

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

THE CHEMOURS COMPANY FC, LLC,
Petitioner,

v.

DAIKIN INDUSTRIES, LTD.,
Patent Owner.

IPR2018-01558
Patent 9,574,123 B2

Before ERICA A. FRANKLIN, JO-ANNE M. KOKOSKI, and
CHRISTOPHER C. KENNEDY, *Administrative Patent Judges*.

KENNEDY, *Administrative Patent Judge*.

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

I. INTRODUCTION

Petitioner The Chemours Company FC, LLC, challenges the patentability of claims 1–5 of U.S. Patent No. 9,574,123 B2 (Ex. 1001, “the ’123 patent”). We have jurisdiction under 35 U.S.C. § 6, and we issue this Final Written Decision under 35 U.S.C. § 318(a) and 37 C.F.R. § 42.73. For the reasons below, we conclude that Petitioner has proven by a preponderance of the evidence that claims 1–5 of the ’123 patent are unpatentable.

A. PROCEDURAL HISTORY

Petitioner filed a Petition seeking *inter partes* review of claims 1–5 of the ’123 patent. Paper 1 (“Pet.”). Patent Owner filed a Preliminary Response. Paper 6. We instituted trial. Paper 8 (“DI” or “Institution Decision”).

During trial, Patent Owner filed a Response (Paper 15, “PO Resp.”), Petitioner filed a Reply (Paper 18, “Reply”), and Patent Owner filed a Sur-reply (Paper 22, “Sur-reply”). Additionally, the parties each filed a paper concerning arguments and evidence in Petitioner’s Reply that Patent Owner alleges to be inappropriate new material. Paper 20 (Patent Owner’s submission); Paper 21 (Petitioner’s submission).

Petitioner relies on the declaration testimony of Donald Bivens, Ph.D. See Exs. 1008, 1033 (collectively, “the Bivens Declarations”). Patent Owner relies on the declaration testimony of E. Bryan Coughlin, Ph.D. (Ex. 2002, “the Coughlin Declaration”), and J. Steven Brown, Ph.D. (Ex. 2045, “the Brown Declaration”).

Oral argument was held on November 15, 2019. A copy of the transcript of that argument was entered into the record. Paper 30 (“Hearing Tr.”).

B. THE ’123 PATENT

The ’123 patent relates generally to compositions comprising three components: (1) a mixture of HFC-32, HFC-125, HFC-134, and HFC-134a¹; (2) at least one of HFO-1234yf or HFO-1234ze; and (3) at least one of HCC-40, HCFC-22, HCFC-124, CFC-115, HCFC-1122, CFC-1113, and 3,3,3-trifluoropropyne. *E.g.*, Ex. 1001 at 12:2–11 (claim 1). The ’123 patent discloses that “the development of environmentally preferable refrigeration and air conditioning equipment ha[s] become increasingly important,” and that known refrigerant compositions include hydrofluoroolefins (HFOs), chlorofluorocarbons (CFCs), hydrochlorofluorocarbons (HCFCs), and hydrofluorocarbons (HFCs) *Id.* at 1:5–25. The ’123 patent also discloses that “compositions comprising a mixture of HFC and HFO are known.” *Id.* at 1:31–32. According to the ’123 patent, HFOs have lower global warming potential than CFCs, HCFCs, and HFCs. *Id.* at 1:20–25.

The ’123 patent acknowledges that a known problem with some of the newer, more environmentally friendly refrigerant compositions is that “the lubrication performance of a composition comprising a mixture of HFC and HFO is lower than those of CFC and/or HCFC.” *Id.* at 1:57–60. A goal of the ’123 patent is “to improve the lubrication performance of the composition comprising a mixture of HFC and HFO before a lubricating oil is used in combination.” *Id.* at 1:63–66. To that end, the ’123 patent

¹ HFC-134 is an isomer of HFC-134a. Ex. 1008 ¶ 23.

discloses compositions comprising mixtures of HFC and HFO, “further comprising a specific third component” such as a hydrochlorocarbon (HCC), an HCFC, or a CFC. *Id.* at 2:20–34. The ’123 patent states that “[t]he compositions of the present invention have improved lubrication performance” and “are useful as refrigerant compositions, for example.” *Id.* at 3:16–24. The ’123 patent also discloses other uses for its compositions, including “aerosol propellants, foaming agents, blowing agents, solvents, cleaning agents, dispersion media, displacement drying agents, buffing abrasive agents, polymerization media, swelling agents, and fire suppression agents.” *Id.* at 7:22–27.

C. ILLUSTRATIVE CLAIM

Claim 1, reproduced below, is illustrative of the challenged claims.

1. A composition comprising HFC and HFO, wherein the composition comprises:
 - 1) HFC-32, HFC-125, HFC-134a, and HFC-134 as the HFC;
 - 2) at least one of HFO-1234yf and HFO-1234ze as the HFO; and
 - 3) at least one member selected from the group consisting of HCC-40, HCFC-22, HCFC-124, CFC-115, HCFC-1122, CFC-1113, and 3,3,3-trifluoropropyne as a third component.

D. PRIOR ART RELIED UPON

Petitioner relies on the following references, as well as two Declarations of Donald Bivens, Ph.D. (Exs. 1008, 1033).

Reference	Patent No.	Date	Exhibit
Mahaut	US 2007/0258909 A1	Nov. 8, 2007	1002
Van Horn	WO 2015/077134 A1	May 28, 2015	1003
Collier	US 2015/0322317 A1	Nov. 12, 2015	1004

Reference	Patent No.	Date	Exhibit
AHRI ² Standard	2014 Standard for Specifications for Refrigerants	2014	1005
Minor	WO 2013/192069 A1	Dec. 27, 2013	1006
Balthasart	US 7,695,595 B2	Apr. 13, 2010	1007

E. INSTITUTED GROUNDS OF UNPATENTABILITY

We instituted *inter partes* review based on the following grounds of unpatentability asserted by Petitioner:

Claims Challenged	35 U.S.C. §	References
1, 2, 5	102(a)(1)	Mahaut
1–5	103	Van Horn, Collier, AHRI Standard
1–5	103	Minor, Balthasart, Collier

II. DISCUSSION

A. LEVEL OF ORDINARY SKILL IN THE ART

The level of ordinary skill in the art is “a prism or lens” through which we view the prior art and the claimed invention. *Okajima v. Bourdeau*, 261 F.3d 1350, 1355 (Fed. Cir. 2001). In the Institution Decision, we noted the similarity of the parties’ proposals, and we adopted Patent Owner’s formulation of the level of ordinary skill in the art:

A person with experience analyzing, evaluating, and developing refrigerant compositions with a bachelor of science degree in a specialty technical area (such as chemical engineering, chemistry[,] mechanical engineering, or material science) with at least five years of work experience in the refrigerant field, or a

² “AHRI” stands for “Air-Conditioning, Heating, and Refrigeration Institute.” Ex. 1005 at 1.

person with a comparable Ph.D. or masters of science degree and 2–3 years of work experience.

DI 5–6.

Following institution, neither party objected to this determination, but Patent Owner provided additional information about what a person of ordinary skill in the art allegedly would have relied on in developing refrigerant compositions. *See* PO Resp. 12–13. We view Patent Owner’s additional information as directed to the merits of whether a person of ordinary skill in the art would have combined the prior art as proposed by Petitioner, rather than as being directly relevant to defining the level of ordinary skill in the art. We address Patent Owner’s contentions concerning the merits of the proposed combinations below. Given that there does not appear to be a material dispute concerning the level of ordinary skill adopted in the Institution Decision, we maintain that level of ordinary skill for purposes of this Final Written Decision. Additionally, we note that the results of the patentability analysis below would be the same under either party’s definition of the level of ordinary skill in the art.

B. CLAIM CONSTRUCTION

No claim term needs to be expressly construed to reach a decision in this case. *See Vivid Techs., Inc. v. Am. Sci. & Eng’g, Inc.*, 200 F.3d 795, 803 (Fed. Cir. 1999) (claim terms need only be construed “to the extent necessary to resolve the controversy”). *see also Nidec Motor Corp. v. Zhongshan Broad Ocean Motor Co.*, 868 F.3d 1013, 1017 (Fed. Cir. 2017) (applying *Vivid Techs.* in the context of an *inter partes* review).

C. ANTICIPATION OF CLAIMS 1, 2, AND 5 BY MAHAUT

Petitioner asserts that claims 1, 2, and 5 are anticipated by Mahaut. Pet. 29–35. For the reasons set forth below, we determine that Petitioner has not carried its burden of showing that Mahaut anticipates the challenged claims. *See Harmonic Inc. v. Avid Tech., Inc.*, 815 F.3d 1356, 1363 (Fed. Cir. 2016) (“In an IPR, the petitioner has the burden from the onset to show with particularity why the patent it challenges is unpatentable.”).

1. Mahaut (Ex. 1002)

Mahaut concerns methods for detecting impurities in HFC-134a by use of gas chromatography and mass spectrometry. Ex. 1002 at code (57). Mahaut includes multiple tables labeled “Table 1.” *Id.* at 3–4 (first table), 42 (additional tables). The first “Table 1” is reproduced in relevant part below, as annotated by Petitioner, and provides “quality control test data.” *Id.* ¶ 36; Pet. 30.

TABLE 1				
Compounds				
No.	Compounds	Abbreviation	Typical Retention time [s]	Quantification ion [m/z]
1	Chlorotrifluoromethane	CFC 13	246	69
2	Trifluoromethane	HFC 23	253	51
3	Chloropentafluoroethane	CFC 115	267	85
4	1,1,1-Trifluoroethane	HFC 143a	280	65
5	Difluoroethane	HFC 32	283	33
6	Trifluoroethene	HFC 1123	283	82
7	Pentafluoroethane	HFC 125	288	101
8	Octafluoro-2-butene (trans)	FC 1318my-trans	289	131
9	Octafluoro-2-butene (cis) ¹⁾	FC 1318my-cis ¹⁾	298	131
10	2,3,3,3-Tetrafluoropropene	HFC 1234yf	328	114
11	1,1,1,2,2-Pentafluoropropane	HFC 245cb	329	65
12	1,1,1,2-Tetrafluoroethane	HFC 134a	approx. 340	main comp.
	1,2,3,3,3-Pentafluoropropene (cis)	HFC 1225ye (cis)	372	113
13	1,1-Difluoroethane	HFC 152a	377	65
14	Fluoroethane	HFC 161	377	33
15	3,3,3-Trifluoropropene	HFC 1243zf	378	96
16	Dichlorodifluoromethane	CFC 12	402	85
17	1,1,2,2-Tetrafluoroethane	HFC 134	404	83
18	1,1,1,4,4,4-Hexafluoro-2-butene (cis)	HFC 1336mzz (cis)	437	95
19	Chlorodifluoromethane	HCFC 22	444	51
20	1,2-Dichloro-1,1,2,2-tetrafluoroethane	CFC 114	554	100
21	1,1-Dichloro-1,2,2,2-tetrafluoroethane	CFC 114a	557	103
22	Chloromethane	HCC 40	558	52
23	1,1-Dichloroethene	HCFC 1123	575	98
24	1-Chloro-1,1,2,2-tetrafluoroethane	HCFC 124a	588	101
25	1-Chloro-1,1,2,2-tetrafluoroethane	HCFC 124	618	67
26	1,2-Difluoroethene (isomer 1) ²⁾	HCFC 1122a/1 ²⁾	635	98

Annotated Table 1, above, shows quality control test data relevant to the method disclosed by Mahaut. Ex. 1002 ¶ 36; Pet. 30. Annotated Table 1 provides test data for 38 compounds including (a) HFC-32, HFC-125, and HFC-134 (yellow); (b) HFC-1234yf (blue)³; and (c) CFC-115, HCC-40, HCFC-1122, and HCFC-124 (green). Mahaut discloses that “calibration mixtures (containing each compound) are prepared from the pure reference substances,” and provides “mass spectra analyses of spiked [HFC-134a]/helium gaseous mixtures containing concentrations of about 2 to 6 ppm (v/v) of each compound (when available) listed in table 1.” *Id.* ¶¶ 39, 42, Figs. 1–26, 28, 30–41.

Mahaut’s second “Table 1” appears in a section labeled “Validation Data” and is reproduced below as annotated by Petitioner.

TABLE 1

Results of the regression analysis (1st order)

Components	Correlation coefficient r	Range [ppm (v/v)]
CFC-13	0.9999	0.5-16
HFC-23	0.9999	0.5-20
CFC-115	1.0000	0.5-15
HFC-143a	0.9999	1-18
HFC-32	1.0000	0.5-19
HFC-1123	0.9999	0.5-16
HFC-125	0.9999	0.5-16
FC-1318any -trans	1.0000	0.2-13
HFC-1234yf	1.0000	0.2-15
HFC-245cb	1.0000	0.5-19
HFC-1225ye (cis)	1.0000	0.5-13
HFC-152a	0.9999	1-19
HFC-161	1.0000	0.5-16
HFC-1243zf	0.9999	0.5-17
CFC-12	0.9999	0.5-17
HFC-134	1.0000	1-140
HFC-1336mzz (cis)	0.9998	0.5-17
HFC-22	0.9997	0.20
CFC-114	1.0000	0.5-15
CFC-114a	0.9998	0.5-15
HCC-40	0.9999	0.5-13
HCFC-1122	0.9998	0.5-15
HCFC-124a	0.9999	1-16
HCFC-124	0.9999	1-15
HCFC-31	0.9998	1-16
CFC-12B1	0.9997	1-15
HFC-152	0.9998	1-17
HCFC-133a	0.9999	1-18
CFC-1112a	0.9998	0.2-16
CFC-11	0.9996	0.5-18
HCFC-123a	0.9995	1-18
HCFC-123	0.9996	1-18
CFC-113	0.9996	1-17
HCFC-1121 (trans)	0.9995	0.5-15
HCFC-132b	0.9992	1-18

³ HFC-1234yf is the same as HFO-1234yf. Ex. 1008 ¶ 35.

Annotated Table 1 shows “Validation Data” obtained “by analyzing gaseous mixtures containing increasing amounts of the compounds in helium.” *Id.*

¶ 45. Table 1 provides data for, *inter alia*, (1) HFC-32, HFC-125, and HFC-134 (yellow); (2) HFC-1234yf (blue); and (3) CFC-115, HCFC-22, HCC-40, HCFC-1122, and HCFC-124 (green).

2. Analysis

With support from Dr. Bivens, Petitioner asserts that each of Mahaut’s calibration mixtures (shown in the tables reproduced above) includes the compounds required by claim 1, and, therefore, anticipates claim 1. Pet. 29–34 (“The calibration mixtures disclosed by [Mahaut] anticipate claims 1, 2, and 5.”); Ex. 1008 ¶¶ 26–40. Petitioner’s assertion relies on its understanding that each of the tables in Mahaut provide the ingredients of a single calibration mixture. *See* Pet. 29–34. In that regard, Petitioner appears to interpret the language “calibration mixtures (containing each compound),” Ex. 1002 ¶ 39, as describing one calibration mixture that contains each compound listed in the respective tables, instead of as describing a list of multiple, different calibration mixtures, each of which contains one compound. *See* Pet. 29–34.

Patent Owner argues that “Mahaut nowhere says that a single mixture was created with all of the components in Table 1.” PO Resp. 14. Patent Owner argues that, “[i]nstead, Table 1 is simply a ‘reference table’ with GC-Mass Spec parameters for each listed compound, for later use by people who want to practice the analytical method of Mahaut to identify unknown components that may be in their particular test sample.” *Id.* For support, Patent Owner relies on the Coughlin and Brown Declarations. *Id.* (citing Exs. 2002, 2045).

Largely for reasons stated by Patent Owner, we are not persuaded that the Petition adequately establishes that the relevant tables of Mahaut represent a single mixture that includes each listed compound. See PO Resp. 13–21. Petitioner does not provide a persuasive discussion of how it reaches the conclusion that the tables represent a single mixture beyond referring to Mahaut’s disclosures of “mixtures (containing each compound).” See Pet. 29–34; Ex. 1002 ¶¶ 39, 42 (“mixtures containing concentrations of about 2 to 6 ppm (v/v) of each compound (when available)”). Mahaut, however, arguably can be interpreted as indicating that each table discloses a single mixture that contains all of the listed compounds, or as indicating that each table lists multiple mixtures, each of which contains one of the listed compounds. Reading Mahaut as a whole, and considering how Mahaut would be understood by a person of ordinary skill in the art, we agree with Patent Owner that the latter interpretation is the more persuasive one.

For example, paragraphs 42 and 44 of Mahaut, in combination with Mahaut’s figures, disclose that the compounds of Table 1 were not all tested using the same carrier. Ex. 1002 ¶¶ 42, 44, Figs. 25, 27; Ex. 2002 ¶ 37. It appears that most compounds were tested using 1,1,1,2-tetrafluoroethane and helium as a carrier. Ex. 1002 ¶ 42, Fig. 1. Other compounds apparently were tested using HFC-134a and no helium. See *id.* ¶ 44, Figs. 25, 27. If all compounds listed in Table 1 were part of a single mixture, it is unclear why some compounds would be tested using one carrier and other compounds would be tested using another carrier. The Petition does not address the issue. On that point, we find persuasive Dr. Coughlin’s testimony that Mahaut “expressly describes which compounds were analyzed in which

carrier,” and that “the use of two different carriers for different compounds in Table 1 further establishes that separate tests were used for the various compounds in Table 1.” Ex. 2002 ¶ 37.

We are also persuaded by Dr. Coughlin’s testimony that, because Mahaut “does not provide any chromatogram resulting from analysis of single, complex mixture showing all 38 compounds,” it is unlikely that “the Mahaut authors had mixed together all 38 compounds and tested that single mixture.” Ex. 2002 ¶ 40. Dr. Coughlin explains that “it is the usual practice to analyze compounds individually as standards in order to generate exactly the type of data provided in Table 1.” Ex. 2002 ¶ 24. Dr. Coughlin supports his explanation with objective evidence that confirms that a common way of calibrating a chromatography column is to “run pure samples of all known and suspected components of a mixture *individually*, just before chromatographing the mixture, to obtain the retention time of each known compound.” *Id.* ¶ 28 (quoting Ex. 2009 at 636–37) (emphasis added). Dr. Coughlin notes that Balthasart’s Example 4 employs this method and shows that validation data was obtained for each potential impurity individually, and, using that data, Balthasart obtains impurity profiles for the samples of interest. Ex. 2002 ¶ 30; Ex. 1007 at cols. 9–11 (“This detection limit was validated by random calibration with respect to 5 concentrations of 1 to 10 ppm of each individual impurity.”).

Dr. Coughlin also points out that several individual compounds in Table 1 have identical or nearly identical GC retention times, and he persuasively explains that, “[i]f multiple compounds are mixed together and injected into the GC column at the same time, one will have no way of knowing which compound is being detected when.” Ex. 2002 ¶ 31. For

example, compounds 5 and 6 each have retention times of 283 seconds. Ex. 1002 ¶ 37 (Table 1). Compounds 7 and 8 have retention times of 288 and 289 seconds. *Id.* Compounds 13 and 14 each have retention times of 377 seconds. *Id.* According to Dr. Coughlin:

If a mixture of these sets of compounds were injected into the carrier entering the GC (i.e., a single mixture containing all of the compounds of Table 1), a series of overlapping peaks would be seen by the GC detector, as well as overlapping and muddled mass spectra signals, given that so many of the compounds have identical or very similar retention times. Without knowing the retention time and quantification data for each compound ahead of time (by running the compounds individually), it would be impossible to identify one compound from the others.

Ex. 2002 ¶ 31. The evidence of record persuasively establishes that data prepared from calibration mixtures, such as the data in Mahaut’s tables, is routinely prepared by analyzing each compound individually, *e.g.*, Ex. 2009 at 636–37, and that it may have been impossible to generate calibration data such as that of Mahaut’s Table 1 if all 38 compounds were tested as part of a single calibration mixture, *e.g.*, Ex. 2002 ¶ 31.

In its Reply, Petitioner presents a new theory as to how Mahaut anticipates claim 1. *See* Reply 20–23. Petitioner argues that ¶ 49 of Mahaut (which was not cited in the Petition) and a new portion of Table 1 (also not cited in the Petition) disclose a mixture made for a “repeatability analysis.” *Id.* Petitioner argues that the mixture made for the repeatability analysis anticipates claim 1. *See id.*

Consistent with the Board’s Rules and Trial Practice Guide, and with decisions of the Board addressing similar factual scenarios, we decline to consider the new theory of anticipation in the Reply because it could have, and should have, been presented in the Petition. *See* Consolidated Trial

Practice Guide 73 (Nov. 2019), *available at* <https://www.uspto.gov/sites/default/files/documents/tpgnov.pdf> (“Petitioner may not submit new evidence or argument in reply that it could have presented earlier, e.g. to make out a prima facie case of unpatentability.”); *Intelligent Bio-Sys., Inc. v. Illumina Cambridge Ltd.*, 821 F.3d 1359, 1369–70 (Fed. Cir. 2016) (holding that “the Board did not abuse its discretion” in refusing to consider new arguments and evidence raised for the first time in a reply brief); *Ariosa Diagnostics v. Verinata Health, Inc.*, 805 F.3d 1359, 1367 (Fed. Cir. 2015) (discussing how, in *inter partes* review proceedings, a petitioner’s reply is “limited to a true rebuttal role” (citing 37 C.F.R. §§ 42.104(b)(5), 42.23(b))); *see also* Paper 20.

As explained above, the Petition directly relies on Mahaut’s “calibration mixtures.” Pet. 29–34 (“The calibration mixtures disclosed by [Mahaut] anticipate claims 1, 2, and 5.”). Petitioner states that “*the* relevant portion of Table 1” was reproduced in the Petition, *id.* at 29–30 (emphasis added), but says nothing about the portion of Table 1 following ¶ 49 that Petitioner relies on in the Reply. Petitioner’s Reply says little to nothing about the calibration mixtures that are the focus of the Petition and the Patent Owner Response, and focuses instead on ¶ 49 and the alleged mixture used for the “repeatability test,” which Petitioner conceded at the hearing is not the same mixture as the calibration mixtures. *See* Reply 20–23; *see also* Hearing Tr. at 21:1–21:12 (acknowledging that “the calibration mixtures” are not “the same as the alleged mixture that was supposedly used for the repeatability test”).

Petitioner does not persuasively show how the Reply arguments simply bolster the theory in the Petition that Mahaut’s calibration mixtures

anticipate claim 1. *See* Paper 21 at 1–2. Petitioner’s arguments and evidence in the Reply are outside the scope of a proper reply because they do more than merely address Patent Owner’s argument that Petitioner did not establish that the calibration mixtures in Mahaut anticipate claim 1; rather, they provide new evidence that was not set forth in the Petition as to why the repeatability analysis in Mahaut anticipates claim 1. That runs afoul the Board’s rules and guidance, and it is within the Board’s discretion to refuse to consider the new theory. *See Ariosa*, 805 F.3d at 1367 (“[T]he PTO has established rules that, while necessarily respecting constitutional and statutory guarantees of procedural fairness, are designed generally to require that the parties make their case in a very small number of filings—with the challenger obliged to make an adequate case in its Petition and the Reply limited to a true rebuttal role.”). Because Petitioner belatedly presented these new arguments and evidence to make its case that Mahaut anticipates claim 1, we decline to consider those portions of the Reply on this issue.

Because neither the Petition nor the Bivens Declaration (Ex. 1008) provides a persuasive reason to believe that the calibration mixtures and/or the portions of Table 1 relied on in the Petition represent data from a single composition rather than reference data prepared by testing individual compounds as mixtures with a carrier, we determine that Petitioner has not established by a preponderance of the evidence that Mahaut anticipates claim 1. Claims 2 and 5 depend from claim 1, and Petitioner’s analysis of those claims does not remedy the deficiency described above. Accordingly, we likewise determine that Petitioner has not established by a preponderance of the evidence that Mahaut anticipates claims 2 and 5.

D. OBVIOUSNESS OF CLAIMS 1–5 IN VIEW OF VAN HORN, COLLIER, AND THE AHRI STANDARD

Petitioner asserts that claims 1–5 would have been obvious over the combined teachings of Van Horn, Collier, and the AHRI Standard. Pet. 36–52. For the reasons set forth below, we determine that Petitioner’s arguments and evidence establish by a preponderance of the evidence that claims 1–5 would have been obvious in view of the cited prior art.

1. *Van Horn (Ex. 1003)*

Van Horn generally concerns “heat transfer compositions . . . for use in refrigeration, air-conditioning, heat pump systems, chillers, and other heat transfer applications.” Ex. 1003at code (57). Van Horn discloses that its compositions “are also advantageous for use” in other applications, such as aerosol propellants, methods of forming foams, methods of suppressing fire, and as solvent compositions. *Id.* at 19:14–20. Van Horn discloses that its “inventive heat transfer compositions can possess reduced global warming potential while providing good capacity and performance.” *Id.*

Table 2 of Van Horn provides “examples of heat transfer compositions,” and is reproduced below, as annotated by Petitioner. Ex. 1003, 10:1–4; Pet. 37.

R-32 (wt%)	R-125 (wt%)	R-134 (wt%)	R-1234ze (wt%)	R-1234yf (wt%)	R-134a (wt%)	GWP (wt%)
20	20	25	25	5	5	1183
20	20	30	25	5	0	1167
20	20	25	30	0	5	1183
25	25	20	25	5	0	1265
25	25	20	25	0	5	1337
25	25	20	20	5	5	1337
30	27	10	23	5	5	1331
30	27	10	13	10	10	1402
25	25	20	26	2	2	1294
25	25	10	20	10	10	1298
30	30	10	25	5	0	1364
30	30	10	20	5	5	1435
30	30	15	15	5	5	1490
23	22	15	25	8	7	1192
23	22	15	20	10	10	1235

As shown above, Table 2 discloses a variety of compositions comprising a mixture of (a) R-32, R-125, R-134, R-134a (yellow), and (b) R-1234ze (HFO-1234ze) and R-1234yf (HFO-1234yf) (blue). Pet. 37. With respect to Table 2, Van Horn states: “It is understood that slight variations in the compositions should be considered as being within the scope of the present invention; including, but not limited to, compositions within +/- 2 wt%, preferably within +/- 1 wt%.” Ex. 1003, 10:4–7.

2. *Collier (Ex. 1004)*

Collier concerns compositions “including the compound HFO-1234yf and at least one other, additional compound.” Ex. 1004 at code (57). Collier teaches that its compositions “are of use in many fields of application such as refrigeration, blowing agents, solvents and aerosols,” *id.* ¶ 1, and Collier states that a “*very important parameter* in the choice of a composition for use in the fields of refrigeration, air conditioning and heat pumps is *its impact on the environment*,” *id.* ¶ 2 (emphases added).

Collier discloses that the manufacture of HFO-1234yf “is accompanied by a multitude of by-products having a boiling point close to HFO-1234yf,” and that the separation of HFO-1234yf from these by-products “by simple distillation [is] impossible.” *Id.* ¶ 4. Collier discloses a number of embodiments of its composition, including, e.g., a “[p]referabl[e]” composition that comprises “the compound HFO-1234yf, HCC-40, and at least one compound chosen from HFO-1234ze, HFC-134a, HCFC-115, HFC-152a and HFO-1243zf.” *Id.* ¶ 77. Collier specifically discloses an embodiment comprising HFO-1234yf, HCC-40, and HCFC-

115.⁴ *Id.* ¶ 64. Collier states that, “[p]referably, all of the additional compounds [beyond HFO-1234yf] represent[] at most 1% by weight of the composition comprising the HFO-1234yf and advantageously at most 0.5% by weight.” *Id.* ¶ 4. With respect to specific additional compounds (CFC-115, HFC-152a, and HCC-40), Collier provides preferred concentrations of “at most 500 ppm” and “particularly preferably . . . at most 50 ppm.” *Id.* ¶ 8.

3. *AHRI Standard (Ex. 1005)*

“The purpose” of the AHRI Standard is, *inter alia*, “to establish purity specifications” for various refrigerant compositions. Ex. 1005 at 5.⁵ The AHRI Standard includes a “SAFETY DISCLAIMER” noting that “AHRI does not set safety standards and does not certify or guarantee the safety of any products, components, or systems designed . . . in accordance with this standard/guideline.” *Id.* at 2. The AHRI further notes that it “uses its best efforts to develop standards/guidelines employing state-of-the-art and accepted industry practices.” *Id.*

Table 1A of the AHRI Standard is titled “Single Component Fluorocarbon Refrigerants and their Maximum Allowable Levels of Contaminants.” *Id.* at 11–13. Table 1A indicates that “All Other Volatile Impurities” may be up to 0.5% by weight of R-1234yf.⁶ *Id.* at 13.

⁴ Patent Owner does not dispute Petitioner’s assertion that Collier’s references to HCFC-115 are actually describing CFC-115. See Pet. 38 n.3.

⁵ Pincites to this reference are to the page number stamp added to the lower right corner of the pages of the exhibit by Petitioner.

⁶ There is no dispute that “HFO-1234yf” and “R-1234yf” are the same.

4. *Principles of Law*

“[A] patent composed of several elements is not proved obvious merely by demonstrating that each of its elements was, independently, known in the prior art.” *KSR Int’l Co. v. Teleflex Inc.*, 550 U.S. 398, 418 (2007). “[I]t can be important to identify a reason that would have prompted a person of ordinary skill in the relevant field to combine the elements in the way the claimed new invention does.” *Id.*

The reason or motivation to combine, however, need not be explicitly stated in the prior art. *KSR* explains that “[o]ne of the ways in which a patent’s subject matter can be proved obvious is by noting that there existed at the time of invention a known problem for which there was an obvious solution encompassed by the patent’s claims.” *See id.* at 419–420. “The combination of familiar elements according to known methods is likely to be obvious when it does no more than yield predictable results.” *Id.* at 416. “[W]hen a patent simply arranges old elements with each performing the same function it had been known to perform and yields no more than one would expect from such an arrangement, the combination is obvious.” *Id.* at 417 (internal quotation marks omitted). Similarly, “the simple substitution of one known element for another” often results in obvious subject matter, absent unexpected results. *Id.*; *see also id.* at 416 (“[W]hen a patent claims a structure already known in the prior art that 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.”), 417 (“[A] court must ask whether the improvement is more than the predictable use of prior art elements according to their established functions.”).

Even prior to *KSR*, the Federal Circuit’s predecessor court—the CCPA—recognized that an “[e]xpress suggestion to substitute one equivalent for another need not be present to render such substitution obvious.” *In re Fout*, 675 F.2d 297, 301 (CCPA 1982). The CCPA also held that “[i]t is prima facie obvious to combine two compositions each of which is taught by the prior art to be useful for the same purpose, in order to form a third composition which is to be used for the very same purpose.” *In re Kerkhoven*, 626 F.2d 846, 850 (CCPA 1980); *see also In re Gee*, 614 F. App’x 495, 498 (Fed. Cir. 2015) (applying and citing *Kerkhoven*).

5. *Analysis*

a. Claim 1

i. *Overview*

Collectively, Van Horn and Collier teach each element of claim 1. Patent Owner does not contend otherwise. *See generally* PO Resp. Table 2 of Van Horn discloses compositions comprising each element of claim 1, including HFO-1234yf, except for element (3), i.e., “at least one member selected from the group consisting of [HCC-40, CFC-115, and other compounds].” *See* Ex. 1003 at 10 (Table 2). Collier discloses compositions that are 99 wt% or more HFO-1234yf but that also include compounds such as HCC-40 and CFC-115 that fall within the scope of element (3) of claim 1. Ex. 1004 ¶ 77. Petitioner argues that substituting one of Collier’s HFO-1234yf compositions for Van Horn’s HFO-1234yf composition would result in a composition that falls within the scope of claim 1, and that it would have been the simple substitution of one known HFO-1234yf composition (Collier’s) for another known HFO-1234yf composition (Van Horn’s). Pet. 46.

Additionally, Petitioner argues that removing by-products discussed by Collier, such as HCC-40 and CFC-115, would have been difficult and would have resulted in lower product yield. *Id.* at 43–44. Petitioner argues that a person of ordinary skill in the art would not have wanted to remove by-products such as HCC-40 because relevant industry purity standards (i.e., the AHRI Standard) allowed for small amounts of by-product and because the by-products were known to increase the lubricity of the refrigerant composition. *Id.* at 44–46. In the Reply Brief, Petitioner further argues that the alleged lubricity benefits would have provided a person of ordinary skill in the art with an affirmative motivation to substitute Collier’s HFO-1234yf compositions for Van Horn’s. *E.g.*, Reply 1.

Patent Owner argues that Petitioner’s “simple substitution” rationale is not adequately supported by the Petition, that a person of ordinary skill in the art would not have regarded the substitution to be simple or predictable, and that a person of ordinary skill in the art would have been motivated to avoid the use of HCC-40 and/or CFC-115 in Van Horn’s refrigerant blends. *See* PO Resp. 22–25. Patent Owner does not argue that the composition resulting from Petitioner’s proposed substitution would fall beyond the scope of claim 1.

ii. *Petitioner’s Proposed Substitution*

We begin by describing in detail the substitution that Petitioner proposes. As set forth above, Table 2 of Van Horn discloses refrigerant blends that comprise each element of claim 1 except for element (3). *See* Ex. 1003 at 10. Most of the blends listed in Van Horn’s Table 2 include some amount of R-1234yf, ranging from 2 to 10 wt%. *Id.* Van Horn provides some flexibility to the precise concentrations of ingredients used:

“It is understood that slight variations in the compositions should be considered as being within the scope of the present invention; including, but not limited to, compositions within +/- 2 wt%, preferably within +/- 1 wt%.” Ex. 1003 at 10:4–7. Additionally, Petitioner’s declarant, Dr. Bivens, persuasively testifies that a person of ordinary skill in the art would not have understood Van Horn as calling for 100% pure ingredients, e.g., R-1234yf; rather, a person of ordinary skill in the art would have understood Van Horn as calling for AHRI Standard compliant R-1234yf, allowing for up to 0.5 wt% of impurities.⁷ Ex. 1033 ¶ 31. Van Horn thus discloses some flexibility as to the precise R-1234yf concentration in its refrigerant blends, both due to Van Horn’s express statements regarding such flexibility, and due to the understanding of a person of ordinary skill in the art that Van Horn does not contemplate 100% purity for its ingredients.

Collier discloses compositions of 99 wt% or more of HFO-1234yf, combined with small amounts of other compounds, including HCC-40 and CFC-115. Ex. 1004 ¶¶ 4–5. Collier discloses that “the additional compounds” beyond HFO-1234yf “[p]referably” “represent[] at most 1% by weight of the composition . . . and advantageously at most 0.5% by weight.” *Id.* ¶ 5. Specifically with respect to embodiments in which the additional compound is CFC-115 or HCC-40, Collier teaches preferable concentrations

⁷ At oral argument, Patent Owner did not agree that Van Horn’s ingredients may have up to 0.5 wt% impurities. Hearing Tr. at 30:1–6. Patent Owner, however, did not identify a portion of the record where Patent Owner rebutted Petitioner’s contention, supported by Dr. Bivens’ testimony, that a person of ordinary skill in the art would have understood Van Horn’s HFO-1234yf to include up to 0.5 wt% impurities. *See* Ex. 1033 ¶ 31. We find that a preponderance of the evidence supports Petitioner’s position.

of 500 ppm “and particularly preferably . . . at most 50 ppm.” *Id.* ¶ 8. Dr. Bivens testifies that a concentration of 500 ppm corresponds to 0.05 wt%, and that a concentration of 50 ppm corresponds to 0.005 wt%. Ex. 1033 ¶¶ 24–25. Collier specifically identifies as a “[p]referabl[e]” composition one that includes both HCC-40 and CFC-115. *See* Ex. 1004 ¶ 64; *see also id.* ¶ 77. Dr. Bivens further testifies that, although Collier does not specify why those compositions are described as preferable, it may have been because of the known lubricity benefits associated with chlorine atoms in refrigerant compositions. *See* Ex. 2046 at 108:14–17 (Dr. Bivens: “[T]he main reason for using Collier is he discloses mixtures that have compounds with chlorine, and that gets back to the previous disclosures of the chlorine effect.”); Ex. 2095 at 191:14–192:6.

With that background, Petitioner proposes substituting Collier’s “HFO-1234yf, HCC-40, HCFC-115” composition,⁸ *see, e.g.*, Ex. 1004 ¶ 64, for Van Horn’s HFO-1234yf composition. Pet. 46. That is, Petitioner is proposing the replacement of one HFO-1234yf composition that a person of ordinary skill in the art would have understood to include up to 0.5 wt% impurities (Van Horn’s) with an HFO-1234yf composition that is likewise 99.5% or more pure HFO-1234yf with minor amounts of other compounds (Collier’s). *See* Ex. 1033 ¶ 31 (“[A] POSA would consider the particular

⁸ Patent Owner argues that this composition may have other ingredients in it. Sur-reply 12–13. We find that ¶ 64 of Collier, which discloses “a mixture” of “HFO-1234yf, HCC-40, HCFC-115,” reasonably suggests a mixture of only those ingredients. *See* Ex. 1004 ¶¶ 53, 64. In any event, we discern no persuasive evidence of record that trace impurities that may be present in Collier’s compositions would change the outcome of the patentability analysis.

preferable HFO-1234yf of [Collier] to be essentially equivalent to the HFO-1234yf of [Van Horn].”).

In terms of weight percentages, the proposed substitute composition (Collier) is nearly the same composition as that for which it is being substituted (Van Horn), i.e., at least 99.5 wt% HFO-1234yf. Focusing on the 50 ppm disclosure of Collier (e.g., a composition suggested by Collier ¶ 8 and ¶ 64 having 50 ppm CFC-115 and 50 ppm HCC-40, remainder HFO-1234yf), Petitioner’s proposed substitution is a 99.99 wt% HFO-1234yf composition (Collier’s) for Van Horn’s HFO-1234yf composition. See Ex. 1004 at ¶¶ 8, 64.

Petitioner asserts that “it would have been obvious to substitute [Collier’s HFO-1234yf] into the disclosed composition of [Van Horn], at least because it would be simply substituting a known composition . . . for its intended use as a refrigerant composition.” Pet. 46.

Patent Owner responds that Petitioner’s s argument is “devoid of any analysis or citations,” and that a person of ordinary skill in the art “would not have agreed” that “it would be a simple substitution to swap Van Horn’s HFO-1234yf with Collier’s mixture containing HFO-1234yf, HCC-40, and CFC-115.” PO Resp. 30; *see also* Sur-reply 5–6 (same).

We disagree that Petitioner’s “simple substitution” argument is devoid of analysis or citations. The Petition’s use of the words “simply substituting” is preceded by an analysis in which Petitioner explains: (1) that the compositions disclosed by Van Horn and Collier are used for the same purpose, i.e., refrigerant compositions, Pet. 36, 40; (2) that the proposed substitute composition (Collier’s HFO-1234yf) includes preferably only “up to 0.5% by weight” of other compounds beyond HFO-1234yf and is

therefore similar to Van Horn's HFO-1234yf, *see, e.g., id.* at 38, 41; and (3) that the proposed substitution involves a composition (i.e., Collier's composition that is 99.5 wt% HFO-1234yf + 0.5 wt% HCC-40 and/or CFC-115) that was regarded as acceptable by the AHRI Standard—the relevant industry purity standard—in terms of its concentration of volatile impurities, *id.* at 44 (citing Ex. 1008 (Bivens Decl.) ¶ 69 (citing Ex. 1005 at 13)). Only after providing that analysis did Petitioner assert that the proposed combination is “simply substituting” one known refrigerant composition for another. *See* Pet. 46.

Based on our review of the record, we find that Petitioner's showing weighs in favor of finding that Petitioner has established that a person having ordinary skill in the art would have regarded Collier's HFO-1234yf composition as a reasonable substitute for Van Horn's. In particular, we observe that Van Horn and Collier each disclose refrigeration as a primary application for their compositions, and that each also discloses a number of additional overlapping applications. *Compare* Ex. 1003 at code (57), 19:10–20 (disclosing various applications for compositions), *with* Ex. 1004 ¶¶ 1, 100 (disclosing various applications for compositions). As set forth above, Collier's HFO-1234yf is at least 99.5 wt% the same as Van Horn's HFO-1234yf, for which it is being substituted, and is as much as 99.99 wt% the same using the 50 ppm embodiment of Collier, if we were to accept Patent Owner's contention that Van Horn's HFO-1234yf is 100% pure, *see supra* n.7.

Additionally, Collier expressly recognizes that “impact on the environment” is a “very important parameter in the choice of a composition for use in the field[] of refrigeration,” and recommends as preferred

compositions those that include HCC-40 and CFC-115. Ex. 1004 ¶¶ 2, 64, 77. The AHRI Standard, while stating that it “does not set safety standards,” explains that it “uses its best efforts to develop standards/guidelines employing state-of-the-art and accepted industry practices,” and—consistent with Collier’s recommendation of a maximum of 0.5 wt% of certain additional compounds—allows up to 0.5 wt% of “all other volatile impurities” in R-1234yf compositions. See Ex. 1005 at 13; *see also* Ex. 1006 at 10:25–31 (“Typically, components of the refrigerant mixtures and the refrigerant mixtures themselves can contain minor amounts (e.g., less than about 0.5 weight percent total) of impurities and/or byproducts . . . which do not materially affect the novel and basic characteristics of the refrigerant mixture.”). There is no dispute that a person of ordinary skill in the art would have understood the term “all other volatile impurities” to encompass HCC-40 and CFC-115. See Hearing Tr. at 39:23–40:1–3.

For the reasons set forth above, the evidence of record weighs in favor of finding that a person of ordinary skill in the art would have regarded Collier’s HFO-1234yf composition as a suitable substitute for Van Horn’s HFO-1234yf composition, and that a person of ordinary skill in the art would have had a reasonable expectation that the resulting composition would have been both adequately safe and environmentally acceptable.

Patent Owner raises a number of additional arguments concerning whether a person of ordinary skill in the art would have regarded Petitioner’s proposed combination as a “simple substitution,” which we address in turn below.

iii. *Concerns for Safety and Compressor Breakdown
Associated with HCC-40*

Patent Owner argues that the inclusion of HCC-40 in a refrigerant composition “would raise significant safety concerns in terms of both toxicity and flammability,” weighing against a determination that a person of ordinary skill would have regarded the proposed combination as a simple substitution. PO Resp. 32–36. Patent Owner asserts that “[a]s of the priority date, a POSA . . . knew that HCC-40 was toxic, but did not know whether there was an allowable level of HCC-40 that was safe, or what that level was,” and “[t]he same is true as to HCC-40’s known flammability.” *Id.* at 32–33. Patent Owner also argues that HCC-40 was known “to increase the risk of compressor breakdown in refrigerant systems.” *Id.* at 33. Patent Owner argues that such concerns would have motivated a person of ordinary skill to remove HCC-40 and CFC-115 from Collier’s compositions. *See* PO Resp. 52.

We determine that those arguments weigh only minimally against a determination that a person of ordinary skill in the art would have regarded the proposed combination as a simple substitution. Patent Owner and Petitioner agree that the safety concerns were known. *See* PO Resp. 32–33; Pet. 44. Despite the known concerns, Collier discloses compositions that include both HCC-40 and CFC-115, and describes them on numerous occasions as being “[p]referabl[e].” *See* Ex. 1004 at ¶¶ 64, 77, 78, 79, 80. Additionally, the AHRI Standard, which claims to “employ[] state-of-the-art and accepted industry practices,” permits up to 0.5 wt% volatile impurities in R-1234yf compositions, which a person of ordinary skill in the art would

have understood to encompass compounds such as HCC-40 and CFC-115. *See* Ex. 1005 at 13.

To the extent that a person of ordinary skill in the art would have had a general concern with the toxicity or flammability of HCC-40, *e.g.*, PO Resp. 32 (“HCC-40 was known to be both toxic and flammable.”), Petitioner is proposing the use of at most 0.5 wt% (and as little as 0.005 wt% in the 50 ppm embodiment of Collier) HCC-40 in Collier’s HFO-1234yf compositions, which would then be further diluted when used as a small component (2–10 wt%) of Van Horn’s refrigerant blend. *See* Ex. 1033 ¶ 21. Dr. Bivens testifies that, at the relevant concentrations, a person of ordinary skill in the art would not have been dissuaded from making the proposed combination by concerns regarding toxicity or flammability associated with HCC-40 and/or CFC-115. *See id.* ¶ 30 (“I have not seen any evidence that would inform a POSA to not use a HFO-1234yf composition including HCC-40 and CFC-115 in the amounts presented in [Collier] because it would exhibit a detrimental toxicity effect or result in a flammable composition.”). We credit that testimony and find that it is consistent with both Collier and the AHRI Standard, as discussed above. Even if a person of ordinary skill in the art would have needed to consult with an expert on safety before commercializing the refrigerant composition, *see* PO Resp. 32, a person of ordinary skill in the art need not have known with certainty that the combination would result in a commercially viable product in order to have had reason to make it. *Cf. PAR Pharm., Inc. v. TWI Pharm., Inc.*, 773 F.3d 1186, 1198 (Fed. Cir. 2014) (“The reasonable expectation of success requirement for obviousness does not necessitate an absolute certainty for success.”).

Patent Owner further contends that “HCC-40 was also well-known to increase the risk of compressor breakdown in refrigerant systems,” at least in part due to the dissolving of the compressor’s aluminum body and the production of highly inflammable gases. PO Resp. 33–34 (quoting Ex. 2031, 2; citing Ex. 2045 ¶ 80). We agree with Patent Owner that the cited evidence weighs somewhat against the use of HCC-40 in a refrigerant composition. However, the persuasive value of the evidence is limited in view of the fact that the cited references do not specify a concentration of HCC-40 necessary to cause damage. *See id.* (quoting Exs. 2031, 2032). Moreover, as we observed in the Institution Decision, the references relied on by Patent Owner pre-date both Collier and the AHRI Standard. *See* DI 20. While the information in Exhibits 2031 and 2032 may have caused a person of ordinary skill some minimal level of doubt in making the proposed combination, Collier and the AHRI Standard indicate that the minor levels of HCC-40 and/or CFC-115 implicated by the proposed combination would have been regarded by a person of ordinary skill as acceptable. *Cf. PAR Pharm.*, 773 F.3d at 1198 (certainty of success not required).

Based on our review of the evidence, we find that concerns for safety and compressor breakdown associated with HCC-40 would not have dissuaded a person of ordinary skill in the art from using Collier’s preferred HFO-1234yf compositions that include HCC-40 and/or CFC-115. We also find that concerns for safety and compressor breakdown would not have been sufficient to cause a person of ordinary skill in the art to believe that the HCC-40 and/or CFC-115 should be removed from Collier’s preferred HFO-1234yf compositions that include HCC-40 and/or CFC-115.

iv. *Environmental Concerns Associated with HCC-40 and/or CFC-115*

Patent Owner provides data addressing the impact of CFC-115 on GWP and ODP, and argues that it weighs against a determination that a person of ordinary skill in the art would have regarded the proposed substitution as “a simple substitution.” See PO Resp. 37–41. In particular, Patent Owner argues that “an HFO-1234yf mixture with 1 wt% of CFC-115 will have an ODP value of at least 0.06, while HFO-1234yf by itself has an ODP value of zero,” and “even at 0.5 wt% CFC-115 in Collier’s HFO-1234yf mixtures, the GWP of the mixture rises from <1 to 384.” *Id.* at 37–38. We have carefully considered the data and the parties’ arguments, and we are persuaded that a person of ordinary skill in the art nevertheless would have regarded the proposed combination as a simple substitution with predictable results.

At the outset, we note that Patent Owner’s data involves concentrations of HCC-40 and/or CFC-115 that are higher than what is being proposed by Petitioner. See Ex. 1033 ¶¶ 18–21. For example, Patent Owner provides ODP data for a mixture of 99% HFO-1234yf and 1% CFC-115, alleging that the ODP of the mixture would be “at least 0.06,” in comparison to an ODP of zero for “HFO-1234yf by itself.” PO Resp. 37.

As Dr. Bivens points out, however, even prior to combining Collier’s mixture with Van Horn’s, Collier teaches a preference for HFO-1234yf compositions having a maximum of 500 ppm or 50 ppm HCC-40 and/or CFC-115, Ex. 1004 ¶ 8, which corresponds to 0.05 wt% or 0.005 wt%—notably less than the 1% relied on by Patent Owner. See Ex. 1033 ¶¶ 20, 24, 25. At 0.05 wt%, Dr. Bivens calculates an ODP of 0.00031 for Collier’s

mixture, and at 0.005 wt%, an ODP of 0.000031. *Id.* ¶¶ 24–25. Dr. Bivens testifies that a person of ordinary skill “would have considered these increases inconsequential.” *Id.*

Dr. Bivens also provides calculations showing the impact on ODP after further diluting the HCC-40 and/or CFC-115 by combining Collier’s composition with Van Horn’s. When using Van Horn’s mixture comprising 2 wt% HFO-1234yf and Collier’s composition comprising 500 ppm HCC-40 and CFC-115, Dr. Bivens calculates an ODP increase of 6.2×10^{-6} over pure HFO-1234yf. Ex. 1033 ¶ 26. While recognizing that “any increase is not favored,” Dr. Bivens testifies that the calculated numbers reflect “[a] trivial increase that would not have prevented a POSA from making such a substitution.” *Id.*

As to GWP, Patent Owner uses a CFC-115 concentration of 0.5 wt% and calculates a GWP increase relative to pure HFO-1234yf from <1 to 384. PO Resp. 38.⁹ Dr. Bivens, using the 0.005 wt% concentration taught by Collier, calculates a GWP value of 1.37—far less than the 384 relied on by Patent Owner. Ex. 1033 ¶ 25. When using Van Horn’s mixture comprising 2 wt% HFO-1234yf and Collier’s HFO-1234yf composition comprising 500 ppm HCC-40 and CFC-115, Dr. Bivens calculates a GWP increase of 0.074 over pure HFO-1234yf, which he characterizes as “a trivial increase that

⁹ It appears that the 384 figure may have been a mathematical error, and that an accurate calculation may have been 37.8. See Ex. 1031 (Brown Transcript) at 123:8–22, 125:6–10; see also Ex. 2045 (Brown Decl.) ¶ 95 (calculating the GWP of “a mixture with only 0.5 wt% CFC-115, and the balance (*i.e.* 99.5 wt%) HFO-1234yf” to be approximately 37.8). Our findings and conclusions would be the same either way.

would not have prevented a POSA from making such a substitution.” *Id.* ¶ 26.

As additional support for his assertion that a person of ordinary skill in the art would have regarded these increases in GWP and ODP as trivial, Dr. Bivens observes that both “[c]urrently” and “at the time of the alleged invention . . . there are (were) refrigerants being commercially used that have higher GWP and ODP than the proposed refrigerant blend with the substitution of HFO-1234yf of [Collier].” Ex. 1033 ¶ 27; *see* Ex. 1031 (Brown Transcript) at 121:8–14 (acknowledging that R-123, a currently available HCFC refrigerant, has “an ODP value of, to the best of my recollection, something like 0.02.”).

We credit Petitioner’s arguments and Dr. Bivens’ supporting testimony because we find them to be more consistent with the record as a whole than Patent Owner’s arguments and evidence. In particular, and as noted above, Collier itself explicitly acknowledges concern for environmental impact but nevertheless proposes compositions having up to 0.5 wt% HCC-40 and/or CFC-115. Ex. 1004 ¶¶ 2, 64, 77. The AHRI Standard likewise permits up to 0.5 wt% volatile impurities. Ex. 1005 at 13. Those references support Dr. Bivens’ testimony that the minimal GWP/ODP increases resulting from the proposed substitution would not have dissuaded a person of ordinary skill in the art from making the proposed substitution because people skilled in the art (e.g., Collier and the AHRI) were not dissuaded from including and/or allowing small amounts of HCC-40 and CFC-115 in refrigerant compositions. The minimal, calculable increases in the ODP and GWP values over those for pure HFO-1234yf support a

determination that the proposed substitution would have had predictable results.

We recognize that the Montreal Protocol desires “[z]ero ODP.” Ex. 2089 at 48; *see* Sur-reply 8. At oral argument, Petitioner described that as a “guideline.” Hearing Tr. 9:18–20. Patent Owner did not dispute that characterization, and further described the Montreal Protocol as “telling you what you were trying to achieve.” *Id.* at 62:20–63:2. Given that Collier describes compositions that do not have zero ODP as “[p]referabl[e],” and that the AHRI Standard permits up to 0.5 wt% impurities including those such as CFC-115 that would result in non-zero ODP, we are not persuaded that the Montreal Protocol would have dissuaded a person of ordinary skill in the art from making the proposed substitution.

Additionally, we recognize that Dr. Bivens testifies that compliance with the AHRI Standard (which permits up to 0.5 wt% volatile impurities such as HCC-40 and CFC-115) is necessary, but not sufficient, to guarantee a successful refrigerant composition. Ex. 2095 at 23:8–25; *see also* Sur-reply 1–2 (citing various portions of Ex. 2095 (Bivens Deposition Transcript)). We are not persuaded that such testimony weighs meaningfully against the proposed substitution. Dr. Bivens does not rely on the AHRI Standard alone as providing the reason that a person of ordinary skill in the art would have understood Collier’s HFO-1234yf to be a suitable substitution for Van Horn’s HFO-1234yf. Dr. Bivens also relies on Collier itself, which describes its HFO-1234yf compositions that include HCC-40 and CFC-115 as being preferable. *E.g.*, Ex. 1004 ¶ 77. As set forth above, we find that the combination of the AHRI Standard and Collier persuasively supports Petitioner’s contentions, even if a person of ordinary skill in the art

would not have viewed those references as adequate—in and of themselves—to guarantee success. *Cf. PAR Pharm.*, 773 F.3d at 1198 (certainty of success not required).

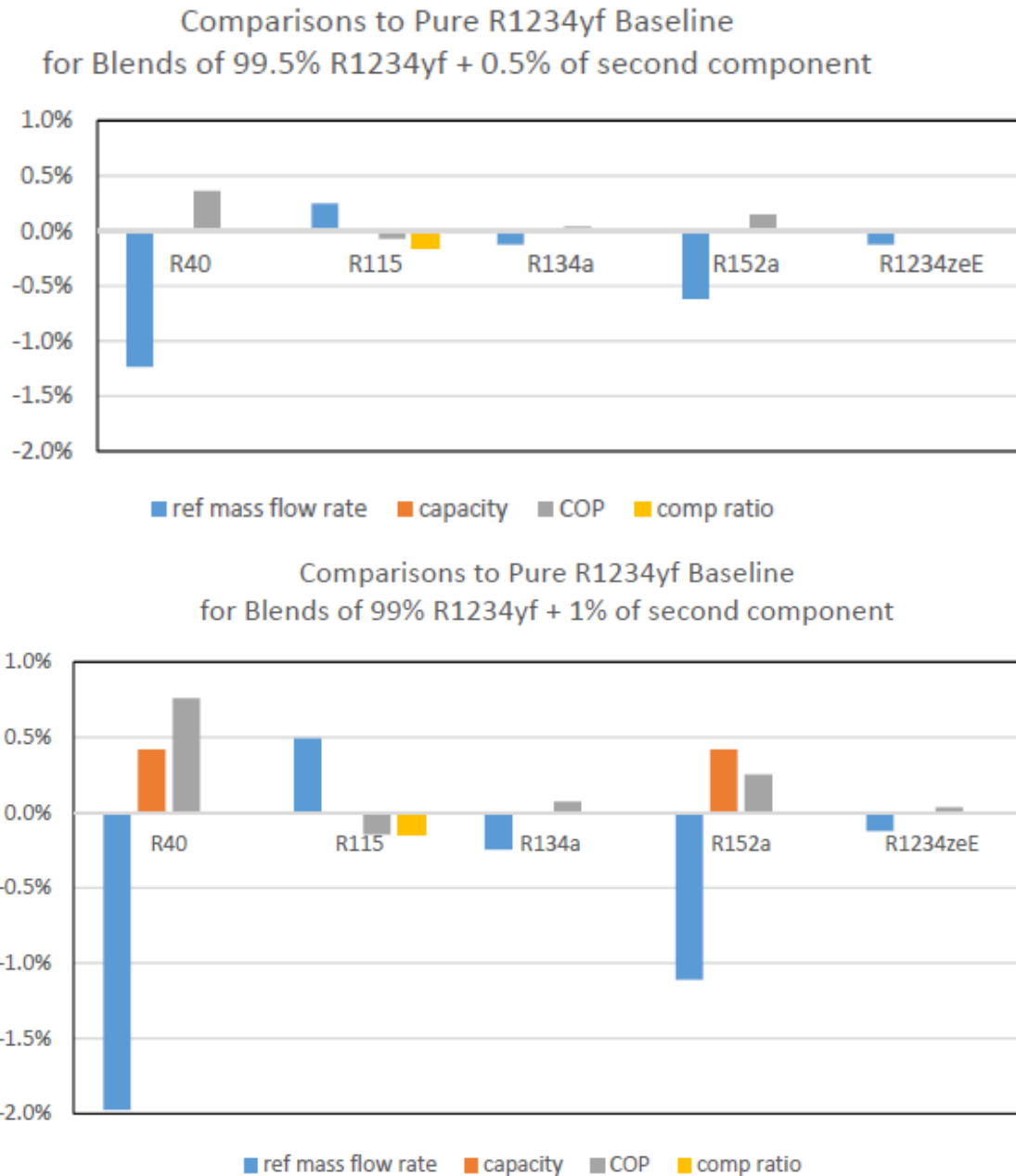
Finally, we note that Patent Owner argues that Petitioner “nowhere . . . address[es] how a POSA would weigh the potential risks or costs of including HCC-40 and/or CFC-115 against the alleged benefits of including one or both of these compounds,” PO Resp. 52 (citing *Winner Int’l Royalty Corp. v. Wang*, 202 F.3d 1340, 1349 n.8 (Fed. Cir. 2000)), but we do not find that argument to be persuasive. Even were we to agree with Patent Owner that the Petition does not *expressly* weigh the advantages and disadvantages of the proposed substitution, that would not meaningfully affect our patentability analysis. As noted above, Petitioner expressly identifies certain drawbacks of the proposed substitution, *e.g.*, Pet. 44 (observing that HCC-40 is volatile, flammable, and toxic), and also observes, despite the identified drawbacks, that (1) Collier (which acknowledges environmental impact as a significant factor in developing refrigerants, Ex. 1004 ¶ 2) describes compositions that include HCC-40 and CFC-115 as preferable, *e.g.*, Pet. 40, and (2) the AHRI Standard—the relevant industry purity standard—permits inclusion of up to 0.5 wt% volatile impurities including HCC-40 and CFC-115, *id.* at 44–45. Petitioner also cites Dr. Bivens’ testimony characterizing potential safety, environmental, and performance concerns associated with the proposed substitution as trivial. *E.g.*, Reply 10–11. Thus, Petitioner’s position that any minimal drawbacks would not have dissuaded a person of ordinary skill in the art from making the proposed substitution is adequately discernable from—and supported by—the record.

v. *Concerns for System Performance Associated with
HCC-40 and/or CFC-115*

Patent Owner argues that “[t]he inclusion of HCC-40 and/or CFC-115 would materially change the performance properties of” Van Horn’s HFO-1234yf mixture. PO Resp. 38. Based on our review of the record, we determine that, as a whole, the evidence and arguments support Petitioner’s contention that a person of ordinary skill in the art would have regarded the proposed combination as a simple substitution with predictable results.

As an initial matter, even assuming that Patent Owner is correct that Van Horn teaches that it is “critical” to match a refrigerant mixture’s performance properties with the equipment it is being used in, and that “[t]he mixtures reported in Table 2 of Van Horn are presumed to be matched to the desired performance parameters,” PO Resp. 38–39; Sur-reply 14, we note that the alleged “critical[ity]” is tempered by Van Horn’s expressly provided flexibility in the concentrations of refrigerant components. *See* Ex. 1003 at 10:5–7 (expressly allowing “slight variations” up to +/- 2 wt%).

Reproduced below are two figures from Dr. Brown’s Declaration showing the relative impact on system performance of replacing a pure R-1234yf baseline composition with a composition that is (1) 99.5 wt% pure R-1234yf (first figure), and (2) 99.0 wt% pure R-1234yf (second figure).



Ex. 2045 ¶ 156. The first figure above shows, for example, that a mixture of 99.5 wt% R-1234yf + 0.5 wt% R-40¹⁰ has the following properties relative to pure R-1234yf: (1) ~1.2% lower mass flow rate, (2) ~0.3% higher coefficient of performance (COP), and (3) apparently immeasurably minor

¹⁰ R-40 is the same as HCC-40. Ex. 2045 ¶ 74.

changes to capacity and compression ratio. The largest change to any property if R-115, rather than R-40, is used is ~0.3%. *See id.*

The second figure above shows that a mixture of 99 wt% R-1234yf + 1.0 wt% R-40 has the following properties relative to pure R-1234yf: (1) ~2% lower mass flow rate, (2) ~0.8% higher COP, (3) ~0.4% higher capacity, and (4) apparently immeasurably minor changes to compression ratio. Ex. 2045 ¶ 156. The largest change to any property if R-115, rather than R-40, is used is ~0.5%. *See id.*

Patent Owner's declarant, Dr. Brown, states that, in view of the performance differences described above, a person of ordinary skill in the art "would not have considered" the various compositions to be "equivalent" or substitutable refrigerants." Ex. 2045 ¶ 159.

Dr. Bivens, by contrast, testifies that such differences would have been deemed "trivial" by a person of ordinary skill in the art, that such differences would not have dissuaded a person of ordinary skill in the art from making the substitution, and that, in some instances, the differences actually would have been viewed as beneficial. *See* Ex. 1033 ¶ 33, ¶ 34 (observing that an increase in COP is a benefit because it means that less energy is being used by the system). These performance numbers are comparable to the weight percentage change made to the baseline composition (e.g., changing the baseline composition by ~1 wt% results in 0–2% changes to composition properties), and, as above with respect GWP and ODP, Dr. Bivens testifies that the numbers would be even smaller if Patent Owner had used, for example, the embodiment of Collier having a maximum of 0.005 wt% HCC-40 and/or CFC-115. *See* Ex. 1033 ¶¶ 20, 32. Dr. Bivens further testifies that they would be smaller still when the HCC-

40/CFC-115 concentration is further diluted by combination with Van Horn. *See id.* ¶¶ 21, 32.

Presented with this competing expert testimony, we credit the testimony of Dr. Bivens at least because it is consistent with the facts that Van Horn expressly minor flexibility to the concentrations of the ingredients of its compositions, Ex. 1003 at 10:4–7, indicating that minor changes to the composition are acceptable, and that the AHRI Standard permits impurity levels up to 0.5 wt%, Ex. 1005 at 13, likewise indicating that minor differences due to minor composition changes are acceptable. Although we acknowledge that Dr. Brown characterized the properties described above as “very different” and as defeating “equivalen[ce],” Ex. 2045 ¶ 159, we discern no persuasive, objective support in the record for those assertions.

We also acknowledge that Dr. Bivens testifies that the mixtures of Collier that appear below ¶ 53 of Collier, *see* Ex. 1004 ¶ 54 *et seq.*, are not “equivalents to each other.” Ex. 2046 at 108:8–13, 114:2–13; *see also* Sur-reply 1–2 (citing various portions of Ex. 2095 (Bivens Deposition Transcript)). However, even if a person of ordinary skill in the art would not have considered any two refrigerant compositions strictly “equivalent” to each other if they did not have identical environmental, safety, and performance properties, we find that the evidence and arguments of record that are discussed throughout this Decision support a determination that a person of ordinary skill would have regarded Collier’s HFO-1234yf compositions relied on by Petitioner as sufficiently “equivalent” to Van Horn’s HFO-1234yf compositions (i.e., at least 99.5 wt% the same composition, taught as being useful for the same purposes, falling within the relevant industry purity standard, etc.) for purposes of the proposed

substitution. *Cf. Perkin–Elmer Corp. v. Westinghouse Elec. Corp.*, 822 F.2d 1528, 1533 (Fed. Cir. 1987) (“To be a[n] . . . ‘equivalent,’ the element substituted in the accused device for the element set forth in the claim must not be such as would substantially change the way in which the function of the claimed invention is performed.”). Considering the testimony of Dr. Bivens as a whole, we do not consider it to be to the contrary. *See, e.g.*, Ex. 1033 ¶ 31 (“[A] POSA would consider the particular preferable HFO-1234yf of [Collier] to be essentially equivalent to the HFO-1234yf of [Van Horn].”).

We find that, as a whole, the system performance data and arguments support Petitioner’s contention that a person of ordinary skill in the art would have regarded the proposed combination as a simple substitution with predictable results.

vi. *Lubricity Benefits Associated with Chlorine-Containing Refrigerant Compounds*

Petitioner argues that lubricity benefits associated with chlorine-containing refrigerant compounds would have provided an affirmative reason for a person of ordinary skill to substitute Collier’s HFO-1234yf + HCC-40 (and/or CFC-115) composition for Van Horn’s HFO-1234yf composition. Pet. 45–46; Reply 1. Patent Owner disagrees. PO Resp. 45–51.

The ’123 patent explains that, at or before the time of the invention, a known disadvantage of HFC/HFO mixtures was that “the lubrication performance of a composition comprising a mixture of HFC and HFO is lower than those of CFC and/or HCFC.” Ex. 1001 at 1:57–60 (“Background Art”); *see also* Ex. 1014 at 3 (“[O]ne could say that a lubricating effect

would be certainly reduced by using HFC as an alternative [to CFC or HCFC].”), 8 (“[T]he lubrication effect in HFC refrigerants was smaller than in CFC and HCFC refrigerants.”); Ex. 1015 at 5 (“All investigators note that refrigerants such as HFC-134a do not themselves have lubrication properties. CFC and HCFC refrigerants were shown to have relatively better lubrication properties . . . most likely due to the anti-seizure properties of chlorine.”). The inventors of the ’123 patent addressed that known problem by including “a specific third component” in its HFC/HFO mixture. Ex. 1001 at 2:14–25. Most of the disclosed “third component” compounds include chlorine, *id.* at 2:26–67; Ex. 1008 ¶ 67 (six of seven limitation (3) members contain chlorine), and at least some embodiments require a chlorine-containing compound, *id.* at 12:20–23 (claim 5).

Although the “Background Art” section of the ’123 patent does not expressly attribute lubricity benefits to chlorine, at least three prior art references of record do indicate lubricity benefits attributable to chlorine. A 1996 article authored by several employees of Daikin Industries states that the “lubricating effect from fluoride . . . was smaller than that of” the lubricating effect “from chloride.” Ex. 1014 at 3. That is consistent with a second 1996 article that states: “CFC and HCFC refrigerants [i.e., chlorine-containing refrigerants] were shown to have relatively better lubrication properties, particularly boundary lubrication, most likely due to the anti-seizure properties of chlorine.” Ex. 1015 at 5. An article published in 1992 similarly discloses that R-12, a CFC refrigerant,¹¹ has the ability to produce

¹¹ See generally Ex. 1021 (appearing to use “CFC-12” and “R-12” interchangeably); Sur-reply 16 (describing R-12 as a “single-component CFC refrigerant”).

“surface films, especially from the chlorine atom in the R12,” and that “R134a [an HFC], on the other hand, has no chlorine atom and does not exhibit lubricative properties.” Ex. 1021 at 12.

Thus, the evidence of record demonstrates not only that it was known at the time of the invention that at least some chlorine-containing refrigerant compounds had improved lubricity relative to compounds without chlorine, but also that the mechanism by which lubricity was affected was known (or at least suspected). See Ex. 1014 at 3; Ex. 1015 at 5; Ex. 1021 at 12; Ex. 1008 ¶ 67 (“It was well known by the earliest effective filing date of the ’123 patent that CFCs and HCFCs had higher lubricity properties than HFOs and HFCs.”). Dr. Bivens concludes that, in view of those disclosures, a person of ordinary skill in the art would have desired “some chlorine content within the refrigerant to improve lubricity.” Ex. 1008 ¶ 67.

Patent Owner argues that the articles relied on by Petitioner are unpersuasive because “they report on studies of the relative lubrication performance of traditional single-component CFC refrigerants like R-12 and R-22 that contain chlorine, as compared to HFC refrigerants such as HFC-32, HFC-125, and HFC-134a.” PO Resp. 45–46; Sur-reply 16–17. Patent Owner also observes that the articles did not study “any of the relevant refrigerant compositions from Van Horn,” and that the studies did not specifically contemplate the lubricity properties of the specific chlorine-containing compounds at issue here: HCC-40 and CFC-115. PO Resp. 45–46. Patent Owner argues that, in view of those deficiencies in the prior art, a person of ordinary skill in the art would not have had a reason to add a HCC-40 or CFC-115 to Van Horn’s compositions, “much less that it would be done with an expectation of success in achieving improved lubricity.” *Id.*

We find Patent Owner's arguments and evidence are persuasive to establish that a person of ordinary skill in the art would not have been *certain* that incorporating a chlorine-containing compound such as HCC-40 or CFC-115 into Van Horn's composition would yield a lubricity benefit. However, we find that Petitioner's evidence provides adequate reason for a person of ordinary skill to believe that HCC-40 and CFC-115 would provide lubricity benefits relative to non-chlorine-containing refrigerant compounds. *See, e.g.*, Ex. 1014 at 3; Ex. 1015 at 5; Ex. 1021 at 12; Ex. 1008 ¶ 67. As explained above, "[t]he reasonable expectation of success requirement for obviousness does not necessitate an absolute certainty for success." *PAR Pharm.*, 773 F.3d at 1198.

We acknowledge that the compounds and mixtures tested in the prior art are not identical to the compounds and mixtures at issue in this case. However, Patent Owner does not persuasively identify relevant differences between the compounds at issue here and the compounds at issue in those references that might have caused a person of ordinary skill in the art to doubt that the teachings of those references (e.g., lubricity benefits associated with chlorine atoms in refrigerant compounds) would apply to the compounds at issue in Collier and Van Horn. In that regard, we find that the evidence of record reasonably suggests that it is the presence of the chlorine atom in a refrigerant compound that improves lubricity. *See* Ex. 1014 at 3 ("lubricating effect from fluoride . . . was smaller than that of" the lubricating effect "from chloride"); Ex. 1015 at 5 ("CFC and HCFC refrigerants were shown to have relatively better lubrication properties, particularly boundary lubrication, most likely due to the anti-seizure

properties of chlorine.”); Ex. 1021 at 12 (“R134a [an HFC], on the other hand, has no chlorine atom and does not exhibit lubricative properties.”).

The record evidence is consistent with Dr. Bivens’ assertion that a person of ordinary skill in the art would have understood that “chlorine content . . . improve[s] lubricity.” Ex. 1008 ¶ 67; *see also* Ex. 1033 ¶ 4 (“By at least 1996 it was known in the industry that chlorine-containing compounds improved lubricity in refrigerants over similar refrigerants not containing chlorine-containing compounds.”), ¶ 8 (“[A]s understood by a person of ordinary skill in the art . . . in the 1990’s . . . the addition of chlorine-containing compounds to a HFO and/or HFC composition results in improved lubricity – a property needed because HFCs and HFOs have worse lubricity than the previous generations [of] CFCs and HCFCs.”); Ex. 2095 at 53:4–9 (“And the mechanism is the chlorine, actually, under the conditions probably in the hot compressor surfaces, metal surfaces, will . . . tend to break off from the compound it was in and react with the metal.”). We determine that a preponderance of the evidence establishes that a person of ordinary skill in the art reasonably would have expected chlorine-containing refrigerant compounds, including HCC-40 and CFC-115, to have enhanced lubricity relative to non-chlorine containing compounds, and we discern no persuasive evidence to believe that combination of HCC-40 and/or CFC-115 with other refrigerant compounds in a refrigerant blend such as those of Collier or Van Horn would nullify the lubricity benefit associated with the chlorine. *See* Ex. 2046 at 151:8–9 (“Being in a mixture does not change that kind of chemistry.”).

We do not think that it was necessary for Petitioner to establish with certainty “that every chlorine-containing refrigerant would have exhibited

the same lubricating properties as the R-12 and R-22 refrigerants tested in EX1014,” as Patent Owner contends. *See* PO Resp. 47; Sur-reply 18 (arguing that “there is no suggestion in the art that every chlorine-containing refrigerant would have exhibited the same lubricating properties as the R-12 and R-22 refrigerants tested in EX1014.”). Rather, Petitioner need only establish that a person of ordinary skill in the art reasonably would have expected chlorine-containing refrigerant compounds to enhance lubricity relative to compounds without chlorine. As set forth above, we find that Petitioner did that.

We also do not agree with Patent Owner’s assertion that a person of ordinary skill in the art would have expected only “molecules having two chlorine atoms (unlike either of HCC-40 or CFC-115)” to demonstrate “improved lubrication, if any.” PO Resp. 47. The references described above attribute improved lubricity to the chlorine atom and do not specifically distinguish between single or double chlorine atoms. Moreover, Dr. Bivens explains that the data in Ex. 1014 reflects that “both the single chlorine-containing compound (HCFC-22) and the double-chlorine containing compound (CFC-12) improved lubricity nearly identically.” Ex. 1033 ¶ 12 (citing Ex. 1014 at 4).

Furthermore, we disagree that unpredictability regarding refrigerant properties defeats a reason to combine or a reasonable expectation of success in this case. *See* PO Resp. 48. We find that the disclosures discussed above would have suggested to a person of ordinary skill that the presence of a chlorine atom in a refrigerant compound provides enhanced lubricity relative to non-chlorine containing compounds, and thereby provide an expectation that HCC-40 and CFC-115 would provide at least some lubricity benefit due

to the presence of chlorine in those compounds. *See Pfizer, Inc. v. Apotex, Inc.*, 480 F.3d 1348, 1364 (Fed. Cir. 2007) (“[T]he expectation of success need only be reasonable, not absolute.”); *see also id.* (“[C]ase law is clear that obviousness cannot be avoided simply by a showing of some degree of unpredictability in the art so long as there was a reasonable probability of success.”).

Patent Owner also argues that, to the extent the prior art suggests a lubricity benefit due to chlorine-containing compounds, it does not suggest a minimum amount of chlorine-containing compound required to achieve measurable lubricity benefits. *See* PO Resp. 48. As Patent Owner observes, Petitioner’s declarant, Dr. Bivens, “couldn’t say” one way or the other whether a person of ordinary skill in the art would have expected the small amounts of chlorine-containing compound that would be present in the compositions of Van Horn and Collier to demonstrate a measurable lubricity benefit. PO Resp. 48; Sur-reply 17 (citing Ex. 2095 at 43:2–47:5). According to Patent Owner, Petitioner’s proposed combination is “the worst kind of hindsight, ‘wherein that which only the invention taught is used against its teacher.’” Sur-reply 17 (quoting *W.L. Gore & Assocs., Inc. v. Garlock, Inc.*, 721 F.2d 1540, 1553 (Fed. Cir. 1983)).

We disagree that Dr. Bivens’ failure to identify a precise concentration of chlorine-containing compound required to achieve a measureable lubricity benefit is evidence of the impermissible use of hindsight. Although Dr. Bivens does acknowledge the 0.5 wt% HCC-40 and/or CFC-115 mixtures in the ’123 patent, *see* Ex. 2095 at 58:15–24, neither Dr. Bivens nor Petitioner relies on those disclosures in the ’123 patent as a reason to make the proposed combination or to use any

particular amount of HCC-40 and/or CFC-115 in the proposed combination. As set forth above, both Petitioner and Dr. Bivens directly rely on the amounts of HCC-40 and/or CFC-115 expressly disclosed by Collier, and on Exhibits 1014, 1015, and 1021 in support of the assertion that the lubricity benefits of chlorine-containing refrigerant compounds were known in the art.

We are also not persuaded that Dr. Bivens' testimony impermissibly relies on speculation. *See* Sur-reply 19. Although Dr. Bivens used the word "speculation" at times during his depositions, *see* Ex. 2046 at 151:8–152:10; Ex. 2095 at 53:3, he subsequently explained that his testimony was based on his training and experience in chemistry, Ex. 2046 at 151:15–16, 152:8–10, and based on the teachings of the references themselves, Ex. 2095 at 54:18–19 ("When I said the data we have, it's all in front of us here. I'm not speculating."). We find that Dr. Bivens' testimony concerning the lubricity benefits of chlorine does not involve the type of speculation that might limit or nullify the probative value of his testimony, because his testimony is based on his knowledge and experience in the field, which Patent Owner does not contest, and is consistent with Exhibits 1014, 1015, and 1021.

Considering Dr. Bivens' declaration and deposition testimony as a whole, we understand Dr. Bivens' position to be that, although a person of ordinary skill in the art at the time of the invention may not have known precisely how much chlorine-containing compound would be required to achieve measurable lubricity benefits or form a complete surface film, *see* Ex. 2095 at 58:15–24, a person of ordinary skill in the art would have expected a refrigerant mixture with any HCC-40 and/or CFC-115 to have at least some lubricity benefit relative to a mixture that has no chlorine-

containing compound at all, *see, e.g.*, Ex. 1008 ¶ 67 (“It was well known by the earliest effective filing date of the ’123 patent that CFCs and HCFCs had higher lubricity properties than HFOs and HFCs.”); Ex. 1033 ¶ 4 (“By at least 1996 it was known in the industry that chlorine-containing compounds improved lubricity in refrigerants over similar refrigerants not containing chlorine-containing compounds.”), ¶ 8 (“[A]s understood by a person of ordinary skill in the art . . . in the 1990’s . . . the addition of chlorine-containing compounds to a HFO and/or HFC composition results in improved lubricity – a property needed because HFCs and HFOs have worse lubricity than the previous generations [of] CFCs and HCFCs.”); Ex. 2095 at 52:17–25 (“[I]t appears that you can have different amounts of chlorine and get very similar lubricity benefits . . .”). We find that position to be supported by the evidence of record because, as set forth above, the relied-upon exhibits attribute the lubricity benefits to the presence of chlorine and its anti-seizure properties. *E.g.*, Ex. 1015 at 5. The record provides no persuasive reason to believe that those anti-seizure properties would vanish (rather than simply be reduced) when only small amounts of chlorine are present in a mixture. *See id.*; *see also* Ex. 1008 ¶ 67; Ex. 1033 ¶¶ 4, 8.

We do not consider the facts (1) that Collier discloses both chlorine-containing and non-chlorine-containing HFO-1234yf compositions, *see* PO Resp. 48, or (2) that Van Horn discloses the use of “traditional lubricants,” *see id.* at 50, to be contradictory to Petitioner’s arguments and evidence. As set forth above, Collier expressly discloses a mixture of HFO-1234yf, HCC-40, and CFC-115, Ex. 1004 ¶ 64, and it expressly describes a mixture including HFO-1234yf, HCC-40, and “at least one [other] compound,” as “[p]referabl[e],” *id.* ¶ 77. The fact that Collier also describes compositions

that do not require HCC-40 and/or CFC-115 does not negate those disclosures. *See Merck & Co. v. Biocraft Labs., Inc.*, 874 F.2d 804, 807 (Fed. Cir. 1989) (“That the [prior art] patent discloses a multitude of effective combinations does not render any particular formulation less obvious.”). Even if Collier described the HCC-40 and/or CFC-115-containing mixtures as inferior, which it does not, that would not negate those disclosures. *See In re Mouttet*, 686 F.3d 1322, 1334 (Fed. Cir. 2012) (“[J]ust because better alternatives exist in the prior art does not mean that an inferior combination is inapt for obviousness purposes.”); *In re Gurley*, 27 F.3d 551, 553 (Fed. Cir. 1994) (“A known or obvious composition does not become patentable simply because it has been described as somewhat inferior to some other product for the same use.”). Similarly, the fact that Van Horn describes the use of traditional lubricants does not negate the prior art’s teaching or suggestion that chlorine-containing refrigerant compounds themselves have improved lubricating properties relative to refrigerant compounds without chlorine. *Cf. In re Fulton*, 391 F.3d 1195, 1201 (Fed. Cir. 2004) (“The prior art’s mere disclosure of more than one alternative does not constitute a teaching away from any of the[] [disclosed] alternatives . . .”).

Finally, we disagree with Patent Owner’s contention that Collier “teaches away from the very combination that the petition proposes.” PO Resp. 43–44; Sur-reply 20. Patent Owner correctly observes that Collier teaches HFO-1234yf compositions that include “at most 1% by weight” of all other compounds, one of which is HFC-134a. Sur-reply 20; *see also* Ex. 1004 ¶¶ 5, 10, 11. Patent Owner also correctly observes that Petitioner proposes to combine a Collier HFO-1234yf composition with a Van Horn

composition that includes more than 1% HFC-134a.¹² PO Resp. 43–44. Patent Owner argues that Collier “teaches away” from such a combination due to its disclosure of compositions comprising a maximum of 1% HFC-134a. *Id.*

As an initial matter, we note that the “teach away” doctrine concerns whether the prior art “teaches away” *from the claimed invention*. *E.g.*, *Fulton*, 391 F.3d at 1201. Patent Owner’s argument concerns whether the disclosures of Collier and Van Horn would have dissuaded a person of ordinary skill in the art from combining them with each other. *See* PO Resp. 43–44. Thus, we understand Patent Owner’s argument to concern motivation to combine Collier and Van Horn rather than teaching away.

In any event, we find the argument to be unpersuasive. Collier discloses HFO-1234yf compositions that are 99 wt% or more HFO-1234yf with a maximum of 1 wt% other refrigerant compounds. *E.g.*, Ex. 1004 ¶ 5. Consistent with the substantial percentage of HFO-1234yf in Collier’s compositions, Dr. Bivens indicates that Collier’s compositions were likely intended to be improvements or alternatives to standalone HFO-1234yf compositions. *See* Ex. 2095 at 190:2–192:6. Collier is best understood as disclosing compositions that are predominantly (i.e., 99 wt% or more) HFO-1234yf and, in that context, recommending that no more than 1 wt% of other compounds (including R-134a) be included in the HFO-1234yf composition. We are not persuaded that a person of ordinary skill in the art would have understood Collier as indicating that its HFO-1234yf compositions cannot be

¹² Van Horn’s Table 2 also discloses compositions with 0 wt% R-134a. Ex. 1003, 10 (Table 2). Petitioner, however, does not rely on those compositions. *See* Pet. 37 (certain compositions emphasized by red boxes).

used in refrigerant blends that include less than 99 wt% HFO-1234yf, such as those of Van Horn.

As explained above, in terms of weight percentage purity levels, Collier's HFO-1234yf is very nearly the same HFO-1234yf composition as Van Horn's, i.e., at least 99.5 wt% the same composition. *See* Ex. 1033 ¶ 31. Dr. Bivens testifies that a person of ordinary skill in the art would have considered the HFO-1234yf compositions of Collier "to be essentially equivalent" to Van Horn's HFO-1234yf. *Id.* Based on the evidence of record, we do not agree with Patent Owner that a person of ordinary skill in the art would have been dissuaded by Collier's disclosure of max 1 wt% "additional compounds" from making the substitution proposed by Petitioner.

Having considered all of the evidence and arguments concerning the lubricity properties of chlorine-containing refrigerant compounds, we determine, for the reasons set forth above, that a preponderance of the evidence supports Petitioner's contention that a person of ordinary skill in the art would have expected refrigerant compounds with chlorine atoms to have improved lubricity relative to refrigerant compounds that do not include chlorine atoms. *See, e.g.*, Ex. 1014 at 3; Ex. 1015 at 5; Ex. 1021 at 12; Ex. 1008 ¶ 67; Ex. 1033 ¶¶ 4, 8, 12. We also determine, as explained above, that a person of ordinary skill in the art would have expected HCC-40 and CFC-115, whether alone or as a minor component of a refrigerant mixture, to possess improved lubricity relative to refrigerant compounds without chlorine. *See, e.g.*, Ex. 1014 at 3; Ex. 1015 at 5; Ex. 1021 at 12; Ex. 1008 ¶ 67; Ex. 1033 ¶¶ 4, 8, 12. Lastly, we determine that, although a person of ordinary skill in the art may not have been able to predict the

magnitude of the lubricity increase expected from the substitution of one of Collier's HFO-1234yf compositions for Van Horn's, a person of ordinary skill in the art would have expected at least some increase due to the presence of chlorine atoms where there previously were none, and that the expected increase in lubricity provides a reason to substitute one of Collier's HFO-1234yf + HCC-40/CFC-115 compositions for Van Horn's HFO-1234yf compositions. *See, e.g.*, Ex. 1014 at 3; Ex. 1015 at 5; Ex. 1021 at 12; Ex. 1008 ¶ 67; Ex. 1033 ¶¶ 4, 8, 12.

vii. *Objective Evidence of Nonobviousness*

Patent Owner argues that Petitioner "fails to adequately account for the unexpected lubricity improvement provided by Patent Owner's claimed compositions." PO Resp. 63. According to Patent Owner, "the improved lubricity evidenced by the '123 patent would have been unexpected by a [person of ordinary skill in the art] which, accordingly, establishes patentability over any obviousness arguments by Petitioner." *Id.* at 65 (citing *Honeywell Int'l Inc. v. Mexichem Amanco Holding S.A.*, 865 F.3d 1348, 1356 (Fed. Cir. 2017)).

"For objective evidence of secondary considerations to be accorded substantial weight, its proponent must establish a nexus between the evidence and the merits of the claimed invention." *In re Kao*, 639 F.3d 1057, 1068 (Fed. Cir. 2011) (quotation and emphasis omitted). "[T]he burden of showing unexpected results rests on he who asserts them." *In re Klosak*, 455 F.2d 1077, 1080 (CCPA 1972); *see also Wm. Wrigley Jr. Co. v. Cadbury Adams USA LLC*, 683 F.3d 1356, 1363 ("Therefore, to show that the [result] was unexpected, [Patent Owner] needed to demonstrate that the

results were unexpected to a significant degree beyond what was already known”).

At the outset, we observe that Patent Owner does not appear to address whether the relied-upon unexpected results involve a comparison to the closest prior art. *See In re Baxter Travenol Labs.*, 952 F.2d 388, 392 (Fed. Cir. 1991) (“[W]hen unexpected results are used as evidence of nonobviousness, the results must be shown to be unexpected *compared with the closest prior art.*” (emphasis added)). And, although Patent Owner asserts that the data reflected in the written description of the ’123 patent is representative of the full scope of the claims, Patent Owner’s arguments appear to be limited to the variety of compounds in the mixtures, and to ignore compound concentrations. *See* PO Resp. 64. We observe, however, that only claim 5 affirmatively requires a chlorine-containing compound (HCC-40). Claims 1–4 encompass compositions in which component (3) is 3,3,3-trifluoropropyne alone (i.e., no chlorine). None of examples in the ’123 patent upon which Patent Owner relies provides any data indicating that a composition without a chlorine-containing compound would exhibit improved lubricity. *See* Ex. 1001 at cols. 7–11.

Additionally, and as Petitioner notes, claim 1 encompasses any concentration of any ingredient so long as each required ingredient is present. Reply 25 (“Thus, the true breadth of the claim would cover compositions having from as little as one ppb of the Limitation 3) compound to essentially 100% of the Limitation 3) compound, with trace amounts of Limitation 1 and 2 compounds.”). The ’123 patent, however, “only describes testing at one specific quantity of Limitation 3 compounds, specifically, 0.5 mass %.” *Id.* Patent Owner fails to address this argument,

and does not otherwise persuasively assert that a person of ordinary skill in the art would consider the component (3) concentration used in the relied-upon examples to be representative of the full scope of the claims. *See ClassCo, Inc. v. Apple, Inc.*, 838 F.3d 1214, 1220 (Fed. Cir. 2016) (“[T]here is no nexus unless the evidence presented is reasonably commensurate with the scope of the claims.” (internal quotation marks omitted)); *Allergan Inc. v. Apotex, Inc.*, 754 F.3d 952, 965 (Fed. Cir. 2014) (“It is the established rule that objective evidence of non-obviousness must be commensurate in scope with the claims which the evidence is offered to support.” (internal quotation marks omitted)); *In re Greenfield*, 571 F.2d 1185, 1189 (CCPA 1978) (“Establishing that one (or a small number of) species gives unexpected results is inadequate proof, for it is the view of [the CCPA] that objective evidence of non-obviousness must be commensurate in scope with the claims which the evidence is offered to support.” (internal quotation marks omitted)).

“To be particularly probative, 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.” *Bristol-Myers Squibb Co. v. Teva Pharms. USA, Inc.*, 752 F.3d 967, 977 (Fed. Cir. 2014) (citing *Kao Corp. v. Unilever U.S., Inc.*, 441 F.3d 963, 970 (Fed. Cir. 2006)). Patent Owner’s failure to meaningfully address (1) the differences between the examples in the ’123 patent and the closest prior art, and (2) whether the data in the ’123 patent is commensurate with the full scope of the claims, reduces any persuasive value the arguments and evidence may otherwise have. *Cf. In re GPAC Inc.*, 57 F.3d 1573, 1580 (Fed. Cir. 1995)

(“To the extent that the patentee demonstrates the required nexus, his objective evidence of nonobviousness will be accorded more or less weight.”).

In any event, Patent Owner’s arguments are, in general, a restatement of arguments discussed above concerning whether a person of ordinary skill in the art would have expected chlorine to enhance the lubricity of a refrigerant composition. *See* PO Resp. 65. For example, Dr. Brown testifies for Patent Owner that, because the evidence of lubricity benefits relied on by Petitioner allegedly involved compounds “contain[ing] two chlorine atoms,” “a POSA would have found it unexpected and surprising for either HCC-40 or CFC-115 [which contain a single chlorine atom] to improve lubricity, particularly when included in relatively low concentrations in a broader mixture, as opposed to the pure, single-component refrigerants tested in Ex. 1014.” Ex. 2045 ¶ 128.

We attribute little persuasive value to Patent Owner’s arguments and evidence. As set forth above, Dr. Bivens persuasively testifies that the data in Ex. 1014 reflects that “both the single chlorine-containing compound (HCFC-22) and the double-chlorine containing compound (CFC-12) improved lubricity nearly identically.” Ex. 1033 ¶ 12 (citing Ex. 1014 at 4). That assertion is consistent with the record, *see* Ex. 1014 at 4 (Fig. 2), and we discern no persuasive basis in the record to reject it.

Additionally, as set forth above, we find that the record as a whole indicates that a person of ordinary skill in the art would have believed that chlorine-containing compounds even in small concentrations would improve lubricity relative to compositions containing only compounds without chlorine. *See, e.g.*, Ex. 1014 at 3; Ex. 1015 at 5; Ex. 1021 at 12; Ex. 1008

¶ 67; Ex. 1033 ¶¶ 4, 8. We discern no persuasive evidence of record that the magnitude of the lubricity improvement was so great as to be unexpected at any particular concentration of chlorine-containing compound, and Patent Owner does not raise any specific arguments concerning the magnitude of the improvement. See PO Resp. 65. Instead, Patent Owner essentially argues that, because the prior art did not explicitly disclose the lubricity benefits of HCC-40 and CFC-115 at low concentrations in the precise refrigerant mixtures of Van Horn, any such lubricity benefits would have been unexpected. See PO Resp. 65. For the reasons set forth above, see *supra* Section II.D.5.a.vi, we do not find that argument to be persuasive.

Considering the record as a whole, we attribute minimal weight to Patent Owner's arguments and evidence concerning unexpected results on this record.

viii. *The Timeliness of Certain Petitioner Reply Arguments*

Before we reach a conclusion as to whether Petitioner has carried its burden of showing that claim 1 would have been obvious in view of the asserted prior art, we also consider Patent Owner's arguments that we should disregard certain portions of Petitioner's Reply (and accompanying evidence) as raising new arguments that should have been presented in the Petition. See Paper 20. Specifically, Patent Owner asks us to disregard: (1) Petitioner's reliance on the 500 ppm and 50 ppm HCC-40/CFC-115 embodiments described in paragraph 8 of Collier, *id.* at 2–3; (2) Petitioner's arguments and evidence concerning the safety, environmental, and performance properties of Collier's HFO-1234yf compositions, *id.* at 3–4; and (3) Petitioner's argument that improved lubricity provides an affirmative

reason to substitute Collier's HFO-1234yf compositions for Van Horn's HFO-1234yf compositions. We address each in turn below.

As to the 500 and 50 ppm disclosures in paragraph 8 of Collier, we recognize that the Petition did not directly cite to that paragraph. Dr. Bivens, however, did, *see* Ex. 1008 ¶ 57, and the Petition cites the paragraph of the Bivens Declaration in which Dr. Bivens quotes paragraph 8 of Collier, *see* Pet. 39, 40, 44 n.4. Additionally, we note that Petitioner repeatedly relies on disclosures in Collier concerning compositions including "up to" or "at most" 0.5 or 1 wt% of compounds such as HCC-40 and CFC-115. Pet. 38, 41, 62. Collier's ¶ 8 disclosure of 500 ppm and 50 ppm concentrations falls within the scope of the "up to" or "at most" 0.5 wt% disclosures expressly relied on by Petitioner. Moreover, the Petition unequivocally relies on Collier's disclosures of compositions comprising HCC-40 and/or CFC-115, and ¶ 8 is specifically relevant to those compositions. *See* Ex. 1004 ¶ 8. We view Petitioner's reliance on Collier ¶ 8 to assist in showing that Collier discloses preferred HFO-1234yf compositions would have presented minimal safety, performance, and environmental concerns, to be appropriate rebuttal to the arguments made in Patent Owner's Response.

We turn next to Petitioner's evidence and arguments that respond to Patent Owner's evidence and arguments concerning the safety, environmental, and performance properties of Collier's HFO-1234yf compositions. *See* PO Resp. 39, 40; *see also* Paper 20 at 2–5. As set forth above, the information presented in the Petition relied on Collier's express disclosure of compositions comprising HCC-40 and/or CFC-115, the AHRI Standard's allowance of up to 0.5 wt% volatile impurities in HFO-1234yf

compositions, and the testimony of Dr. Bivens, to support an assertion that a person of ordinary skill in the art would have viewed the proposed combination as a suitable and predictable substitution. Pet. 36–46. We disagree with Patent Owner’s apparent assertion, *see* Paper 20 at 4, that Petitioner needed to preemptively perform the calculations regarding environmental and performance properties in order to later be allowed to respond to the calculations presented by Patent Owner in its Response, particularly given, as set forth above, we find that, if anything, Patent Owner’s calculations are consistent with Petitioner’s arguments. We also do not view it as so clearly foreseeable that Patent Owner would raise the arguments that it did (e.g., that a ~2% change in mass flow rate and a 0.3% change in COP would cause a person of ordinary skill in the art to view two compositions as significantly different from each other and nonequivalent) that Petitioner should not be permitted to respond to those arguments in its Reply. Accordingly, we view the contested portions of Petitioner’s Reply and accompanying expert declaration as appropriate rebuttal to arguments raised in Patent Owner’s Response.

Finally, we turn to Petitioner’s argument that lubricity benefits associated with chlorine-containing refrigerant compounds would have positively motivated a person of ordinary skill in the art to substitute Collier’s HFO-1234yf composition for Van Horn’s HFO-1234yf composition. Although we agree with Patent Owner that Petitioner’s framing of the issue in the Reply is not identical to the framing of the issue in the Petition, we do not view the minor shift to be inconsistent with our rules or to otherwise be inappropriate or impermissible. Rather, we view it

to be a reasonable and predictable evolution of arguments in view of a developing trial record.

The Petition unequivocally cited and relied on evidence that a person of ordinary skill in the art would have understood that chlorine atoms provide lubricity benefits to refrigerant compositions. Pet. 45–46. Petitioner relied on that evidence in support of its assertion that chlorine-containing compounds would have been viewed as desirable in refrigerant compositions. *See id.* Although Petitioner specifically argued that the lubricity benefits are a reason that a POSA “would *not* have been motivated to” *remove* chlorine-containing compounds from a refrigerant blend, *id.*, in the very next sentence the Petitioner positively asserts that “it would have been obvious to substitute [Collier’s 1234yf] for [Van Horn’s].” *Id.*

Relying on the very same evidence relied on in the Petition (e.g., Exs. 1014, 1015, 1021), in the Reply Petitioner makes explicit what is implicit, or at least reasonably discernable, in the Petition: that a person of ordinary skill in the art would have made the proposed substitution to achieve known lubricity benefits. Reply 1 (“Collier’s preference for HFO-1234yf having HCC-40 as a refrigerant, coupled with AHRI Standard compliance and recognition that chlorine is a ‘positive factor in lubrication’ provides ample motivation to substitute Collier’s HFO-1234yf for Van Horn’s HFO-1234yf.”).

Moreover, Petitioner’s framing of this issue in the Reply is consistent with the way it was framed in the Institution Decision: “Thus, a person of ordinary skill in the art would have had reason to believe that substituting one of Collier’s HFO-1234yf compositions . . . for the HFO-1234yf composition of Van Horn, would have yielded a refrigerant composition

with improved lubricity. For purposes of institution, Petitioner has adequately shown that a person of ordinary skill in the art would have had a reason to combine the references.” DI 18.

Accordingly, Patent Owner was on notice of the issue, and Patent Owner had a full and fair opportunity to address the issue. A substantial portion of Patent Owner’s Response is dedicated to addressing the issues that Patent Owner asserts were not properly raised in the Petition. See PO Resp. 22–51.

On the record before us, we discern nothing impermissible about the development of Petitioner’s arguments in its Reply (except as to the proposed anticipation ground based on Mahaut, as set forth in detail above in our discussion of that ground), and we discern no prejudice or unfairness to Patent Owner resulting from that development.

Accordingly, in this Final Written Decision, we consider Petitioner’s arguments as presented in the Petition and as further developed in the Reply Brief.

*ix. Conclusion as to the Patentability of Claim 1*¹³

When considering all of the evidence of obviousness and nonobviousness together (see *In re Cyclobenzaprine Hydrochloride Extended-Release Capsule Patent Litig.*, 676 F.3d 1063, 1079 (Fed. Cir.

¹³ We need not address the parties’ arguments concerning whether HCC-40 and CFC-115 are inherent in all of Collier’s HFO-1234yf compositions because, as explained in the Institution Decision and as set forth above, Collier explicitly discloses HFO-1234yf compositions that include HCC-40 and CFC-115, and Petitioner’s inherency theory is not critical to Petitioner’s unpatentability arguments. See DI 18–19.

2012)), we conclude that Petitioner has shown by a preponderance of the evidence that the subject matter of claim 1 would have been obvious over the combined teachings of Van Horn, Collier, and the AHRI Standard.

More specifically, we find that Van Horn and Collier collectively teach each element of claim 1, and we determine that Petitioner has adequately shown that a person of ordinary skill in the art would have considered Petitioner's proposed substitution to be a "simple substitution" as described in *KSR*. We also determine that Patent Owner's evidence of unexpected results does not weigh persuasively in favor of a conclusion of nonobviousness. As described in detail above, the proposed substitute composition (Collier's) is nearly identical in terms of the wt% ingredients to the composition that it is being proposed to replace (Van Horn's); it is disclosed as being useful for the very same primary purpose (refrigerant in HVAC equipment) and several secondary purposes (e.g., aerosol propellant, foaming agent, solvent); it falls within the scope of the relevant industry purity standard; and a person of ordinary skill in the art would have viewed any effects on safety, the environment, and/or system performance to be both predictable and minimal. *See, e.g., KSR*, 550 U.S. at 416 ("[W]hen a patent claims a structure already known in the prior art that 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."), 417 ("[W]hen a patent simply arranges old elements with each performing the same function it had been known to perform and yields no more than one would expect from such an arrangement, the combination is obvious." (internal quotation marks omitted)), 417 ("[A] court must ask whether the improvement is more

than the predictable use of prior art elements according to their established functions.”).

To the extent that an express reason to make the substitution is necessary in a case such as this, as set forth above, we find that the known lubricity benefits associated with chlorine-containing refrigerant compounds relative to non-chlorine-containing refrigerant compounds would have provided a motivation to make the substitution.

For those reasons, Petitioner has carried its burden of showing that claim 1 is unpatentable.

b. Claim 2

Claim 2 depends from claim 1 and further recites “wherein a total amount of the HFC and HFO is 95 mass % or more when a total amount of the HFC, the HFO, and the third component is 100 mass %.” Ex. 1001 at col. 12. That language permits the third component to be a maximum of 5 mass %.¹⁴

Petitioner contends that “a person of ordinary skill in the art would have been motivated to limit the amount of the ‘third component’ from Limitation 3) to less than 1% based on” Collier’s teaching that the additional components in the HFO-1234yf composition represent at most 1% by weight of the composition. Pet. 47 (citing Ex. 1008 ¶ 69). Petitioner relies on the substitutions discussed above using Collier’s max 1 wt% and 0.5 wt% embodiments and argues that the proposed combination would result in a

¹⁴ Patent Owner raises no arguments concerning a distinction between the “mass %” of claim 2 and the “% by weight” of Collier.

composition with “less than 1%” component (3). *Id.* (citing Ex. 1004 ¶ 11; Ex. 1008 ¶ 69; Ex. 1005 at 13).

Patent Owner responds that “all of the arguments [concerning claim 1] apply equally to [claim 2],” and that “[Petitioner] and Dr. Bivens fail to establish that any improved lubrication performance allegedly tied to chlorine-containing refrigerants would have been expected [at] the low levels of the group 3 components called for in claim[] 2.” PO Resp. 51.

There is no dispute that the proposed combination, if made, would fall within the scope of claim 2. Based on the evidence of record, we determine that a person of ordinary skill in the art would have made the substitution for reasons set forth above. And, as set forth above, we determine that Patent Owner has not shown that unexpected results meaningfully weigh against a conclusion of obviousness in this case.

Accordingly, we determine that Petitioner has shown sufficiently that the combined teachings of Van Horn, Collier, and the AHRI Standard account for all of the limitations of claim 2, and that a person of ordinary skill in the art would have had reason to combine the teachings to achieve the claimed subject matter. Pet. 47–48; Ex. 1008 ¶ 69.

c. Claim 3

Claim 3 depends from claim 1 and further recites that the composition “is a refrigerant composition.” Ex. 1001 at col. 12. For reasons set forth above in our discussion of claim 1, Petitioner’s arguments and the evidence of record persuasively establish that a person of ordinary skill in the art would have used the composition of the combined prior art as a refrigerant composition. *See* Pet. 48–49. Patent Owner does not present separate arguments for claim 3. We have reviewed the evidence and arguments

presented in the Petition and find that Petitioner has shown sufficiently that the combined teachings of Van Horn, Collier, and the AHRI Standard account for all of the limitations of claim 3, and that a person of ordinary skill in the art would have had reason to combine the teachings to achieve the claimed subject matter. Pet. 48–49.

d. Claim 4

Claim 4 depends from claim 1 and further recites that the composition “comprises a refrigerant oil in an amount of 10 to 50 mass % in the composition.” Ex. 1001 at col. 12.

Petitioner contends that Van Horn discloses that its compositions “may be used in combination with a lubricating oil,” and that “[a] typical composition for testing is a 50/50 wt/wt mixture of refrigerant/lubricant, though other compositions can be used.” Pet. 50 (citing Ex. 1003 at 14:28–31, 17:4–6, 17:10–11). Petitioner asserts that a person of ordinary skill in the art would have been motivated to use a lubricant at up to 50 wt% “to reproduce the refrigerant/lubricant performance while in use as a replacement refrigerant.” *Id.* at 50–51. Patent Owner does not present separate arguments for claim 4.

We have reviewed the evidence and arguments presented in the Petition and find that Petitioner has shown sufficiently that the combined teachings of Van Horn, Collier, and the AHRI Standard account for all of the limitations of claim 4, and that a person of ordinary skill in the art would have had reason to combine the teachings to achieve the claimed subject matter. Pet. 49–51; Ex. 1008 ¶¶ 71–72.

e. Claim 5

Claim 5 depends from claim 1 and further recites, “wherein HCC-40 is contained in an amount of 1 mass % or less when a total amount of the HFC, the HFO, and the third component is 100 mass %.” Ex. 1001 at col.12.

Petitioner relies on the substitutions discussed above using Collier’s max 1 wt% and 0.5 wt% HCC-40 embodiments and argues that the proposed combination would result in a composition with “an amount of HCC-40 of 1 mass % or less. Pet. 51–52 (citing Ex. 1004 ¶¶ 3, 6, 11; Ex. 1008 ¶¶ 73–75).

Patent Owner argues that “all of the arguments [concerning claim 1] apply equally to [claim 5],” and that “Chemours and Dr. Bivens fail to establish that any improved lubrication performance allegedly tied to chlorine-containing refrigerants would have been expected [at] the low levels of the group 3 components called for in claim[] 5.” PO Resp. 51.

There is no dispute that the Collier teaches compositions having 1 mass % or less HCC-40, or that the proposed combination, if made, would fall within the scope of claim 5. We determine that a person of ordinary skill in the art would have made the substitution for reasons set forth above. And, as set forth above, we determine that Patent Owner has not shown that unexpected results meaningfully weigh against a conclusion of obviousness in this case.

Accordingly, we determine that Petitioner has shown sufficiently that the combined teachings of Van Horn, Collier, and the AHRI Standard account for all of the limitations of claim 5, and that a person of ordinary

skill in the art would have had reason to combine the teachings to achieve the claimed subject matter. Pet. 48–49; Ex. 1008 ¶¶ 71–72.

E. OBVIOUSNESS OF CLAIMS 1–5 IN VIEW OF MINOR, BALTHASART, AND COLLIER

Petitioner argues that claims 1–5 would have been obvious in view of Minor and Collier or in view of Minor and Balthasart. Petitioner’s stated rationale to combine the teachings of Minor and Collier or Minor and Balthasart is similar to the rationale based on combining Collier with Van Horn, discussed in detail above, and involves many overlapping arguments. *See* DI 26. At oral argument, neither party identified noteworthy differences in that obviousness rationale as compared to the ground based on Van Horn, Collier, and the AHRI Standard. *E.g.*, Hearing Tr. 54:21–55:20, 58:14–22. Although we recognize that Petitioner’s additional reliance on Balthasart in this proposed ground presents a nonoverlapping set of issues relative to the proposed grounds discussed above, in the interest of efficiency and because, in our analysis above we hold all challenged claims unpatentable on the basis of Van Horn, Collier, and the AHRI Standard, we decline to reach a decision as to the proposed ground based on Minor, Balthasart, and Collier. *See SAS Inst. Inc. v. Iancu*, 138 S. Ct. 1348, 1359 (2018) (holding that a petitioner “is entitled to a final written decision addressing all of the claims it has challenged”).

III. CONCLUSION

After reviewing the record and weighing the evidence offered by both parties, we determine that Petitioner (1) *has not demonstrated* by a preponderance of the evidence that claims 1–5 are anticipated by Mahaut, and (2) *has demonstrated* by a preponderance of the evidence that claims 1–

5 would have been obvious over Van Horn, Collier, and the AHRI Standard.¹⁵

IV. ORDER

It is hereby:

ORDERED that Petitioner has proven by a preponderance of the evidence that claims 1–5 are unpatentable;

FURTHER ORDERED that, pursuant to 35 U.S.C. § 318(b), upon expiration of the time for appeal of this decision, or the termination of any such appeal, a certificate shall issue canceling claims 1–5;

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:

¹⁵ 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, 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).

Claims	35 U.S.C. §	Reference(s)	Claims Shown Unpatentable	Claims Not Shown Unpatentable
1–5	102(a)	Mahaut		1–5
1–5	103	Van Horn, Collier, AHRI Standard	1–5	
1–5	103	Minor, Balthasart, Collier		
Overall Outcome			1–5	

IPR2018-01558
Patent 9,574,123 B2

PETITIONER:

Dipu A. Doshi
Michael S. Marcus
Jonathan W.S. England
BLANK ROME LLP
ddoshi@blankrome.com
mmarcus@blackrome.com
jwengland@blankrome.com

PATENT OWNER:

Michael R. Houston
Michael D. Kaminski
James P. McParland
Foley & Lardner LLP
mhouston@foley.com
mkaminski@foley.com
jmcparland@foley.com