the range of 11 to 16% reported in Schlicht, the 12.8 and 12.9 wt. % calcium levels reported in Woodle,[14] and the 11.9% calcium value reported in the '685 patent. Ex. 1002 ¶¶ 83–85 (citing Ex. 1011, 2:43–50; Ex. 1012, 5:47–6:22, 6:42–7:15; Ex. 1001, 11:45–46, Table 3); Ex. 1055 ¶¶ 55–60.

Petitioner, with supporting testimony from Dr. Smolenski, calculates that use of a typical overbased calcium sulfonate in Example 16 of

[14] US 3,373,108, issued Mar. 12, 1968 (Ex. 1012, "Woodle").

Toshikazu would result in a total calcium concentration of between 0.08 and 0.12 wt. %, a range that the calcium range recited in claim 1 fully encompasses. Pet. 27 (citing Ex. 1002 ¶¶ 82–85). And to the extent it was possible to find "outlier overbased calcium detergents" that would result in Example 16 having a range of calcium content outside the claimed range, Petitioner contends the range of calcium content Example 16 suggests would have "at a minimum rendered the claimed range obvious." *Id.* at 28 (citing *Peterson*, 315 F.3d at 1329).

Patent Owner does not expressly dispute that typical overbased calcium sulfonate detergents known in the art had a calcium content between 11 and 16%, but contends it is impossible to know the total calcium in the composition of Example 16 because Toshikazu does not report the pedigree of the calcium sulfonate, which is usually delivered in a diluent oil. PO Resp. 33–35. Patent Owner further contends there is no reason to assume the same calcium sulfonate was used in both Toshikazu and the '685 patent, or that the total calcium wt. % would be the same as in Schlicht or Woodle. *Id.* at 34–35. Finally, Patent Owner contends Woodle discloses the use of at least one calcium sulfonate that would provide a total calcium content of 0.0144 wt. % in Example 16, which is outside the range recited in claim 1. *Id.* at 35.

We agree with Patent Owner that it is impossible to determine, based on the information provided in Toshikazu, the calcium content provided by the overbased calcium sulfonate detergent of Example 16. That said, Petitioner presents an obviousness ground, not an anticipation ground, and with supporting testimony from Dr. Smolenski and Dr. Rizvi, demonstrates that (1) one of ordinary skill in the art looking to replicate Example 16 of

Toshikazu would have used a typical overbased calcium sulfonate detergent, (2) typical overbased calcium sulfonate detergents generally had a calcium content ranging from 11 to 16%, and (3) using a typical overbased calcium sulfonate detergent in Example 16 would result in a range of calcium between 0.08 and 0.12 wt. %. Pet. 27; Pet. Reply 11–13; Ex. 1002 ¶¶ 84–85; Ex. 1055 ¶¶ 56–60 (examining the amount of calcium used in prior art lubricating compositions); Ex. 1012, 2:7–9 (Woodle disclosing that its overbased calcium sulfonate concentrate *preferably* has a calcium content of 11 to 18 wt. %); Ex. 1011, 2:50–51 (Schlicht disclosing that its overbased calcium sulfonate concentrate has a calcium content of between about 11 and 16 wt. %).[15] This evidence is sufficient to demonstrate that one of ordinary skill in the art would have found it obvious to provide a calcium content for use in Example 16 of Toshikazu that is within the range recited in claim 1.

Patent Owner presents evidence that some overbased calcium sulfonates are delivered in diluent oil. Ex. 2003 ¶ 121. Even if it is possible that a particular batch of a typical overbased calcium sulfonate detergent could be diluted, however, the range of calcium Toshikazu teaches or suggests would still significantly overlap the range of calcium recited in claim 1. Pet. 27–28; Pet. Reply 12; Ex. 1053, 107:12–25 (Dr. Bansal testifying that the range of calcium recited in claim 1 is "pretty broad"). Thus, the calcium range of claim 1 is presumptively obvious. *See E.I. du*

[15] Petitioner cites to calcium sulfonate products identified in the '685 patent. Pet. 27. We do not rely on these disclosures as evidence of the state of the art as of the filing date of the '685 patent. We note, however, that the identified disclosures are consistent with Petitioner's arguments regarding typical overbased calcium sulfonate detergents.

Pont de Nemours & Co. v. Synvina C.V., 904 F.3d 996, 1006 (Fed. Cir. 2018) ("[W]here the general conditions of a claim are disclosed in the prior art, it is not inventive to discover the optimum or workable ranges by routine experimentation.") (quoting *In re Aller*, 220 F.2d 454, 456 (CCPA 1955)); Pet. 28 (citing *In re Peterson*, 315 F.3d at 1329); Pet. Reply 12.

A presumption of obviousness may be overcome by showing the range in question is "critical," i.e., the range produces new and unexpected results, or by showing that the prior art taught away from the claimed range. *E.I. DuPont*, 904 F.3d at 1006. On this record, we are presented with no evidence or argument to suggest that the *calcium range* recited in claim 1 is "critical," or that the prior art taught away from such a range. *See* PO Resp. 58 (Patent Owner asserting that it is the combination of relatively small amounts of molybdenum compounds and organic ashless nitrogen-free friction modifiers that provides unexpected results). Thus, Patent Owner has not rebutted the presumption of obviousness in this case.

Upon review of the evidence as a whole, we find that the combined disclosures of Toshikazu and Henderson render the range of calcium recited in claim 1 obvious.

d. Selection of Example 16 of Toshikazu

Toshikazu discloses nineteen Example lubricants for internal combustion engines that demonstrate "excellent wear resistance," "low friction coefficient," and better performance than five Comparative Example lubricants. Ex. 1005 ¶¶ 11, 44–51, Abstract, Tables 1, 2; Pet 14. Petitioner contends one of ordinary skill in the art would have selected any one of Toshikazu's Example lubricants, including Example 16, for further development and improvement. Pet. 15, 20–21, 25–27; Pet. Reply 1–2.

Patent Owner contends Petitioner has not persuasively demonstrated that one of ordinary skill in the art would have looked to any of Toshikazu's nineteen Example lubricants, much less specifically selected Example 16 of Toshikazu for further development. PO Resp. 5–7, 24–26. First, Patent Owner contends one of ordinary skill in the art would not have looked to any of Toshikazu's Example lubricants in view of its incomplete disclosure of the viscosity of its base oil, the wt. % of calcium, and the amount of molybdenum and phosphorus in its lubricating oils. *Id.* at 5–6, 25 (citing Ex. 2003 ¶¶ 41–42, 69–73, 90). We are not persuaded by this argument.

Toshikazu discloses the amount of MoDTC, overbased calcium sulfonate, and ZnDTP in Example 16, and Petitioner persuasively demonstrates that one of ordinary skill could have readily calculated from Toshikazu's disclosures the ranges of molybdenum and phosphorus in Example 16. Pet. 28–30; Pet. Reply 4–5; Ex. 1005, Table 2. In addition, for the reasons discussed above, we find that one of ordinary skill in the art would have found it obvious in view of Henderson and the general knowledge of one of ordinary skill in the art to use a typical overbased calcium sulfonate detergent, a base oil having a viscosity index above 95, and a base oil with a Noack volatility below 15%.[16] Pet. 19–21, 24–28; Pet. Reply 4–5. Accordingly, we are not persuaded that one of ordinary skill

[16] Petitioner presents persuasive evidence that one of ordinary skill in the art would have understood how to successfully blend the additives with the base oil of Toshikazu. Pet. Reply 4–5 (citing Ex. 1055 ¶¶ 25, 33; Ex. 1053, 57:21–58:3, 58:18–59:22, 98:20–103:12); *see also* Ex. 1001, 10:16–17 (instructing that "[t]he individual additives may be incorporated into a base stock in any convenient way").

in the art would have avoided the disclosures of Toshikazu in view of a perceived lack of critical information.

Second, Patent Owner contends that even if one of ordinary skill in the art were to look to Toshikazu's Examples, they would not have selected Example 16 for further development because this lubricating composition performed worse than the lubricating compositions of Examples 3, 5, and 7. PO Resp. 7, 25–26; Ex. 2003 ¶¶ 91–92 (Dr. Bansal testifying that Example 16 of Toshikazu "did not perform as well in friction coefficient and wear track diameter as Examples 3, 5, and 7").

As Patent Owner notes, the results reported for the inventive Examples are not identical. PO Resp. 25–26. For example, the lubricant of Example 16 of Toshikazu provides a friction coefficient of 0.045 and a wear track diameter (mm) of 0.43, whereas the lubricants of Examples 3, 5, and 7 provide a friction coefficient of 0.041, 0.041, and 0.039, respectively, and a wear track diameter (mm) of 0.41, 0.41, and 0.41, respectively. Ex. 1005, Tables 1, 2; PO Resp. 25–26 (provided chart).

Dr. Rizvi testifies that the ASTM standard test for measuring coefficient of friction uses a "shell-type four ball test" having a repeatability of "0.20 x average value" and the standard test for wear preventive characteristics has a repeatability of "0.12 mm scar diameter difference." Ex. 1055 ¶¶ 34–37. According to Dr. Rizvi, because the results reported in Toshikazu for coefficient of friction and wear track diameter are all within the repeatability of the applicable tests, a person of ordinary skill in the art would not have considered the differences in Examples 1–19 to be significant or important. *Id.* ¶¶ 34–38, 94. Patent Owner did not contest the substance of this testimony in its briefing. *See* Sur-reply 5–7. Given that the

results reported in Toshikazu are all within the repeatability of the applicable tests, we credit the testimony of Dr. Rizvi that one of ordinary skill in the art would not have differentiated the results reported for Examples 1–19 of Toshikazu.[17] Ex. 1055 ¶¶ 33–38; Pet. Reply 2.

Patent Owner argues "Petitioner cannot credibly allege that *Toshikazu* Examples 16 and 2 motivate a skilled artisan to the claims of the '685 patent while at the same time argue that they are no different than any other example." Sur-reply 7. According to Patent Owner, the disclosure of nineteen similar example lubricants is "at most an invitation at guesswork that would only be successful via hindsight if the '685 patent was used as a blueprint." *Id.*

As Petitioner explains, Toshikazu discloses that its lubricating oil compositions for internal combustion engines have "excellent wear resistance," "a low coefficient of friction," and perform better than Comparative Examples 1–5. Pet. 14–15 (citing Ex. 1005 ¶¶ 1, 9, Tables 1, 2, Abstract; Ex. 1002 ¶¶ 44–47). These disclosures provide ample reason for one of ordinary skill in the art to have selected any of the example lubricating oils of Toshikazu for further development. Moreover, even if the results reported for Examples 3, 5, and 7 were understood to be quantifiably better than those reported for Example 16, we agree with Petitioner that there was still a reason one of ordinary skill would have selected any of Examples 1–19 for further development; namely, these example lubricants

[17] During cross examination, Dr. Smolenski agreed that the friction wear results reported for Examples 3, 5, and 7 of Toshikazu were "better" than those reported for Example 16. Ex. 2005, 216:5–10. Dr. Smolenski did not concede, however, that one of ordinary skill in the art would have considered these numerically "better" results significant or important.

all provided excellent results and outperformed each of the Comparative Examples.[18] Pet. Reply 1–2 (citing Ex. 1005 ¶¶ 52–53, Tables 1, 2; Ex. 1053, 171:9–25).

Third, Patent Owner contends the data in Toshikazu and Waddoups[19] would have led away from the claimed invention by encouraging the use of more MoDTC, not less, and the use of less ashless nitrogen-free friction modifier, not more. PO Resp. 7, 26 (asserting that a comparison of Examples 2 and 3 of Toshikazu would have led away from the claim elements of the '685 patent), 52 (asserting formulations in Waddoups with 900 ppm molybdenum provided superior performance). We do not find this argument persuasive because, as discussed above, we credit the testimony of Dr. Rizvi that one of ordinary skill in the art would not have differentiated the results reported for the Example lubricants of Toshikazu.

Moreover, even if one of ordinary skill in the art would have differentiated the results reported for Toshikazu's examples, we do not agree that they would have been led from these examples to use more MoDTC and less aliphatic glyceride. As Petitioner notes, Examples 2 and 3 of Toshikazu vary in aliphatic glyceride content, whereas Examples 1 and 3 contain the same amount of aliphatic glyceride. Pet. Reply 3; Ex. 1005, Table 1. The

[18] Patent Owner asserts a "lead compound" analysis should be used in this case. Sur-reply 1, 8; PO Resp. 6. To the extent a lead compound analysis were applicable to lubricating oil compositions, however, the Federal Circuit has expressly rejected the argument that a lead compound analysis requires that the prior art point to only a single, or best, lead compound for further development efforts. *See Altana Pharm. Ag v. Teva Pharms. USA, Inc.*, 566 F.3d 999, 1008–09 (Fed. Cir. 2009).

[19] US 6,074,993, issued June 13, 2000 (Ex. 2008, "Waddoups").

results reported for Examples 1 and 3 demonstrate that the composition containing lower amounts of MoDTC in combination with an aliphatic glyceride actually provides better results (at least under Patent Owner's interpretation of the test results). Pet. Reply 3 (citing Ex. 1055 ¶ 95); Ex. 1005, Table 1.

In view of the foregoing, and upon review of the parties' arguments and the art as a whole, we find that one of ordinary skill in the art would have selected Example 16 of Toshikazu for further development.

e. Unexpected Results

Patent Owner contends that, in the 1990s, there was a movement to reduce the phosphorous content of engine oils by limiting the amount of ZDDP additive in lubricating oil compositions. PO Resp. 55 (citing Ex. 2003 ¶ 252). As part of this movement, additive companies began to use oil-soluble molybdenum compounds in place of phosphorus-containing anti-wear additives. *Id.* at 55–56. According to Patent Owner, prior art patents, including Waddoups, demonstrated that lubricating oil compositions with high levels of molybdenum provided superior performance in terms of coefficient of friction as compared to formulations containing small amounts of molybdenum. *Id.* at 56. In view of these coefficient of friction results, Patent Owner contends one of ordinary skill in the art would have believed that formulations with large amounts of molybdenum would also provide superior fuel economy performance, especially under boundary conditions. *Id.* (citing Ex. 2003 ¶¶ 260–266).

Patent Owner contends test results reported in the '685 patent show the same improvement in coefficient of friction when relatively high amounts of molybdenum are used in lubricating compositions, but also show

that when these same lubricating oils were subjected to a fuel economy test, compositions containing a low amount of molybdenum in combination with an organic ashless nitrogen-free friction modifier actually provided superior fuel economy results. *Id.* at 57–58. Patent Owner contends these results "are truly unexpected." *Id.* at 58.

Secondary considerations of nonobviousness must be considered when present "and can serve as an important check against hindsight bias." *Bristol-Myers Squibb Co. v. Teva Pharms. USA, Inc.*, 752 F.3d 967, 977 (Fed. Cir. 2014). "To be particularly probative," however, "evidence of unexpected results must establish that there is a difference between the results obtained and those of the closest prior art, and that the difference would not have been expected by one of ordinary skill in the art at the time of the invention." *Id.* (citing *Kao Corp v. Unilever U.S., Inc.*, 441 F.3d 963, 971 (Fed. Cir. 2006)). A finding of unexpected results may also be entitled to limited weight when there would have been a separate reason to modify the prior art to arrive at the claimed invention. *Id.* at 976.

Patent Owner provides no comparison of fuel economy improvement between the claimed lubricating compositions and the closest prior art. For example, Patent Owner does not compare the fuel economy results for the claimed lubricating compositions and the lubricating composition of Example 16 of Toshikazu, which has the same combination of relatively low molybdenum levels and an organic ashless nitrogen-free friction modifier that the '685 patent reports provides the alleged unexpected results. Ex. 1001, 13:3–35. Thus, we cannot conclude that Patent Owner has demonstrated "a difference between the results obtained" in the '685 patent "and those of the closest prior art." *Bristol-Meyers Squibb*, 752 F.3d at 977.

In addition, Toshikazu reports that its inventive Examples provide "excellent" results. These reported results provide a strong reason to use low levels of molybdenum in combination with an organic ashless nitrogen-free friction modifier. Patent Owner's evidence that this same combination of additives also provides an additional benefit with respect to fuel economy does not alter the fact that the advantages of the combination of low molybdenum and an organic ashless nitrogen-free friction modifier were known in the art. Pet. Reply 25 ("A [person of ordinary skill in the art] would have understood from *Toshikazu* and other literature that MoDTC and ashless organic friction modifiers should be combined."). Thus, we find that Patent Owner's evidence of unexpected results with respect to fuel economy is entitled to limited weight. *See Allergan, Inc. v. Sandoz Inc.*, 726 F.3d 1286, 1293 (Fed. Cir. 2013) (noting that evidence that a particular combination also solved additional problems is not meaningful when "the motivation to make the combination was real"); *Bristol-Myers Squibb*, 752 F.3d at 976 ("As here, *Dillon*'s claimed compound demonstrated both expected and additional, unexpected properties. Those additional unexpected properties, however, did not upset an already established motivation to modify a prior art compound based on the expected properties of the resulting compound.") (citing *In re Dillon*, 919 F.2d 688, 692 (Fed. Cir. 1990) (en banc)).

f. Conclusion with Respect to Claim 1

As discussed above, Petitioner has identified where Toshikazu and Henderson teach or suggest every limitation of claim 1. Petitioner also provides a persuasive explanation as to why record evidence supports that one of ordinary skill in the art would have sought to combine the teachings

of Toshikazu and Henderson with a reasonable expectation of success. When Petitioner's arguments and supporting evidence are considered in combination with Patent Owner's relatively weak evidence of non-obviousness, we determine that Petitioner has demonstrated by a preponderance of the evidence that the subject matter of claim 1 would have been obvious over the combined disclosures of Toshikazu (Example 16) and Henderson.

4. Analysis—Dependent Claims 2, 3, 6–8, 10, 11, and 13–15

Petitioner provides detailed analysis explaining where Toshikazu and Henderson teach or suggest the subject matter of dependent claims 2, 3, 6–8, 10, 11, and 13–15. Pet. 30–35. In particular, Petitioner identifies where the combined disclosures of Toshikazu and Henderson teach or suggest: (1) using an overbased calcium sulfonate detergent (claims 2 and 3) (*id.* at 30–31 (citing Ex. 1002 ¶¶ 91–92; Ex. 1005 ¶¶ 50, 52, 53)); (2) using an organo-molybdenum compound in the form of molybdenum dialkyldithiocarbamate (claims 6–8) (*id.* at 31–32 (citing Ex. 1002 ¶¶ 93–98; Ex. 1005 ¶¶ 49, 53)); (3) using a molybdenum/sulfur complex of a basic nitrogen compound (claim 10) (*id.* at 32 (citing Ex. 1002 ¶¶ 99–100; Ex. 1005 ¶¶ 49, 53)); (4) using at least one zinc dihydrocarbyl dithiophosphate compound in the form of *sec*-C_{3-6}ZnDTP (claim 11) (*id.* at 33 (citing Ex. 1002 ¶¶ 101–102; Ex. 1005 ¶ 53)); (5) using an organic ashless nitrogen-free friction modifier that is an ester (glycerol monooleate) (claims 13–14) (*id.* at 33–34 (citing Ex. 1002 ¶¶ 103–105 (Dr. Smolenski testifying that the glycerol monooleate of Toshikazu is an aliphatic acid ester); Ex. 1005 ¶¶ 49–50, 53)); and (6) a composition that contains between 0.09 to 0.12 wt. % phosphorus from the metal dihydrocarbyl dithiophosphate compound (*sec*-C_{3-6}ZnDTP), a range

that overlaps the claimed range of about 0.025 wt. % to about 0.1 wt. % (claim 15) (*id.* at 34–35 (citing Ex. 1002 ¶¶ 106–108; Ex. 1005 ¶¶ 51, 53)).

Patent Owner does not address Petitioner's arguments or evidence with respect to these challenged claims, apart from asserting that these claims would not have been obvious over Toshikazu and Henderson because they depend from claim 1. PO Resp. 35–36.

Upon review of the evidence of record and the parties' arguments as a whole, and for the reasons discussed above with respect to claim 1, we determine that Petitioner has demonstrated by a preponderance of the evidence that claims 2, 3, 6–8, 10, 11, and 13–15 would have been obvious over the combined disclosures of Toshikazu (Example 16) and Henderson. Pet. 30–35 (citing Ex. 1005 ¶¶ 49, 50, 52, 53; Ex. 1002 ¶¶ 91–108).

5. Analysis—Dependent Claims 18–20

As noted above, we conclude that the preambles of claims 18–20 are not limiting. Thus, these claims require the steps of (1) adding the lubricating oil of claim 1 to an internal combustion engine and (2) operating the engine. Ex. 1001, 14:52–65.

Toshikazu discloses a lubricating oil composition for internal combustion engines that provides "excellent wear resistance and friction characteristics" and Henderson reports that its disclosed lubricating oils provide improved properties when used in an internal combustion engine. Ex. 1005, Abstract; Ex. 1006, 4. As Petitioner notes, to achieve the results reported in Toshikazu and Henderson, the lubricating oil composition of Toshikazu and Henderson would necessarily be added to an internal combustion engine and the engine then operated using this oil, thereby meeting both steps of claims 18–20. Pet. 35–40 (and evidence cited

therein); Ex. 1002 ¶¶ 110, 112. Accordingly, Petitioner has demonstrated by a preponderance of the evidence that the subject matter of claims 18–20 would have been obvious over the combined disclosures of Toshikazu and Henderson.

Even if we were to find that the preambles of claims 18–20 are limiting, Petitioner has sufficiently demonstrated that Toshikazu and Henderson teach or suggest these limitations. As Petitioner notes, Toshikazu expressly discloses that its lubricating compositions provide excellent wear performance (claim 19) and Henderson discloses that using a base oil with a viscosity index exceeding 95 and a Noack volatility level below 15% would lead to improved fuel economy and retention (claim 18). Pet. 36–39 (citing Ex. 1006, 4 (Henderson explaining that high viscosity index base oils provide "improved fuel economy and retention")). Petitioner also demonstrates that one of ordinary skill in the art would have reasonably expected Example 16, which utilizes a nitrogen-free friction modifier, to provide improved compatibility with fluoroelastomer seals of an internal combustion engine. *Id.* at 40 (citing Ex. 1008, 2; Ex. 1002 ¶ 121); Pet. Reply 15 (citing Ex. 1055 ¶¶ 66–70).

In view of the foregoing, Petitioner has demonstrated by a preponderance of the evidence that the subject matter of claims 18–20 would have been obvious over the combined disclosures of Toshikazu (Example 16) and Henderson.

6. Conclusion

Upon review of Petitioner's and Patent Owner's arguments and supporting evidence, we determine that Petitioner has demonstrated by a preponderance of the evidence that the subject matter of claims 1–3, 6–8, 10,

11, 13–15, and 18–20 of the ’685 patent would have been obvious over the combined disclosures of Toshikazu (Example 16) and Henderson.

E. Obviousness of Claim 4 in View of Toshikazu (Example 16), Henderson, and Schlicht

Claim 4 depends from claim 3 and further requires that the “overbased calcium sulfonate has a total base number of between about 150 to 450.” Ex. 1001, 14:3–5. Petitioner contends the subject matter of claim 4 would have been obvious over the combined disclosures of Toshikazu (Example 16), Henderson, and Schlicht. Pet. 41–42; Pet. Reply 16.

1. Schlicht

Schlicht discloses “a method of producing very highly overbased calcium sulfonate-lube oil concentrates.” Ex. 1011, 1:25–28. The example overbased calcium sulfonates disclosed in Schlicht have a TBN from 193 to 311. *Id.* at 5:21–7:27.

Schlicht reports that “[o]verbased metal sulfonates are known to have excellent detergent characteristics and are particularly effective in preventing sludge build-up in heavy duty oils used for combustion engines.” *Id.* at 1:45–48. According to Schlicht, “[o]ne of the most effective overbased sulfonates is overbased calcium sulfonate.” *Id.* at 1:51–52.

2. Analysis

Example 16 of Toshikazu contains 0.72 wt. % overbased calcium sulfonate, but Toshikazu does not report the precise type of calcium sulfonate used in its example lubricants. Ex. 1005 ¶ 50. Petitioner contends that, because Schlicht discloses that its overbased calcium sulfonates are particularly effective in preventing sludge build-up and were “known to have excellent detergent characteristics,” one of ordinary skill in the art

would have sought to use these disclosed detergents (having a TBN between 193 and 311) in Example 16 of Toshikazu. Pet. 42 (citing Ex. 1011, 1:45–48; Ex. 1002 ¶¶ 124–126). Petitioner further contends that one of ordinary skill in the art would have expected the detergents of Schlicht to work successfully in the lubricating composition of Toshikazu and Henderson, as Toshikazu reports that overbased calcium sulfonates have a minimal effect on the friction reducing properties of the lubricating composition. *Id.* (citing Ex. 1005 ¶ 34).

Patent Owner asserts that one of ordinary skill in the art would not have looked to Schlicht's disclosures because they would not have known whether the overbased calcium sulfonate suggested in Schlicht was compatible with Example 16 of Toshikazu. PO Resp. 41–42; Sur-reply 14–15 (asserting that use of a new overbased calcium sulfonate detergent could require a formulation change). We do not find this argument persuasive.

First, Petitioner persuasively argues that one of ordinary skill would have combined the disclosures of Toshikazu, Henderson, and Schlicht to achieve the excellent results reported in Schlicht for its overbased calcium sulfonate detergents. Pet. 42 (citing Ex. 1011, 1:45–48). Patent Owner does not dispute this reasoning. Sur-reply 14 (Patent Owner asserting that there may well have been "a motivation to apply the teaching of *Schlicht to Toshikazu*").

Second, the reasonable expectation of success requirement looks to "the likelihood of success in combining references to meet the limitations of the claimed invention," and there is no credible argument from Patent Owner or testimony from Dr. Bansal that one of ordinary skill would have had any difficulty in adding the overbased calcium sulfonates suggested in

Schlicht to the lubricating oil of Toshikazu and Henderson to arrive at the claimed invention. *See Intelligent Bio-Systems, Inc. v. Illumina Cambridge Ltd.*, 821 F.3d 1359, 1367 (Fed. Cir. 2016); Ex. 1055 ¶ 72 (Dr. Rizvi testifying that Dr. Bansal's concerns with respect to the selection of a particular overbased calcium sulfonate detergent are "overstated"); Ex. 1005 ¶¶ 33–34 (Toshikazu disclosing that the metal detergent may be selected from any of calcium sulfonates, magnesium sulfonates, calcium phenates, and magnesium phenates); Ex. 1001, 7:53–8:12.

In view of the foregoing, we find that Petitioner provides a persuasive rationale supported by factual underpinnings to explain why one of ordinary skill in the art would have sought to use overbased calcium sulfonates having a TBN between 193 and 311 in Example 16 of Toshikazu. Petitioner also sufficiently demonstrates that one of ordinary skill in the art would have had a reasonable expectation of success in combining the disclosures of Toshikazu, Henderson, and Schlicht to arrive at the subject matter of claim 4 of the '685 patent. Pet. 42; Pet. Reply 16. Thus, Petitioner has demonstrated by a preponderance of the evidence that the subject matter of claim 4 would have been obvious over the combined disclosures of Toshikazu (Example 16), Henderson, and Schlicht.

F. Obviousness of Claims 9, 16, and 17 over Toshikazu (Example 16), Henderson, and Walker

Claim 9 depends from claim 8 and further requires that the molybdenum compound is a trinuclear molybdenum compound. Ex. 1001, 14:21–23. Claim 16 depends from claim 15 and further requires that the composition contains "from about 0.025 wt. % to 0.075 wt. % phosphorus from the metal dihydrocarbyl dithiophosphate compound." *Id.* at 14:44–47.

Claim 17 depends from claim 16 and further requires that the composition contains "from about 0.025 wt. % to 0.05 wt. % phosphorus from the metal dihydrocarbyl dithiophosphate compound." *Id.* at 14:48–51.

Petitioner contends the subject matter of claims 9, 16, and 17 would have been obvious over the combined disclosures of Toshikazu (Example 16), Henderson, and Walker. Pet. 42–47.

1. Walker

Walker discloses crankcase lubricants for internal combustion engines that comprise "a lubricating base stock, a dispersant, a metal dihydrocarbyl dithiophosphate, and either a copper-containing compound or a molybdenum-containing compound." Ex. 1007, 1:3–5, 2:12–15.[20]

Walker instructs that the molybdenum compound may be selected from, among other things, molybdenum salts of inorganic or organic acids, or molybdenum compounds comprising a "trinuclear molybdenum core." *Id.* at 11:7–12:11. The trimer form of the molybdenum compounds in Walker "may be represented by the general formula $Mo_3S_kL_p$," wherein "L represents a ligand for example dithiocarbamate," "p is in the range from 1 to 4," and "k is at least 4, especially 4 to 10, preferably 4 to 7." *Id.* at 12:6–11.

Walker discloses that use of ZDDP or other dihydrocarbyl dithiophosphate salts as anti-wear agents was "common," but it had been found that the phosphorus in such materials has a harmful effect on catalytic converters. *Id.* at 2:4–7. As such, Walker indicates that "it is desirable to minimize the proportions of such materials so far as possible." *Id.* at 2:8–11.

[20] We refer to the original page numbers of Walker found at the top of each page.

In Walker's inventive lubricating compositions, "the phosphorus content of the composition is at most 0.08% and preferably it is at most 0.06%, more preferably at most 0.05%, by weight of the composition." *Id.* at 2:26–29.

2. Analysis—Claim 9

Petitioner contends one of ordinary skill in the art would have understood that the trinuclear molybdenum dialkyldithiocarbamate of Walker "was substitutable with other molybdenum dialkyldithiocarbamates" and would have expected this trinuclear molybdenum compound to exhibit "similar results" to the molybdenum compound used in Example 16 of Toshikazu. Pet. 43–44 (citing Ex. 1002 ¶ 130). Petitioner further contends that one of ordinary skill in the art "would not have believed that a substantial difference in amount" of trinuclear molybdenum "would be required to meet or exceed improvements in friction coefficient and wear." *Id.*; Pet. Reply 16–17 (citing Pet. 43–44; Ex. 1002 ¶¶ 128–130; Ex. 1055 ¶ 73).

Patent Owner asserts that one of ordinary skill in the art "would not necessarily modify Example 16 from Toshikazu to incorporate a trinuclear molybdenum compound as disclosed in Walker," because one of ordinary skill in the art "would be left to guess how much of the trinuclear molybdenum compound would need to be employed in order to achieve the same or improved performance in terms of friction coefficient and wear." PO Resp. 43 (citing Ex. 2003 ¶ 159).

When a known composition is altered "by the mere substitution of one element for another known in the field, the combination must do more than yield a predictable result." *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."). On this record, Petitioner sufficiently demonstrates that one of ordinary skill in the art would have considered the trinuclear molybdenum compound of Walker to be interchangeable with the MoDTC compound used in Example 16 of Toshikazu, and would have expected this substitution to yield a predictable result. Ex. 1002 ¶¶ 129–130; Ex. 1055 ¶¶ 73–74. As such, we are persuaded that one of ordinary skill in the art would have found it obvious to use a trinuclear molybdenum compound in Example 16 of Toshikazu.

Contrary to Patent Owner's arguments, we are not persuaded that one of ordinary skill in the art would have needed to blindly "guess" as to the appropriate amount of trinuclear molybdenum to use in Example 16 of Toshikazu. PO Resp. 43. First, Toshikazu Example 16 uses between 300 and 320 ppm molybdenum, and Patent Owner fails to persuasively rebut Petitioner's argument and evidence that the amount of trinuclear molybdenum necessary to achieve the same results in Example 16 would not be substantially different. Pet. 43–44; Pet. Reply 16–17. Second, although the precise amount of trinuclear molybdenum required in Example 16 of Toshikazu is not disclosed in Toshikazu, Henderson, or Walker, Petitioner provides credible evidence that the appropriate amount of trinuclear molybdenum could be determined using a simple bench test. Ex. 1055 ¶ 73. Third, Walker and other prior art references expressly suggest using specific amounts of molybdenum that fall within the range of claim 9. Pet. Reply 17 (citing Ex. 1055 ¶ 74); Ex. 1007, 10:31–11:2 (Walker disclosing that the most preferred amount of molybdenum is 250 ppm).[21]

[21] Example 16 of Toshikazu utilizes between 300 and 320 ppm molybdenum and Walker's preferred range is 50 to 350 ppm. Patent Owner does not

In view of the foregoing, Petitioner has demonstrated by a preponderance of the evidence that the subject matter of claim 9 would have been obvious over the combined disclosures of Toshikazu (Example 16), Henderson, and Walker.

3. Claims 16 and 17

The lubricating composition of Example 16 of Toshikazu contains between 0.09 and 0.12 wt. % phosphorus. Pet. 29, 44 (citing Ex. 1002 ¶¶ 89, 132, 137). Petitioner asserts that one of ordinary skill in the art would have been motivated to lower the level of phosphorus in Example 16 to 0.05 wt. % because it was well known in the art that the phosphorus in engine oils poisons emission control devices and the proposed GF-4 standard mandated lower levels of phosphorus in lubricating oils. *Id.* at 44–45; Ex. 1007, 2:4–11 (noting that phosphorus in engine oils is harmful to catalytic converters), 2:26–28 (setting the preferred range of phosphorus to a level of "at most 0.05%"); Ex. 1014, 1 (noting that the GF-4 standard limited phosphorus to "between 0.05 percent and 0.08 percent"); Ex. 1002 ¶¶ 133, 138.

Patent Owner argues that because Walker's test results indicate "that decreasing phosphorus loading from 0.09% to 0.05% could increase the friction coefficient of a lubricating oil," one of ordinary skill in the art would not have reasonably expected to achieve the "same or improved

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direct us to any evidence to suggest that use of Walker's trinuclear molybdenum compound in Toshikazu would require increasing total molybdenum levels, or that such a substitution would result in less than 10 ppm molybdenum, which is the lower end of the range recited in claim 1 of the '685 patent.

performance" when modifying Example 16 to have a phosphorus loading of 0.05%. PO Resp. 44. We are not persuaded by this argument.

A proposed combination or modification need not result in the "same or improved performance." *See Transocean Offshore Deepwater Drilling Inc. v. Maersk Contractors USA, Inc*., 617 F.3d 1296, 1304 n.1 (Fed. Cir. 2010) ("[W]e note that the focus must be on whether the claimed invention would have been obvious to one of skill in the art, not whether it is an improvement over the prior art."). There must instead be an articulated reason that would have caused one of ordinary skill in the art to make the proposed combination. Here, Petitioner articulates a factually supported reason to make the proposed change even if performance is degraded to some degree, i.e., to avoid catalyst damage and to comply with the upcoming GF-4 standard Pet. 44–45; Ex. 1007, 2:4–11, 2:26–28; Ex. 1014, 1.

Moreover, success in the context of claims 1, 16, and 17 does not require any particular level of performance, only the successful combination of each lubricating oil component to arrive at the subject matter of claim 1, i.e., a composition. *See Intelligent Bio-Systems*, 821 F.3d at 1367. The evidence of record does not suggest that one of ordinary skill would have had any difficulty in formulating the lubricating oil of Example 16 to have 0.05% phosphorus from the metal dihydrocarbyl dithiophosphate compound. Indeed, Walker expressly discloses successfully reducing phosphorus to a preferred level of 0.05 wt. %. Ex. 1007, 2:26–29 (disclosing that the phosphorus content of the composition is "preferably at most 0.05%, by weight of the composition").

In view of the foregoing, we find that one of ordinary skill in the art would have sought to lower the phosphorus content in Example 16 of Toshikazu to 0.05 wt. % in order to avoid catalyst damage and to comply with the upcoming GF-4 standard. We further find that one of ordinary skill in the art would have had a reasonable expectation of success in lowering the phosphorus levels of Example 16 of Toshikazu to 0.05 wt. %. Accordingly, Petitioner has demonstrated by a preponderance of the evidence that the subject matter of claims 16 and 17 would have been obvious over the combined disclosures of Toshikazu (Example 16), Henderson, and Walker.

G. Obviousness of Claims 1–3, 5–8, 10–15, and 18–20 over Toshikazu (Example 2) and Henderson

Petitioner contends the subject matter of claims 1–3, 5–8, 10–15, and 18–20 would have been obvious over the combined disclosures of Toshikazu (Example 2) and Henderson. Pet. 47–65.

The compositions of Examples 2 and 16 of Toshikazu are reproduced below:

		Example	
		2	16
Friction Reducing Agent	MoDTC	0.075	0.15
	MoDTP	---	---
	Aliphatic Acid Glyceride	0.225	0.075
	Oleamide	---	---
Metal Detergent	Ca-S (Overbased)	0.72	0.72
	Ca-S (Neutral)	---	---
	Ca-P (Overbased)	---	---
	Mg-S (Overbased)	---	---
Ashless Detergent/Dispersant	Boron-based Alkenyl Succinimide	2.4	2.4
	Alkenyl Succinimide	---	---
	Benzylamine	---	---
Antiwear Additive	*sec*-$C_{3–6}$ZnDTP	0.96	0.96

		Example	
		2	16
	pr-$C_{3–6}$ZnDTP	---	---
	sec-$C_{3–6}$ZnDTC	---	---
Base Oil		Mineral Oil	Synthetic Oil
Friction and Wear Characteristics	Friction Coefficient	0.045	0.045
	Wear Track Diameter (mm)	0.44	0.43

The table above is a reproduction of a portion of Tables 1 and 2 of Toshikazu and shows the contents of Examples 2 and 16. Ex. 1005, Tables 1, 2. As shown in the table, Example 2 of Toshikazu differs from Example 16 in that it has a lower level of MoDTC and a higher level of aliphatic acid glyceride. *Id.* Example 2 also differs in that it uses a mineral base oil as opposed to a synthetic base oil. *Id.*

1. Analysis—Independent Claim 1

Petitioner persuasively demonstrates, and Patent Owner does not contest, that the lubricating oil composition of Example 2 of Toshikazu contains at least one calcium detergent (overbased calcium sulfonate) (Pet. 49); at least one oil soluble molybdenum compound (MoDTC) (*id.* at 50); at least one organic ashless nitrogen-free friction modifier (aliphatic acid glyceride) (*id.*); and at least one metal dihydrocarbyl dithiophosphate compound (*sec*-$C_{3–6}$ZnDTP) (*id.* at 50–51). Petitioner also persuasively demonstrates that Example 2 of Toshikazu is substantially free of ashless aminic friction modifiers (*id.* at 51 (citing Ex. 1002 ¶¶ 157–158)); contains between 150 to 160 ppm molybdenum from the MoDTC compound (*id.* at 54); and contains between 0.09 to 0.12 wt. % phosphorus from the ZnDTP compound (*id.* at 29–30, 55). Petitioner also repeats its argument regarding the level of calcium discussed above with respect to Example 16. *Id.* at 54.

Petitioner contends the mineral base oil of Example 2 could have a viscosity index of greater than 95 and a "Noack volatility approaching 15 wt. %," but in any event, one of ordinary skill in the art would have selected a synthetic base oil for Example 2 that had viscosity index of greater than 95 and a Noack volatility level of no more than 15%, in view of Henderson's disclosure that the art was rapidly shifting toward these types of oils due to their improved properties. *Id.* at 47–49, 51–53.

Patent Owner contends, for the same reasons discussed above with respect to Example 16, that one of ordinary skill in the art would not have selected Example 2 for further development. PO Resp. 45. Patent Owner further contends that there is insufficient evidence that the mineral oil of Example 2 has a viscosity index of 95 or greater or a Noack volatility of 15% or less. *Id.* at 46, 48. Finally, Patent Owner contends one of ordinary skill in the art would not have substituted the mineral oil in Example 2 of Toshikazu with a synthetic oil with the recited properties, because mineral oils are cheaper than synthetic oils, the mineral oil-based lubricants of Toshikazu "achieved the best performance in terms of both Friction Coefficient and Wear Track Diameter," and a formulator would have recognized that modification of the base oil would require extensive testing and possibly further modification of the oil formulation to achieve similar results. *Id.* at 45–50.

Patent Owner's arguments are not persuasive. First, for the reasons discussed above with respect to Example 16, we are persuaded that one of ordinary skill in the art would have selected any of Examples 1–19 for further development, including Example 2. *See* Section II.D.3.d. Second, although mineral oils are cheaper than synthetic oils, Petitioner presents

persuasive evidence that one of ordinary skill in the art would have sought to substitute the mineral oil of Example 2 with, for example, a synthetic oil having a viscosity index of 95 or above and Noack volatility of less than 15%, in order to comply with the GF-3 standard and to achieve the benefits of higher quality oils discussed in Henderson. Pet. 48–49, 52–53 (and evidence cited therein). Finally, as discussed above with respect to Example 16, we are not persuaded that one of ordinary skill in the art would have had any significant concern in substituting the mineral oil in Example 2 with the synthetic oil of Toshikazu, as Toshikazu reports that there is no limit on the type of lubricating oil used in his invention and test results show that the same additive package could be successfully used with a synthetic oil, a mineral oil, or a mineral oil/high pressure hydrogenated oil. Pet. Reply 2; Ex. 1005, Tables 1, 2; Ex. 1055 ¶¶ 52–53.

In view of the foregoing, Petitioner has demonstrated by a preponderance of the evidence that the subject matter of claim 1 would have been obvious over Toshikazu (Example 2) and Henderson.

2. Dependent Claims 2, 3, 6–8, 10, 11, and 13–15

With respect to dependent claims 2, 3, 6–8, 10, 11, and 13–15, Petitioner persuasively identifies where the subject matter of these claims is disclosed in Toshikazu (Example 2) and Henderson. Pet. 55–64. In particular, Petitioner identifies where the combined disclosures of Toshikazu and Henderson teach or suggest: (1) using an overbased calcium sulfonate detergent (claims 2 and 3) (*id.* at 55–56 (citing Ex. 1002 ¶¶ 174–175; Ex. 1005 ¶¶ 50, 52)); (2) using an organo-molybdenum compound in the form of molybdenum dialkyldithiocarbamate (claims 6–8) (*id.* at 57–58 (citing Ex. 1002 ¶¶ 180–185; Ex. 1005 ¶¶ 49, 52)); (3) using a molybdenum/sulfur

complex of a basic nitrogen compound (claim 10) (*id.* at 59 (citing Ex. 1002 ¶¶ 186–187; Ex. 1005 ¶¶ 49, 52)); (4) using at least one zinc dihydrocarbyl dithiophosphate compound in the form of *sec*-C_{3-6}ZnDTP (claim 11) (*id.* at 59 (citing Ex. 1002 ¶¶ 188–189; Ex. 1005 ¶ 52)); (5) using an organic ashless nitrogen-free friction modifier that is an ester (glycerol monooleate) (claims 13–14) (*id.* at 62–63 (citing Ex. 1002 ¶¶ 196–198 (Dr. Smolenski testifying that the glycerol monooleate of Toshikazu is an aliphatic acid ester); Ex. 1005 ¶¶ 50, 52, 53)); and (6) a composition that contains between 0.09 to 0.12 wt. % phosphorus from the metal dihydrocarbyl dithiophosphate compound (*sec*-C_{3-6}ZnDTP), a range that overlaps the claimed range of about 0.025 wt. % to about 0.1 wt. % (claim 15) (*id.* at 63–64 (citing Ex. 1002 ¶¶ 199–201; Ex. 1005 ¶¶ 51, 52; Ex. 1013, 63 (noting that phosphorus in engine oil generally poisons emission control devices); Ex. 1014, 1)).

Patent Owner does not address these claims beyond noting that they depend from claim 1. PO Resp. 50; Pet. Reply 21.

Upon review of the parties' arguments and supporting evidence, we determine that Petitioner has demonstrated by a preponderance of the evidence that the subject matter of claims 2, 3, 6–8, 10, 11, and 13–15 would have been obvious over Toshikazu (Example 2) and Henderson.

3. Dependent Claim 5

Claim 5 depends from claim 1 and further requires "wherein said molybdenum from a molybdenum compound is present in an amount of about 30 ppm to 200 ppm." Ex. 1001, 14:6–8. Petitioner persuasively demonstrates, and Patent Owner does not dispute, that the molybdenum content in Example 2 of Toshikazu is between 150 and 160 ppm. Pet. 56 (citing Ex. 1002 ¶ 177). Patent Owner asserts, however, that the

performance data reported in Toshikazu would have led one of ordinary skill in the art to use more MoDTC, not less. PO Resp. 51–52. This argument is not persuasive because Example 2 has a range of molybdenum that the range recited in claim 5 fully encompasses, and we previously found that the results reported for Examples 1–19 in Toshikazu would not have been differentiated by one of ordinary skill in the art. Pet. Reply 21–22; *see* Section II.D.3.d.

In view of the foregoing, Petitioner has demonstrated by a preponderance of the evidence that the subject matter of claim 5 would have been obvious over the combined disclosures of Toshikazu (Example 2) and Henderson.

4. Claim 12

Claim 12 depends from claim 1 and further requires "wherein said organic ashless nitrogen-free friction modifier is present in an amount of from about 0.25 wt. % to about 2.0 wt. %, based on the total weight of the composition." Ex. 1001, 14:31–34.

Petitioner concedes that the 0.225 wt. % aliphatic acid glyceride content in Example 2 of Toshikazu falls outside the 0.25 wt. % range recited in claim 12. Pet. 60. Petitioner contends, however, that one of ordinary skill in the art would have been motivated to increase the amount of organic ashless nitrogen-free friction modifier in Example 2 to at least 0.25 wt. % because this compound was known to be less expensive than other anti-wear compounds, including molybdenum. *Id.* at 60–61. Petitioner further contends that one of ordinary skill in the art would have expected this modification to be successful because other Examples in Toshikazu indicate that the amount of organic ashless nitrogen-free friction modifier may be

increased without significantly affecting the performance of the lubricating compositions. *Id.*; Pet. Reply 22–23.

Patent Owner contends one of ordinary skill in the art would not have sought to increase the amount of friction modifier in Example 2 because molybdenum friction modifiers are more effective at reducing the coefficient of friction than ashless friction modifiers, and the Examples of Toshikazu containing higher levels of aliphatic acid glyceride performed worse than those containing lower amounts of these compounds. PO Resp. 53–54 (citing Ex. 1005, Tables 1, 2; Ex. 2003 ¶ 211).

To the extent the term "about 0.25 wt. %" does not encompass 0.225 wt. % aliphatic acid glyceride, we find persuasive Petitioner's argument that one of ordinary skill in the art would have found it obvious to increase the amount of aliphatic acid glyceride in Example 2 to at least "about 0.25 wt. %" in order to save on costs. Pet. 61 (citing Ex. 1002 ¶ 192) (Petitioner providing evidence that aliphatic acid glycerides are less expensive than molybdenum compounds). Patent Owner's arguments based on an alleged decrease in performance from such a change are not persuasive because we have found that one of ordinary skill in the art would not have differentiated the performance results reported for Examples 1–19 of Toshikazu. *See* Section II.D.3.d.

With respect to the question of reasonable expectation of success, given the successful results reported in Toshikazu for lubricating compositions containing increased levels of aliphatic acid glyceride, we credit the testimony of Drs. Smolenski and Rizvi that one of ordinary skill in the art would have had a reasonable expectation of success in increasing the aliphatic glyceride content in Example 2 from 0.225 wt. % to at least "about

0.25 wt. %." Pet. 60–61 (citing Ex. 1002 ¶¶ 191–192); Pet. Reply 22–23 (citing 1055 ¶¶ 99–102).

In view of the foregoing, Petitioner has demonstrated by a preponderance of the evidence that the subject matter of claim 12 would have been obvious over Toshikazu (Example 2) and Henderson.

5. Dependent Claims 18–20

With respect to claims 18–20, Petitioner and Patent Owner repeat their arguments discussed above for Example 16 of Toshikazu. Pet. 35–40, 64–65; PO Resp. 54; Pet. Reply 23. Accordingly, for the reasons set forth above in Section II.D.5, Petitioner has demonstrated by a preponderance of the evidence that the subject matter of claims 18–20 would have been obvious over Toshikazu (Example 2) and Henderson.

H. Obviousness of Claim 4 over Toshikazu (Example 2), Henderson, and Schlicht and Claims 9, 16, and 17 over Toshikazu (Example 2), Henderson, and Walker

With respect to dependent claims 4, 9, 16, and 17, Petitioner and Patent Owner rely on the same arguments presented above for the grounds based on Example 16 of Toshikazu. Pet. 66–67; PO Resp. 54–55. Accordingly, for the reasons discussed above in Sections II.E and II.F, Petitioner has demonstrated by a preponderance of the evidence that the subject matter of claim 4 would have been obvious over Toshikazu (Example 2), Henderson, and Schlicht, and the subject matter of claims 9, 16, and 17 would have been obvious over Toshikazu (Example 2), Henderson, and Walker.

III. PATENT OWNER'S IDENTIFICATION OF ALLEGEDLY IMPROPER REPLY ARGUMENTS AND EVIDENCE

Patent Owner previously requested permission to file a motion to strike Petitioner's Reply, the declaration of Dr. Rizvi, and Exhibits 1023–1052, 1054, 1055. We denied this request, but authorized the parties to file a joint chart identifying the Reply arguments and evidence Patent Owner believes are improper and providing Petitioner's response to Patent Owner's arguments.[22] Paper 23 ("Objec."). We address the issues the parties identify below.

A. Person of Ordinary Skill in the Art

The Petition provides a definition of one of ordinary skill in the art and supports that definition with Dr. Smolenski's testimony. Pet. 13 (citing Ex. 1002 ¶ 17). Patent Owner disagrees with this analysis in its Response, providing testimony of Dr. Bansal to support its arguments. PO Resp. 4–5; Ex. 2003 ¶¶ 17–27. In response to these counter arguments, Dr. Rizvi provides additional evidence and arguments in support of Petitioner's original definition of one of ordinary skill in the art, and explains why we should consider Dr. Smolenski's testimony under either Petitioner's or Patent Owner's definition. Ex. 1055 ¶¶ 20–24.

Patent Owner objects to paragraphs 19–24 of Dr. Rizvi's declaration as allegedly offering new opinions on the level of skill in the art that are not in the Petition. Objec. 1–2.

Neither Petitioner's Reply nor Dr. Rizvi's declaration testimony seek to change the proposed definition of one of ordinary skill in the art set forth

[22] Patent Owner subsequently filed a Motion to Exclude Exhibits 1016, 1017, 1023–1052, and 1054, the declaration of Dr. Rizvi (Ex. 1055), and certain cross-examination testimony of Dr. Bansal (Ex. 1053). Paper 24.

in the Petition. Dr. Rizvi, instead, addresses the specific arguments made in Patent Owner's Response and Dr. Bansal's declaration. As such, we find that Dr. Rizvi's testimony related to the level of ordinary skill in the art constitutes proper rebuttal.

B. General Rebuttal Arguments and Evidence

Patent Owner also objects to multiple portions of Dr. Rizvi's testimony as advancing new theories and relying on new evidence. Objec. 2–5. Upon review of Patent Owner's objections and Petitioner's responses to those objections, we are persuaded that the identified portions of Dr. Rizvi's testimony represent proper rebuttal arguments intended to respond to opinions Dr. Bansal presented in his declaration, and not to fill gaps in the prior art disclosures.

Patent Owner is correct that many Exhibits Dr. Rizvi discusses are not addressed in the Petition. As our reviewing court has instructed, however, "the introduction of new evidence in the course of the trial is to be expected in *inter partes* review trial proceedings and, as long as the opposing party is given notice of the evidence and an opportunity to respond to it, the introduction of such evidence is perfectly permissible under the [Administrative Procedure Act]." *Genzyme Therapeutic Prod. Ltd. P'ship v. Biomarin Pharm. Inc.*, 825 F. 3d 1360, 1366 (Fed. Cir. 2016). Here, Patent Owner deposed Dr. Rizvi after receiving his reply declaration, had an opportunity to respond to his arguments and supporting evidence in a Sur-reply, and has filed a motion to exclude his testimony on relevance grounds. *See Yeda Research v. Mylan Pharms, Inc.*, 906 F.3d 1031, 1040 (Fed. Cir. 2018). Thus, we find that Dr. Rizvi's testimony and supporting documentary evidence are not improper.

IV. MOTION TO EXCLUDE

Patent Owner filed a Motion to Exclude Exhibits 1016, 1017, 1023–1052, 1054, and 1055, as well as certain portions of Dr. Bansal's cross-examination testimony (Paper 24, "Mot. to Excl."). We address Patent Owner's arguments below.

A. Exhibits 1016, 1017, 1027–1031, 1034, and 1048

Patent Owner moves to exclude Exhibits 1016, 1017, 1027–1031, 1034, and 1048 as irrelevant because they allegedly postdate the April 4, 2002, filing date of the '685 patent. Mot. to Excl. 2–3.

1. Exhibits 1016 and 1017

Exhibit 1016 is titled "Automotive Lubricants Reference Book" and contains as Appendix 10 the ILSAC GF-3 standards for passenger car engine oils, which is itself dated October 12, 2000. Ex. 1016, 591. Exhibit 1017 appears to be the front cover of the ILSAC GF-4 standard for passenger car engine oils and bears a date of January 14, 2004. Ex. 1017, 1. Patent Owner contends that because Exhibits 1016 and 1017 were each published after the April 4, 2002, filing date of the '685 patent they are irrelevant to show the state of the art as of the filing date of the '685 patent. Mot. to Excl. 3.

Because both parties agree that the GF-3 standard contained in Exhibit 1016 was released prior to April of 2002 and was accessible to those of ordinary skill in the art, we are not persuaded that the relied upon portion of Exhibit 1016 is irrelevant due to its publication date. Ex. 1055 ¶ 52; Ex. 1002 ¶ 76; Ex. 1053, 36:19–37:5.

Petitioner does not rely upon Exhibit 1017 to show the state of the prior art as of the April 2002 filing date of the '685 patent, but instead to show when the GF-4 standard was ultimately adopted in 2004. Paper 28, 3.

Because Petitioner is not relying on Exhibit 1017 to show the state of the art as of the filing date of the '685 patent, Patent Owner's motion to exclude Exhibit 1017 is *denied*.

In view of the foregoing, we deny Patent Owner's motion to exclude Exhibits 1016 and 1017 in view of their publication dates.

2. Exhibits 1027, 1030, and 1031

Exhibits 1027, 1030, and 1031 were introduced during Dr. Bansal's deposition. Ex. 1053, 192:20–21, 214:8–12, 221:9–11. As Petitioner and Dr. Rizvi do not cite or rely upon these exhibits, we dismiss Patent Owner's motion to exclude Exhibits 1027, 1030, and 1031 as *moot.*

3. Exhibits 1028, 1029, and 1048

Patent Owner contends Exhibits 1028, 1029, and 1048 were all published after the filing date of the '685 patent and, therefore, are irrelevant to show the state of the art as of the filing date of the '685 patent. Mot. to Excl. 2–3.

Petitioner contends it is not relying on the identified exhibits to show the state of the art as of the filing date, but to show that the TBN associated with overbased detergents did not change after the filing date of the '685 patent. Paper 28, 4.

Because Petitioner is not relying on Exhibits 1028, 1029, and 1048 to show the state of the art as of the filing date of the '685 patent, Patent Owner's motion to exclude Exhibits 1028, 1029, and 1048 is *denied.*

4. Exhibit 1034

Exhibit 1034 is an article identifying both Dr. Smolenski and Dr. Bansal as "peer experts." Ex. 1034, 32; Pet. Reply 26–27. This document was published in 2018, well after the 2002 filing date of the

'685 patent, and it does not show the state of the art in 2002. That said, Exhibit 1034 is at least somewhat relevant to the questions of whether Dr. Smolenski's testimony will be helpful to the trier of fact and whether he can opine from the viewpoint of one of ordinary skill in the art. Accordingly, Patent Owner's motion to exclude Exhibit 1034 is *denied.*

B. Exhibits 1023–1052, 1054, and 1055

Patent Owner contends Exhibits 1023–1052, 1054, and 1055 are not relevant because they were submitted for the first time with Petitioner's Reply. Mot. to Excl. 4. Patent Owner further contends that we should exclude Exhibits 1025, 1027, 1030, and 1031 because they are not cited in the Reply or Dr. Rizvi's declaration, and that we should exclude Exhibits 1029, 1033, 1036, 1039–1046 and 1048–1052 because they are cited only in Dr. Rizvi's declaration, but not in Petitioner's Reply. *Id.* at 5–6.

As noted above, there is nothing improper with submitting new Exhibits with a Reply declaration. *Genzyme*, 825 F. 3d at 1366. Accordingly, we deny Patent Owner's motion to exclude Exhibits 1023–1052, 1054, and 1055 on this basis.

Exhibits 1025, 1027, 1030, and 1031 were introduced during Dr. Bansal's cross-examination, but are not cited in Dr. Rizvi's declaration or in the Reply. As the parties and this Decision do not rely upon these documents, we dismiss as *moot* Patent Owner's motion to exclude Exhibits 1025, 1027, 1030, and 1031.

Exhibits 1029, 1033, 1036, 1039–1046, and 1048–1052 are cited in Dr. Rizvi's declaration, but not in the Reply. *Id.* at 5–6. As Dr. Rizvi cites these documents, we decline to exclude them as irrelevant.

C. Authentication of Exhibit 1030

Exhibit 1030 is a slide-deck bearing the corporate logo of Infineum. Ex. 1030. Patent Owner contends we should exclude Exhibit 1030 because it is unauthenticated and not cited in the Petition, Reply, Dr. Smolenski's declaration, or Dr. Rizvi's declaration. Mot. to Excl. 6.

As Petitioner and Dr. Rizvi do not rely on Exhibit 1030, and this Decision does not cite to or rely upon this exhibit, the motion to exclude Exhibit 1030 is dismissed as *moot*.

D. Exhibit 1053 Beyond Scope of Direct

Patent Owner contends we should exclude certain portions of Dr. Bansal's deposition testimony because Petitioner's questions went beyond the scope of Dr. Bansal's direct testimony. Mot. to Excl. 7–8. In particular, Patent Owner contends Petitioner questioned Dr. Bansal about documents he had never seen before, about issues related to enablement, and about ownership interests of various parties. *Id.* at 7–9.

Petitioner's Reply does not rely upon the majority of the testimony to which Patent Owner objects. As such, Patent Owner's motion to exclude this testimony is dismissed as *moot*.

Petitioner specifically identifies, however, testimony cited at pages 8, 10, 24, and 25 of the Reply. Mot. to Excl. 9. Having reviewed this testimony, we find that the recited testimony is within the scope of Dr. Bansal's direct testimony. For example, Petitioner asserts that one of ordinary skill in the art would have understood that the combination of 80 wt. % poly-α-olefins and 20 wt. % diisodecyl adipate (a diester) would have a viscosity index above 95. Pet. 20 (citing Ex. 1009, 450, Figures 4, 5). In support of this argument, Petitioner cites to specific record evidence. *Id.*

Patent Owner and Dr. Bansal disagree that the recited evidence demonstrates that the synthetic oil of Toshikazu had a viscosity index above 95, arguing that absent more specific information regarding the viscosity index of the diisodecyl adipate, the viscosity index of the mixture is "unknowable." PO Resp. 29 (citing Ex. 2003 ¶ 100).

During his deposition, Petitioner presented Dr. Bansal with a reference showing that the viscosity index of diisodecyl adipate was known in the art and is greater than 95. Ex. 1038; Ex. 1053, 193:25–194:9. Petitioner's questions related to the viscosity index of diisodecyl adipate are directly relevant to the position both Patent Owner and Dr. Bansal take that the viscosity index of the synthetic oil of Example 16 was "unknowable." As such, we do not agree that Petitioner's questions went beyond the scope of Dr. Bansal's direct testimony.

We have reviewed the additional testimony Patent Owner identifies (Mot. to Excl. 8) and likewise conclude that this testimony was within the scope of Dr. Bansal's direct testimony. Accordingly, Patent Owner's motion to exclude Exhibit 1053 is *denied*.

E. Exhibit 1055

Exhibit 1055 is the declaration of Dr. Rizvi. Ex. 1055. Patent Owner contends we should exclude this exhibit because it advances new theories and its probative value is outweighed by the unfair prejudice to Patent Owner in admitting such evidence. Mot. to Excl. 10.

As discussed above, we find that Dr. Rizvi's testimony properly responds to Patent Owner's arguments and the testimony of Dr. Bansal. *See Genzyme*, 825 F. 3d at 1366. Accordingly, Patent Owner's motion to exclude Exhibit 1055 is *denied.*

V. CONCLUSION[23]

For the reasons discussed herein, Petitioner has demonstrated by a preponderance of the evidence that claims 1–20 of the '685 patent are unpatentable.

VI. ORDER

It is hereby

ORDERED that claims 1–20 of the '685 patent are unpatentable;

FURTHER ORDERED that Patent Owner's Motion to Exclude is *denied* with respect to Exhibits 1016, 1017, 1027–1031, 1034, and 1048 and further dismissed as *moot* with respect to Exhibits 1025, 1027, 1030, and 1031.

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.

In summary:

Claim(s)	References	35 U.S.C §	Claims Shown Unpatentable	Claims Not Shown Unpatentable
1–3, 6–8, 10, 11, 13–15, 18–20	Toshikazu, Henderson	103	1–3, 6–8, 10, 11, 13–15, 18–20	

[23] Should Patent Owner wish to pursue amendment of the challenged claims in a reissue or reexamination proceeding subsequent to the issuance of this Decision, we draw Patent Owner's attention to the April 2019 *Notice Regarding Options for Amendments by Patent Owner Through Reissue or Reexamination During a Pending AIA Trial Proceeding*. *See* 84 Fed. Reg. 16,654 (Apr. 22, 2019). If Patent Owner chooses to file a reissue application or a request for reexamination of the challenged patent, we remind Patent Owner of its continuing obligation to notify the Board of any such related matters in updated mandatory notices. *See* 37 C.F.R. § 42.8(a)(3), (b)(2).

4	Toshikazu, Henderson, Schlicht	103	4	
9, 16, 17	Toshikazu, Henderson, Walker	103	9, 16, 17	
1–3, 5–8, 10–15, 18–20	Toshikazu, Henderson	103	1–3, 5–8, 10–15, 18–20	
4	Toshikazu, Henderson, Schlicht	103	4	
9, 16, 17	Toshikazu, Henderson, Walker	103	9, 16, 17	
Overall Outcome			1–20	

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