

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

DYNATEMP INTERNATIONAL INC. AND FLUOROFUSION SPECIALTY
CHEMICALS, INC.
PETITIONERS

V.

R421A LLC, D/B/A CHOICE REFRIGERANTS
PATENT OWNER

CASE NO. IPR2023-_____
PATENT NO. 11,345,840 B2

DECLARATION OF DR. MICHAEL G. KOEHLER

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I, Dr. Michael G. Koehler, declare as follows:

I. INTRODUCTION

1. I, Michael G. Koehler, Ph.D., have been retained by Michael Best & Friedrich, LLP, on behalf of Dynatemp International Inc. and Fluorofusion Specialty Chemicals, Inc. (“Petitioners”) as an independent expert to analyze the claims of U.S. Patent No. 11,345,840 (EX1001, “the ’840 Patent”) in view of the prior art and to discuss the prior art and the knowledge and understanding of those skilled in the art of chlorofluorocarbon (CFC) and hydrochlorofluorocarbon (HCFC) refrigerant replacements in the time preceding September 2003. I understand that this Declaration accompanies a petition for inter partes review (IPR) of the ‘840 patent.

2. I am being compensated for the time I spend on this matter at the rate of \$310/hour, but my compensation is not contingent upon my opinions or the outcome of this or any other proceeding. I have no other financial interest in this matter or the parties thereto.

II. QUALIFICATIONS

3. I briefly summarize my experience here; my C.V. has a more detailed description. See EX1004, *Koehler C.V.* I received Bachelor of Science degrees in Chemistry, Mathematics and Computer Science from the Loyola University Chicago. I also studied chemistry at the graduate level and did graduate research

involving the design of chemicals and materials, receiving a Ph.D. in Medicinal Chemistry from the University of Illinois in 1986.

4. Following my Ph.D. studies, I completed post-doctoral work at the University of Illinois in Materials Science. I began my professional working career at AlliedSignal in 1987 in the corporate research and development laboratories. At the time, AlliedSignal was one of the primary manufacturers of CFC, HCFC, and HFC refrigerants, solvents, propellants, and blowing agents. My work at AlliedSignal R&D included extensive work to identify and develop alternatives to the CFC and HCFC refrigerants, which due to global environmental concerns related to atmospheric ozone depletion, were restricted from manufacturing under the International Montreal Protocol, an international treaty established to protect the earth's atmospheric ozone layer by phasing out the production and sale of chemical substances, such as CFCs and HCFCs, that are responsible for atmospheric ozone depletion. I was involved in various aspects of research on alternatives to CFC material, including the identification and characterization of replacements for CFC refrigerants. When I joined AlliedSignal in 1987, there was an intense effort, involving a large team to find replacements for CFC materials. My research involved the development of computational methods to calculate the properties of candidate replacement materials. These computational methods allowed rapid screening of proposed replacements prior to

the rigorous process of synthesizing and testing the material. My research included the evaluation of multicomponent blends of refrigerant. These blended CFC replacements combined two or more refrigerant chemicals to produce both azeotropic and zeotropic refrigerants. In the 1990s, subsequent research involved the evaluation of CFC replacement refrigerants with both traditional and novel lubricants and lubricant formulations. Beginning in 1994, my role expanded to lead research teams which were involved in the development process technologies, including processes for manufacturing AlliedSignal's CFC replacement products which were transitioning to commercial production. While my initial research involved research on non-ozone depleting CFC replacements, the focus of research shifted to include CFC replacements with low global warming potential. I continued to support the corporation's research efforts on alternative refrigerants and lubricants throughout my career at AlliedSignal and its successor corporation Honeywell through 2008. My current role at Professional Analysis and Consulting includes consulting on aerosol propellants, which was another application of CFC and HCFC materials.

5. I believe I am qualified to render opinions in this case on the basis of my education and experience in chemistry and refrigeration technology.

III. SUMMARY OF OPINIONS TO BE EXPRESSED

6. As explained in more detail below, it is my opinion that, based on prior art and information known to those skilled in the relevant art, each claim in the '840 patent was anticipated or would have been obvious in light of the prior art.

IV. MATERIALS CONSIDERED

7. In forming my opinions, I have considered at least the following:

- The '840 Patent (EX1001);
- The prosecution history of the '840 Patent (EX1002);
- Provisional Application No. 60/501,049 ("049 Provisional") (EX1006)
- The prosecution history of Application No. 10/937,736, filed on September 8, 2004, now abandoned (EX1007);
- The prosecution history of U.S. Patent No. 9,982,179 (the '179 Patent) (EX1008);
- The prosecution history of U.S. Patent No. 10,703,949 (the '949 Patent) (EX1009);
- Agreed Claim Constructions in *R421A LLC, d/b/a Choice Refrigerants v. Dynatemp International, Inc. et al.*, 5:20-cv-00147 (E.D. N.C.), which has been consolidated with *Dynatemp International Inc. et al. v. RMS of Georgia et al.*, 5:20-cv-142 (E.D. N.C.), pending (collectively, "Patent Family Litigation") (EX1025);
- The prior art references of discussed below; and
- any other materials that I specifically cite to and mention throughout this report.

8. In addition to these materials, I also relied upon my decades of experience and expertise in CFC and HCFC replacements, lubricants used in air

conditioning and refrigeration systems, the concepts and theories of chemical refrigerants, and the physical chemistry and properties of these materials. In forming my opinions, I have also taken into account the common sense, common wisdom, and common knowledge of a person of ordinary skill in the art as of the priority date of the '840 Patent.

9. I may consider additional documents and information in forming any supplemental opinions. To the extent I am provided with additional documents or information, including any expert declarations in this proceeding, I may offer further opinions.

V. LEGAL PRINCIPLES APPLIED IN ANALYSIS; CONSTRUED

CLAIM TERMS

10. The opinions I express in this declaration involve the application of my technical knowledge and experience to evaluating certain prior art with respect to the '840 Patent. In preparing this declaration, certain patent law concepts have been explained to me by legal counsel, a summary of which is provided.

A. Claim Construction

11. I understand that that the Patent Trial and Appeal Board ("PTAB") applies the same claim construction standard used in district courts, where the claims are given their ordinary meaning as understood by a skilled artisan at the

time of the effective filing date in light of the claim language, patent specification, and prosecution history.

12. I understand the parties agreed to certain claim constructions of terms in the Patent Family Litigation, some of which are common or directly relevant to the '840 Patent. *See EX1025, Agreed Claim Constructions.* I have used those definitions in my analyses.

Parties' Agreed Upon Claim Construction Proposals in Patent Family Litigation	
TERM	DEFINITION
apparatus	refrigeration equipment, air-conditioning equipment, and HVAC equipment
chlorodifluoromethane refrigerant	R-22
substituting the chlorodifluoromethane with a refrigerant composition	replacing R-22 in an apparatus with a refrigerant composition
refrigerant	substance used in a refrigeration system that, after compression in the system's compressor, gives off heat as it changes from gas to liquid in the condenser and, after injection into the evaporator, absorbs heat as it changes from liquid to gas before it is returned to the compressor
refrigerant composition designed to achieve a phase change	refrigerant composition designed so that the refrigerant composition, after compression in a refrigeration system's compressor, gives off heat

	as it changes from gas to liquid in the condenser and, after injection into the evaporator, absorbs heat as it changes from liquid to gas before it is returned to the compressor
consisting of	composed only of the element or elements specified
substitute refrigerant composition	refrigerant composition usable in an apparatus as a substitute for R-22
cylinder can	cylindrical container like the standard 25 or 30 lb. container used for containing R-22
chlorodifluoromethane recharging manifold	a port for conveying R-22 from a pressurized container into an apparatus

13. Otherwise, based on my review of the claims, the specification, and the prosecution history of the '840 patent and its family, it is my opinion that the terms of the asserted claims are clear and nothing in the claim language, specification, or prosecution history necessitates a special definition. For example, although the '840 Patent claims do not use the term "refrigerant," it is plain that the claimed "composition designed to achieve a phase change over a range of working temperatures and pressures of the apparatus" refers to a blend of two refrigerants,

R-125 and R-134a. Accordingly, I have performed my analyses below applying the claim terms' plain and ordinary meanings.

B. Anticipation

14. A patent claim is invalid as anticipated (*i.e.*, it is not new or not novel) when a single prior art reference discloses within the four corners of the document every limitation recited in the claim arranged or combined in the same way as recited in the claim.

15. In addition, when a patent claims a range, that range is anticipated by a prior art reference if the reference discloses a point within the range. Stated differently, a later genus claim limitation is anticipated by, and therefore not patentably distinct from, an earlier-disclosed species falling within the genus.

16. In the case where the claimed value or range overlaps or lies inside ranges disclosed by the prior art, the claimed subject matter may be anticipated if it is disclosed in the reference with sufficient specificity such that the species within the range can be readily envisioned by one skilled in the art. Whether the range is disclosed with sufficient specificity depends on a number of factors, such as the size of the ranges, the extent of the overlap, whether the variables related to the range are well-known and predictable, and the criticality of the claimed range relative to the prior art range.

17. Alternatively, if the subject matter is not disclosed with sufficient specificity, the claimed subject matter may be prima facie obvious (discussed below).

C. Obviousness

18. Where a single prior art reference does not disclose all limitations of a claim, that claim may nonetheless be proven invalid as obvious under 35 U.S.C. § 103. For a claim to be obvious, all limitations of the claimed invention must be present in two or more prior art references, or a single prior art reference that discloses a broader range than the claimed range, or in one or more prior art references combined with the knowledge generally possessed by one of ordinary skill in the art. In determining obviousness, one must consider the claim as a whole, including the problem to be solved.

19. There must be some reason to combine the limitations in the fashion claimed by the invention at issue. Factors used to determine the existence of such a reason include: (1) interrelated teachings of multiple patents; (2) the effects of demands known to the design community or present in the marketplace; (3) and the background knowledge and common sense possessed by a person having ordinary skill in the art. Furthermore, any need or problem known in the field of endeavor at the time of invention and addressed by the patent at issue can provide a reason for combining the limitations in the manner claimed.

20. A patent claim is invalid as obvious if the differences between the claimed subject matter and the prior art are such that the subject matter as a whole at the time of the invention would have been obvious to a person having ordinary skill in the art of the subject matter to which the patent claim pertains. It is improper, however, to use hindsight in assessing obviousness by, for example, using the claim as a template for piecing together components (or steps) found in separate prior art references. Furthermore, a person skilled in the art must have a reasonable expectation of success that the references combined to establish obviousness would result in the claimed invention.

21. A person of ordinary skill is a person of ordinary creativity, not an automaton. The ordinary artisan recognizes that familiar items may have obvious uses beyond their primary purposes, and in many cases a person of ordinary skill will be able to fit the teachings of multiple patents together like pieces of a puzzle.

22. The following factual inquiries are employed in an obviousness determination: (1) the level of ordinary skill in the art; (2) the scope and content of the prior art; (3) the differences between the prior art and the claims at issue; and (4) other objective evidence of non-obviousness.

D. Unexpected Results

23. Unexpected results can demonstrate an invention was not obvious. During prosecution of the '840 Patent and its predecessors, the patent office found

a prima facie case of obviousness was made. One way for a patent applicant to rebut a prima facie case of obviousness is to make a showing of “unexpected results,” i.e., to show that the claimed invention exhibits some superior property or advantage that a person of ordinary skill in the relevant art would have found surprising or unexpected.

24. An unexpected result does not necessarily rebut a showing of obviousness, but it is an evidentiary factor pertinent to the legal conclusion of obviousness.

25. To show unexpected results it is not enough to show that results merely differ from those obtained in the prior art; rather, that difference must be shown to be an unexpected difference.

26. *Expected* beneficial results are evidence of obviousness of a claimed invention, just as *unexpected* results are evidence of non-obviousness. Stated differently, what is unexpected must be defined by what is expected.

VI. PERSON HAVING ORDINARY SKILL IN THE ART

27. I understand that claim construction and many doctrines in patent law are to be applied from the viewpoint of one of ordinary skill in the relevant art. To determine the level of skill that would be “ordinary,” I understand that a person of ordinary skill must generally have the capability of understanding the general principles that are applicable to the pertinent art.

28. In the case of the '840 Patent, these general principles include chemistry, physical chemistry, chemical thermodynamics, fluid mechanics, chemical engineering, and heat transfer/mechanical engineering. More specifically, knowledge in the areas of coefficient of performance, capacity, heat transfer, chemical thermodynamics, refrigeration cycles, toxicity, and chemical environmental fate. Many refrigerant blends include two or more components, and thus fundamental concepts also include chemical formulations, compatibility, phase behavior, chemical miscibility, and chemical stability. Because lubrication in a refrigeration system is extremely important, general principles include the principles of solubility and compatibility, lubricity characteristics, volatility of lubricants, and lubricant stability.

29. For the purposes of my opinions in this report, I have used the filing date of the earliest provisional patent application to which the '840 Patent claims priority (which is September 8, 2003).

30. For purposes of this report, I have considered the characteristics of a person having ordinary skill in the art. Such a person would have at least a Bachelor's degree in Mechanical Engineering, Chemical Engineering, or similar engineering discipline relevant to refrigeration, or Chemistry with at least 3-5 years of experience in a combination of (1) design and synthesis of refrigerant compositions, (2) testing and evaluation of refrigerant compositions in the

laboratory and/or refrigeration systems, and (3) chemical blends and formulations relevant to refrigerant compositions. The refrigerant compositions can include refrigerants, lubricating oils, and additives. Preferably, such a person would have a Ph.D. in one of the named areas.

31. I am advised that other cases involving refrigerants have invoked similar skill levels. *See, e.g., Chemours Company FC, LLC v. Daikin Industries, Ltd.*, IPR 2018-01558, 2020 WL 402064, *2 (Patent Tr. & App. Bd. 2020) (describing the person of ordinary skill to be one “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 person with a comparable Ph.D. or masters of science degree and 2-3 years of work experience.”).

32. Based on my education and experience, I at least meet the definition of one skilled in the art at the time of the invention for the ‘840 Patent. In addition, I am familiar and can opine on how one of ordinary skill in such art would have understood the ‘840 Patent, the relevant technology, and related issues as of their priority date. I have performed my analyses from such a person’s perspective as of the priority date of the ‘840 Patent.

VII. BACKGROUND, STATE OF THE ART, AND SCOPE AND CONTENT OF THE PRIOR ART

33. The technology generally relates to a vapor-compression refrigeration cycle, which involves circulating a refrigerant fluid through four basic stages of a closed system: compression, condensation, expansion, and evaporation. As the refrigerant circulates through the system, it is alternately compressed and expanded, changing its state from a liquid to a vapor (gas). Tracing the path of the refrigerant fluid through the system aids in understanding the process.

34. Compression: Starting just before the compressor, the refrigerant exists as a low-pressure vapor (gas). As the fluid enters the compressor, the compressor compresses the refrigerant to a high-pressure vapor, causing it to become hot. Next, the hot fluid leaves the compressor and enters the condenser.

35. Condensation: The condenser is typically a long, thin, coiled tube or set of tubes (to increase the surface area, which in turn allows for better heat exchange). As the hot vapor flows through the condenser, a relatively cool fluid (e.g., air) is forced across the tubes (e.g., by a fan). Because the air being blown across the tubes is cooler than the refrigerant, heat transfers from the refrigerant inside the tubing to the cooler air. This heat transfer causes the hot vapor refrigerant to cool to its saturated temperature. Once the saturation temperature is reached, further heat transfer causes the fluid to change state from a vapor to a

liquid, in this case a liquid at high pressure. By the time the fluid leaves the condenser, it is fully in the liquid state. At this point, although it is in the liquid state, the fluid is still at a relatively high temperature.

36. Expansion: After the condenser, the high-pressure liquid goes through a metering device (e.g., an expansion valve), which causes the fluid's pressure to lower, in turn reducing its temperature.

37. Evaporation: In a cool, low-pressure liquid state, the refrigerant then enters the evaporator, which (like the condenser) is typically a long, thin, coiled tube or set of tubes (to increase the surface area, which in turn allows for better heat exchange). In the evaporator, the cool liquid refrigerant flows through the tubes as fans blow relatively warm air from the conditioned space across the outside of the tubes. The cooler refrigerant in the evaporator coils begins to boil, thereby absorbing the heat out of the warmer air passing over the tubes. This cools air flowing over the tubes, and the cooled air then flows into the conditioned space.

38. By the time the fluid reaches the end of the evaporator, it is fully in the vapor phase (gas) at low pressure. This low-pressure vapor is ready to start the cycle over again as it reenters the compressor.

A. Refrigerants and the Global Need to Replace R-22 and Other Chlorine-Containing Refrigerants

39. The '840 Patent relates to and describes apparatuses, systems, and methods involving a refrigerant blend used to replace R-22, the blend consisting of

a blend of pentafluoroethane (R-125) and 1,1,1,2-tetrafluoroethane (R-134a) at a ratio of 59-57% R-125 and 41-43% R-134a by weight.

40. The refrigerant blend in this case is used to replace a refrigerant called R-22, a hydrochlorofluorocarbon (HCFC) refrigerant that, according to the patent, at one time was the dominant refrigerant in many air-conditioning systems. R-22, also known as chlorodifluoromethane, was developed in the 1930s as an HCFC refrigerant for use in low-temperature refrigeration systems as well as air conditioners. Other traditional refrigerants developed around the same time include chlorofluorocarbon (CFC) refrigerants R-11 (trichlorofluoromethane) and R-12 (dichlorodifluoromethane).

41. In the 1970s, two chemist, F. Sherwood Rowland, and Mario J. Molina, presented research that suggested organic halocarbons, more specifically those halocarbons containing chlorine, such as the CFC refrigerants R-11 and R-12, migrate into the earth's stratosphere, and catalytically destroy stratospheric ozone, an essential atmospheric gas of O₃ (trioxygen) that protects the lower atmosphere from damaging ultraviolet (UV) light. Loss of the ozone in the stratosphere would reduce the filtering of harmful UV light, resulting in serious health and agricultural consequences, including increases in skin cancers, permanent blindness, and certain eye diseases. UV radiation would also cause detrimental harm to most plant and animal life. Subsequent studies of the earth's

atmosphere revealed a significant loss of ozone in the atmosphere and a growing “ozone hole,” an area where stratospheric ozone levels are critically low over the north and south poles of the earth.

42. Although R-22 contains a chlorine atom in the molecule, the presence of hydrogen reduces the atmospheric lifetime of R-22 to approximately 12 years, compared to the atmospheric lifetime of 100 years and 45 years for R-12 and R-11, respectively. This decreased R-22’s stratospheric ozone depletion potential to about 5% of R-11 and R-12, since the reduced atmospheric lifetime of R-22 made it less likely to transport from the lower atmosphere to the stratosphere. But R-22 still damaged the ozone layer.

43. This research raised an international environmental alarm. As a result, the Montreal Protocol, an international agreement which aimed to protect the earth’s ozone layer by phasing out the production and use of stratospheric ozone-depleting chemicals, was established in 1987. The Montreal Protocol targeted production of CFCs to cease by 1996. Thus, finding replacements for CFCs like R-11 and R-12 was a high priority. Recognizing the critical role of CFC refrigerants for food preservation, building air-conditioning, and other applications, major research efforts were undertaken globally to identify non-ozone depleting refrigerants to replace CFC refrigerants.

44. Even though HCFCs like R-22 were less harmful to the ozone than CFCs, HCFCs were nevertheless harmful. Thus, in 1992, the Montreal Protocol was amended to add HCFCs, such as R-22, to the list of substances that needed to be phased out. Thus, efforts began in the 1990s to replace R-22 as well. The US EPA prohibited the use of R-22 in new equipment as of January 2010 and mandated the cessation of production by 2020.

B. Early Work with Blends of R-125, R-134a, and other HFCs

45. Fairly quickly, in the 1980s intense research efforts for alternative refrigerants focused on hydrofluorocarbons (HFCs), chemicals without any chlorine atoms in the chemical structure, because, without chlorine, they did not deplete the ozone. *See, e.g.,* EX1041, McLinden & Huber, *(R)Evolution of Refrigerants*, 65 J. CHEM. ENG. DATA § 2.4.1 (2020), available at <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC8739722/pdf/nihms-1642330.pdf>. These research efforts included blends of two or more HFCs. *Id.* at § 2.4.2. The research also included not only laboratory experimentation, but also the development and application of computations to calculate the properties of the refrigerants and blends based on established chemical theories. *Id.* at § 3.2-3.3. The most significant early HFC identified was 1,1,1,2 Tetrafluoroethane (R-134a). It was introduced in the early 1990s as a replacement for R-12. Pentafluoroethane (R-125), another non-ozone depleting HFC also gained popularity in the 1990s in

refrigerant blends to replace R-22. *Id.* at 2.4.1 (“As the Montreal Protocol was amended over time to also phase out the HCFCs . . . leaving only R-134a and R-125 as nonflammable, low-toxicity, zero-ODP fluids.”).

46. In the 1980s and early 1990s scientists investigated multiple HFCs and HFC blends as replacements for R-22 and R-12. *Id.* at §2.4.2. The work is voluminous. It established all the basic properties of the HFCs and blends, such as molar mass, density, boiling point, dew point, critical temperature and pressure, specific heat capacity, etc. In addition, basic safety and environmental data (including Ozone Depletion Potential (ODP) and Global Warming Potential (GWP)) were organized or generated. Some of the fruits of this research of the components and blends of R-125 and R-134a include: EX1026, Haynes, *Thermophysical Properties of HCFC Alternatives*, NIST Report DOE/CE/23810-80 (1996); EX1027, Widiatmo et al., *Liquid Densities of Alternative Refrigerants Blended with Difluoromethane, Pentafluoroethane, and 1,1,1,2-Tetrafluoroethane*, 42 J. CHEM. ENG. DATA, 270-277 (1997) (“Widiatmo”); EX1028, Gunther & Steimle, *Mixing Rules for the Specific Heat Capacities of Several HFC-Mixtures*, 20 LNT. J. REFRIG. 235 (1997); and EX1029, McLinden, *Thermodynamic Properties of CFC Alternatives: A Survey of the Available Data*, 13 INT. J. REFRIG. 149 (1990).

47. The painstakingly gathered data allowed development of sophisticated equations of state (EOS) and computerized applications of the EOS to predictively model the properties (e.g., pressure-temperature) of pure substances like R-134a and R-125 and mixtures in liquid and gaseous states. *See, e.g.*, EX1030, McLinden, *The History of NIST's Refrigerants Program II. Thermophysical Properties Research*, 107 ASHRAE TRANSACTIONS 699, CI-01-09-5, p. 702-706 (2001). Computer programs such as REFPROP employed the EOS and allowed users to calculate the properties of refrigerants and refrigerant mixtures. *Id.* at 706.

48. In addition to EOS, scientists developed software and predictive models, such as CYCLE_D, that used the EOS and further simulated vapor compression refrigeration cycles that use pure refrigerants or blends of refrigerants. *See* EX1031, Didion, *The History of NIST's Refrigerants Program: I. Zeotropic Mixture Cycles and Heat Transfer*, 107 ASHRAE TRANSACTIONS 688, 692 (2001). This software allowed prediction of important metrics such as coefficient of performance (COP), volumetric capacity, thermodynamic parameters, and thermodynamic charts. Volumetric capacity is the cooling ability of a refrigerant per unit volume. COP, sometimes referred to as efficiency, is the ratio of heat extracted to the work required to extract the heat. All else equal, a higher capacity and higher COP are desirable traits. I further discuss REFPROP, CYCLE_D, and related topics in Section X, below.

49. An early example of mathematical modeling is found in Japanese Patent JP07-042454, issued to Segami, which published in 1988. EX1021. Segami explored blends including a binary blend of R-125 and R-134a as a replacement for chlorine-containing refrigerants. *Id.* at Table 2. Using mathematical models, Segami calculated and reported various performance characteristics of the blends, including COP and capacity. *Id.*

50. A few years later, in 1992, an EPA publication explored multiple HFC blends, including binary blends of R-125 and R-134a, as replacements for chlorine-containing refrigerants, and calculated various performance characteristics. *See* EX1022, Radermacher & Jung, *Theoretical Analysis of Replacement Refrigerants for R22 for Residential Uses*, EPA/400/1-91/041, p.33 (1992). In 1997, additional work on the properties of various blends, including binary blends of R-125 and R-134a, was published. *See* EX1032, Holcombe et al., *Selected Thermodynamic Properties for Mixtures of R-32 (Difluoromethane), R-125 (Pentafluoroethane), R-134A (1,1,1,2-Tetrafluoroethane), R-143A (1,1,1-Trifluoroethane), R41 (Fluoromethane), R-290 (Propane), and R-744 (Carbon Dioxide)*, NIST Tech. Note 1397 (1997).

51. Thus, by the late 1990s, R-125, R-134a, and blends of them had been extensively studied, both by laboratory experimentation and via computer models. Other refrigerants and blends had also been extensively studied. Those skilled in

the art knew of these different blends and their properties at any given concentration and could calculate the properties of various blends. They perceived (and continue to perceive) other blends to be superior on the whole to binary blends of R-125 and R-134a for various reasons, but also recognized binary blends of R-125 and R-134a were viable options.

52. One skilled in the art would have known of and used the available tools to evaluate different ratios of a binary blend of R-125 and R-134a to optimize for a particular variable of interest. One skilled in the art would also have known the tradeoffs involved in such optimization. For example, adjusting the ratio to raise the COP would lower the capacity (and vice versa). Adjusting the blend to match the pressure characteristics of R-22 might lead to a lower COP or capacity, etc., but it would allow use in preexisting equipment. *See, e.g.,* EX1018, Siva Gopalnarayanan, *Choosing the Right Refrigerant*, MECH. ENG'G 92 (Oct. 1998), p.94 (“For example, by adjusting the composition of a blend containing a high-pressure and a low- pressure refrigerant, the vapor pressure of the final fluid can be tailored to match that of the CFC or HCFC being replaced.”). To accommodate the variations in refrigeration and air conditioning equipment and the desire to optimize for different emphases (e.g., lower GWP versus better pressure-temperature match), the optimization of a refrigerant blends usually covers a range of properties, and likewise a range of refrigerant component concentrations in the

blend. It is standard practice for one skilled in the art to evaluate and report the effects of blend concentrations on the properties across a range, and one would understand how each incremental variation in component concentrations would affect the properties.

C. Mr. Ponder's Use of Prior Art Solutions to the Problems

53. Beyond replacing CFCs and HCFCs, an additional problem known in the art well before 2002 was to maintain adequate lubrication of the system's compressor, which involved ensuring the lubricant circulated through the system. The new HFCs did not interact well with traditional mineral oil lubricants, so additional steps needed to be taken to either use different lubricants or to modify lubricants or refrigerant compositions such that the lubricant would travel through the system and return to the compressor. These problems were present for both R-12 and R-22 replacements. Before describing the prior art references, I note that before the alleged invention, Mr. Ponder's company sold two products that embody two of the basic alternative solutions to the known issue of facilitating mineral oil return to a compressor. First, it sold R-417A. EX1023, *Ponder Deposition*, pp.87-88. R-417A is a mixture of R-125 and R-134a and also includes a hydrocarbon (butane), which facilitates lubricant return to the compressor. Mr. Ponder testified that he didn't sell R-417 "any longer than [he] had to" because he was "coming up with a product [he] could control." EX1023, *Ponder Deposition*,

p.89. Several CFC and HCFC alternatives were patented by the time Mr. Ponder sought to develop his own product.

54. Second, Mr. Ponder sold RB-276 (branded FreeZone), which was described on the RMS Website in early 2002 (EX1020, *RMS Website – FreeZone Overview*), and was also allegedly covered by U.S. Patent 5,492,643, issued to a third party in 1996 (“’643 Patent”, EX1005). In fact, in reviewing the ‘643 Patent and the ‘840 Patent, it is plain that the ‘840 Patent literally copied the text of the ‘643 Patent and simply replaced words where needed. For example, the refrigerant R-142b was changed to R-125, the lubricant ROYCO 783 was changed to ROYCO 2302, and the refrigerant to be replaced was changed from R-12 to R-22. As discussed below, the sale of the product embodying the ‘643 Patent and described in the 2002 RMS Website demonstrates that the concepts disclosed in those prior art references, such as facilitating oil return by including a lubricant in the blend, were already well known in the art and to the inventor specifically.

55. RB-276/FreeZone was an R-12 replacement used in systems such as refrigerators, chillers, and automobile and window air conditioners. RB-276 facilitated lubricant return with an additive, a ROYCO light naphthenic lubricant. EX1005, *’643 Patent*, at 4:47-64; EX1033, *2002 RMS Website – FreeZone Chiller Conversion ¶5*. In this way, RB-276/FreeZone is also similar to U.S. Patent No. 6,640,841 issued to Thomas et al. (EX1014) in that it uses additives other than

hydrocarbons to facilitate mineral oil return to the compressor. Mr. Ponder's business website as of early 2002 stated that the light naphthenic lubricant in RB-276 "thins" the existing mineral oil in the system, thereby facilitating lubricant return to the compressor. EX1033, *2002 RMS Website – FreeZone Chiller Conversion* ¶5.

56. I do not rely on R-417A or RB-276 in my obviousness analysis. But, Mr. Ponder' prior public uses and sales of available products embodying two alternative solutions to the known problem of facilitating mineral oil lubricant return further demonstrates that those alternative solutions were well known in the art. Although the RB-276 product was an R-12 replacement rather than an R-22 replacement, as discussed, the state of the art was such that one skilled in the art would have looked to concepts involved in any relevant replacement of refrigerants being phased out by the Montreal Protocol. If a light naphthenic additive thinned the mineral oil in an existing R-12 system, it would likewise have thinned the mineral oil in an R-22 system. One skilled in the art would have understood the RB-276 "thinning naphthenic additive" solution was a substitute for the R-417A "hydrocarbon additive" solution and would have been motivated to use it, or similar technology (such as Thomas), as such.

D. Japanese Patent Document H05-117643 (“Yoshida”; EX1013)

57. Yoshida published on May 14, 1993. EX1013. The PTO did not have Yoshida before it when it evaluated the applications that led to the ‘840 Patent or its family, nor is Yoshida duplicative of any art that the PTO considered.

58. Yoshida is from the same field of endeavor as the ‘840 Patent and teaches a refrigerant blend to replace R-22 that can optionally be binary or ternary that does not harm the ozone layer. *Id.* at ¶¶4-5. Yoshida states that it meets the “strong demand for the early development of the working fluid as an alternative to R22.” *Id.* at ¶ 3. Yoshida teaches a binary blend using the refrigerants pentafluoroethane (R-125) and tetrafluoroethane (R-134a). *Id.* at ¶¶ 4, 11. Yoshida teaches that propane is an optional third component; one can see that it is optional because Yoshida consistently teaches it can be present in 0%. *Id.* at ¶¶ 5, 6, 11.

59. Because it is used in refrigeration and air conditioning as a replacement for R-22, Yoshida’s blend is designed to achieve a phase change from a liquid to a gas and then back to a liquid as it travels through the system, just like R-22 does. *E.g., id.* at ¶¶ 1-2.

60. Yoshida indicates that its refrigerant blend is designed with a goal of minimizing Ozone Depletion Potential (ODP) and reducing Global Warming Potential (GWP). *Id.* at ¶ 4, 7, 9. It also teaches that its invention matches the P-T characteristics of R-22: “it is possible to provide a working fluid having a vapor

pressure equivalent to that of R-22 at approximately 0 to approximately 50 °C which is a use temperature of a heat pump device such as for an air conditioner and a refrigerator, and which can be used in a current apparatus as an alternative to R-22.” *Id.* at ¶ 8.

61. Yoshida teaches what it terms the particularly desirable composition ranges of the components as follows

- Pentafluoroethane (R-125): “approximately 55 to approximately 65% by weight”
- Tetrafluoroethane (R-134a): “approximately 30 to approximately 45% by weight”
- Propane (R-290): “0 to approximately 6% by weight”

Id. at ¶11. Yoshida explains that these proportions are particularly desirable “because it [i.e., the refrigerant blend] has a vapor pressure substantially equal to that of R-22 at all use temperatures between 0 °C and 50 °C.” *Id.*

62. Thus, by 1993, the art taught binary blends of R-125 and R-134a in various percentages and how to optimize the percentages (ratios) to match the vapor pressure of R-22 so that the blend can be used as a replacement refrigerant for R-22 in existing apparatuses. Yoshida is discussed further in Section IX.A on Invalidity Opinions as to Anticipation and Obviousness.

E. U.S. Patent No. 6,640,841 (“Thomas”; EX1014)

63. Thomas issued on November 3, 2003, and is a divisional of U.S. patent application no. 09/943,063, filed on Aug. 30, 2001, and published on April

25, 2002, as US2002/0046568 (EX1039), which claims the benefit of U.S. Provisional Application No. 60/235,746, filed Sept. 27, 2000. EX1014. Although US2002/0046568 (EX1039) has identical disclosure, I have provided citations to EX1014 because the line and column numbers are more precise than the paragraph numbers in EX1039. The PTO did not have Thomas before it when it evaluated the applications that led to the '840 Patent. Thomas is not duplicative of any art that the PTO considered when it evaluated the application that led to the '840 Patent.

64. Thomas is from the same field of endeavor as the '840 Patent and teaches an R-22 replacement refrigerant composition comprising (1) hydrofluorocarbon refrigerants (such as R-125 and R-134a), (2) a surfactant, and (3) a solubilizing agent (which can be a lubricant such as PAGs and polyol esters). *Id.* at 1:23-33; 3:28-41. The composition is designed so that when an existing system is emptied of its chlorine-containing refrigerant, one can leave the traditional, existing lubricant (e.g., mineral) oil in the system and yet facilitate its circulation through the system and return to the compressor. *Id.* at 1:23-2:39.

65. Regarding the refrigerant, Thomas teaches that “[a]ny of a wide range of non-chlorine-containing refrigerants can be used,” including R-134a and R-125 and mixtures thereof, which includes the binary mixture. *Id.* at 3:28-41.

66. Regarding the surfactant, Thomas teaches a variety of surfactants for use in blending with the refrigerants. *Id.* 3:42-4:33.

67. As to the solubilizing agent, Thomas teaches that “[a]ny of a wide range of solubilizing agents can be used” (*id.* at 4:50), and specifically teaches lubricants such as PAGs and polyol esters (such as ester and diester lubricants based on acids such as pentaerythritol). *Id.* at 4:50-65. Thomas also teaches that “the solubilizing agent independently enhance[s] the solubility and dispersibility of the refrigerant in the [existing, traditional] lubricant.” *Id.* 4:46-49.

68. Thomas further teaches removing from an existing air conditioning system the chlorine-containing refrigerants (i.e., R-22) without removing the mineral oil lubricant and adding the non-chlorine-containing refrigerants (e.g., R-125 and R-134a) to form efficient and environmentally desirable refrigerant/lubricant systems. *Id.* at 2:10-54; 6:64-7:23.

69. Thomas further teaches that the composition can also include other “additives and materials” such as “corrosion inhibitors” and that “Examples of such additives are disclosed in U.S. Pat. No. 5,254,280.” *Id.* at 5:40-52. Thomas incorporates U.S. Pat. No. 5,254,280 (the ‘280 Patent”) by reference. *Id.* at 4:6-8. The ‘280 Patent (included herein as EX1034), and thus Thomas, into which it is incorporated, teaches a variety of additives. EX1034, ‘280 *Patent* at 11:45-47. Thomas is discussed further in Section IX.B on Invalidity Opinions as to Anticipation and Obviousness.

70. Thomas shows that by the year 2000 a skilled artisan knew how to blend a variety of lubricants and a variety of additives, including corrosion inhibitors, surfactants, foaming agents, and mixtures thereof, into an HFC blend of R-125 and R-134a.

F. Published PCT Application No. WO/93/24597 (“Schnur”; EX1015)

71. Schnur published on December 9, 1993. EX1015. The PTO did not have Schnur before it when it evaluated the application that led to the ‘840 Patent. Schnur is not duplicative of any art that the PTO considered when it evaluated the application that led to the ‘840 Patent.

72. Schnur is from the same field of endeavor as the ‘840 Patent and teaches compositions comprising a blend of optionally only two refrigerants, pentafluoroethane and tetrafluoroethane, that further include a lubricating oil in the form of a polyol ester. *Id.* at pp. 1-2, 13-14, 22-24. Schnur teaches that the refrigerant can consist essentially of pentafluoroethane and tetrafluoroethane and 15% or less of polyol ester. *Id.* at pp. 22-24.

73. Schnur teaches that the lubricant that is blended with the composition contains “other materials generally denoted in the art as additives, such as ... corrosion inhibitors, detergents, ... [and] antifoaming agents,” including mixtures thereof. *Id.* at p.10.

74. Schnur shows that by 1993 a skilled artisan knew how to blend

lubricants and a variety of additives, including corrosion inhibitors, surfactants, foaming agents, and mixtures thereof, into an HFC blend of R-125 and R-134a. Schnur is discussed further in Section IX.B on Invalidity Opinions as to Anticipation and Obviousness.

VIII. THE ‘840 PATENT

75. The ‘840 patent issued on May 31, 2022 from U.S. Patent Application No. 16/920,905 (“the ‘905 application”), filed on July 6, 2020. EX1001.

76. The ‘840 Patent relates to a refrigerant composition used to replace R-22 in air conditioning, refrigeration, and HVAC equipment, the blend consisting of a blend of pentafluoroethane (R-125) and 1,1,1,2-tetrafluoroethane (R-134a) at a ratio of 59-57% R-125 and 41-43% R-134a by weight. *Id.* The composition can be used in an existing R-22 apparatus, and a generic method of refilling such an apparatus with the composition is also claimed. *Id.* Some dependent claims require the refrigerant composition to include a lubricant or alternatively additives including an acrylic polymer, a corrosion inhibitor, a surfactant, a foaming agent, and mixtures thereof (or both a lubricant and an additive).

77. The ‘840 Patent acknowledges that methods of refilling an air conditioner with refrigerant under pressure supplied from a cylinder can via a compatible manifold were known in the art:

Refrigerant R-22 (chlorodifluoromethane) recharging typically involves 30

lb. cans or cylinders typically used in the HVAC/R industry. The cylinders are fitted with a dispensing outlet compatible with a commercially available refrigeration manifold. In order to recharge an air-conditioning system, a customer need to only fit the can or cylinder to the manifold and discharge, or “add to” the refrigerant charge directly into the air conditioning system.

Id. at 2:27-34.

78. The ‘840 Patent acknowledges that the disclosed ROYCO 2302 lubricant was commercially available before the filing of the earliest priority application. *Id.* at 4:56-67 (“the lubricant is selected from those lubricants sold by Anderol ... under the trademark ROYCO 2302.”). The ‘840 Patent acknowledges that the commercially available ROYCO 2302 “contain the corrosion inhibitors mentioned above can also contain acrylic polymer.” *Id.* at 9:26-28.

79. The ‘840 Patent acknowledges that at one time R-22 “was the major, if not sole refrigerant, used in residential air-conditioners, refrigerators, freezers and window air-conditioning units.” *Id.* at 1:46-50.

A. The Challenged Claims

80. I understand that all claims (1-12) of the ‘840 Patent are challenged. The text of those claims is contained in the claim charts that follow later.

B. Priority Date

81. The ’840 patent purports to claim priority to Application No. 105/989,655, filed on May 25, 2018, now U.S. Patent No. 10,703,949 (“’949

patent”), which is a continuation of Application No. 13/493,491, filed on June 11, 2012, now U.S. Patent No. 9,982,179 (“’179 patent”), which is a continuation of Application No. 12/961,045, filed on December 6, 2010, now U.S. Patent No. 8,197,706 (“’706 patent”), which is a continuation of Application No. 10/937,736, filed on September 8, 2004, now abandoned. The ‘840 Patent, through the above chain, claims priority to provisional Application No. 60/501,049, filed on September 8, 2003, which is the earliest possible date to which the ‘840 patent can claim priority.

IX. INVALIDITY OPINIONS AS TO ANTICIPATION AND OBVIOUSNESS (INCLUDING THE DIFFERENCES BETWEEN THE CLAIMS AND THE PRIOR ART)

82. The prior art described above either anticipates or renders obvious each of the challenged claims. It is my opinion that each claim was anticipated or would have been obvious to a person having ordinary skills in the art as of the priority date of the ‘840 Patent. The basis for invalidity is explained in detail below.

A. Ground 1(A&B): Yoshida (A) Anticipates or (B) Renders Obvious the Challenged Claims.

83. Yoshida anticipates or would have rendered all challenged claims obvious as of the priority date.

84. The claim charts below details where each challenged claim limitation from the **‘840 Patent** is anticipated or rendered obvious by Yoshida. All cross

references are to the claim limitations in this GROUND unless otherwise specified.

Lim.	'840 Patent, Claim 1	Yoshida (EX1013)
1[a]	1. In an apparatus designed for use with chlorodifluoromethane refrigerant, the improvement comprising,	<u>Ground 1(A)</u>: Yoshida discloses air conditioning and refrigeration systems designed for use with chlorodifluoromethane refrigerant. (EX1013, ¶¶ 1-2, 8) <u>Ground 1(B)</u>: Same as Ground 1(A).
1[b]	substituting the chlorodifluoromethane with	<u>Ground 1(A)</u>: Yoshida discloses replacing R-22 refrigerant with a different refrigerant composition designed as a replacement for R-22 and designed to be used in the apparatus originally designed for R-22. (EX1013, ¶¶ 2, 7, 8). Yoshida teaches that its working fluid “can be used in a current apparatus as an alternative to R22.” (EX1013, ¶¶ 8, 22(3)) <u>Ground 1(B)</u>: Same as Ground 1(A).
1[c]	a composition designed to achieve a phase change over a range of working temperatures and pressures of the apparatus	<u>Ground 1(A)</u>: Yoshida discloses replacing R-22 with a “working fluid” (i.e., refrigerant composition), which is a composition designed to achieve a phase change over a range of working temperatures and pressures of the apparatus. (EX1013, ¶¶ 1, 2, 8). Yoshida teaches the composition will undergo a “condensation process and the evaporation process” (EX1013, ¶8; see also ¶¶14-15 (describing embodiments in which the condensation temperature and vaporization temperature substantially equal to R22)) Yoshida teaches that the phase change will occur over a range of working temperatures and pressures of the apparatus. Specifically, in one embodiment it teaches the “working fluid having a vapor pressure equivalent to that of R22 at approximately 0 to approximately 50°C which is a use temperature of a heat pump device such as

		for an air conditioner and a refrigerator, and which can be used in a current apparatus as an alternative to R22.” (EX1013, ¶8) In a closed system like Yoshida’s air-conditioner or refrigerator with a given working fluid, the range of working temperatures necessarily correspond to a range of working pressures. <i>See, e.g.</i>, Table 2 of the ‘840 Patent (EX1001). <u>Ground 1(B)</u>: Same as Ground 1(A).
1[d]	the composition consisting of a blend of tetrafluoroethane and pentafluoroethane	<u>Ground 1(A)</u>: Yoshida discloses refrigerant compositions consisting of a blend of tetrafluoroethane and pentafluoroethane. (EX1013, ¶11) (Propane is disclosed as an optional component that can be present at “0 to about 6% by weight.” (EX1013, ¶11)). <u>Ground 1(B)</u>: Same as Ground 1(A).
1[e]	wherein said pentafluoroethane is present in an amount of 59% to 57% by weight and said tetrafluoroethane is present in an amount of 41% to 43% by weight of the combined weight of the pentafluoroethane and tetrafluoroethane on the basis of the combined weights of said pentafluoroethane and said tetrafluoroethane totaling 100%	Yoshida discloses a ratio of tetrafluoroethane to pentafluoroethane in at least the range: • 55% to 65% pentafluoroethane by weight and 30% to 45% tetrafluoroethane by weight (EX1013, ¶ 11) The percentage by weight is calculated using the combined weight of the pentafluoroethane and tetrafluoroethane on the basis of the combined weights of said pentafluoroethane and said tetrafluoroethane totaling 100%. In the embodiments where the optional propane is not present, the composition comprises only pentafluoroethane and tetrafluoroethane, and those components will make up and total 100% of the weighted components. <u>Ground 1(A)</u>: One skilled in the art would immediately recognize the individual members of the genus

		as the whole-number percentages between 55% to 65% pentafluoroethane by weight and 35% to 45% tetrafluoroethane by weight. The ‘840 Patent refers to the refrigerant ranges in whole numbers without decimals, indicating the last significant digit is the “ones” digit. Also, in general, at and before the priority date of the ‘840 Patent, unless an HFC blend was aiming for azeotropic behavior, ASHRAE typically listed HFC blends with a tolerance of at least $\pm 1\%$.¹ During prosecution, applicants themselves admitted that under the “the trade association, ASHRAE, ... refrigerants are defined by percentages of, for example, $\pm 1\%$.” EX1002, B0047 (<i>Office Action Response Dated 12-6-21</i>, arguing that the range of 40-60% in Takigawa, EX1017, is too broad). Tolerances of $\pm 1\%$ demonstrate that one skilled in the art would not regard variations of $\pm 1\%$ as materially changing the relevant properties. As blends changed in percentages, one skilled in the art could predict and know with a high level of accuracy how the properties changed. This is shown by the smooth data presented in Table 2 of the ‘840 Patent, which was generated by publicly available government software that was available for years before the claimed priority date (see footnote 3 in ¶115 of this Declaration). Therefore, one skilled in the art would immediately recognize that Yoshida discloses a list of 11 species of R-125/R-134a mixtures.
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¹ See EX1045, ASHRAE Designation and Safety Classification of Refrigerants, https://www.ashrae.org/file%20library/technical%20resources/standards%20and%20guidelines/standards%20addenda/34_2019_f_20191213.pdf. Note that ASHRAE assigns R-numbers sequentially and that the commercial embodiment covered by the instant claims is R-421A. During prosecution the applicants pointed to ASHRAE as authoritative. Although ASHRAE does not consider the performance of a blend, its tolerances provides evidence that one skilled in the art would understand a range of blends to constitute a known group of distinct species.

		That is, Yoshida discloses a list of 65/35%, 64/36%, ... 55/45%.² I am advised that under the law when a reference discloses a small range of species and the individual species in that range are immediately identifiable because they are given with sufficient specificity, the genus anticipates the species. I believe that one skilled in the art would regard Yoshida's disclosure to be such a case. Even assuming percentages specified to the tenth of a percent, the changes in properties as the percentages change were well known and predictable as shown by the smooth data presented in Table 2 of the '840 Patent, which as mentioned was generated by publicly available government software that was available for years before the claimed priority date. Moreover, Yoshida teaches that the disclosed the percentages best match the vapor pressure of R-22 across the range of use temperatures of the air conditioner or other device (EX1013, ¶¶8, 22), the very property the '840 Patent seeks to optimize. (The '840 Patent teaches to mix R-125 and R-134a "in a defined ratio such that the temperature-pressure relationship of the mix approximates that of Refrigerant R-22" for the range of temperatures encountered by an air conditioner or other apparatus. EX1001, 1:30-33; see also id. 4:12-16.)
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² Yoshida lists and its range of blends without a decimal point, indicating that the last digit of significance is the "ones" digit. Yoshida also provides examples in Tables 1 and 2 with propane that list percentages down to the tenth of a percent. Generally, when blends add a small amount of hydrocarbon, it is not uncommon for the digit of significant to the "tenths" digit as the small amount of hydrocarbon is often carefully controlled to avoid flammability. The smallest tolerances/specification in ASHRAE is 0.1%. Even assuming a tolerance of a tenth of a percent, one skilled in the art would easily envision the individual species of the genus, which follow well known and predictable patterns in terms of properties as percentages change.

		Moreover, there is nothing critical about the claimed ratios or ranges that distinguish them from the predictable range of species disclosed by Yoshida. Each species within Yoshida's range smoothly follows known and predictable characteristics. Indeed, the '840 Patent teaches (and its ancestor application originally claimed) a range of between 55% to 60% pentafluoroethane by weight and 40% to 45% tetrafluoroethane, showing that broader ranges were contemplated. See EX1001, '840 Patent, Table 2. The '840 Patent always refers to the percentages of R-125 and R-134a as whole numbers, further indicating that one skilled in the art would understand the blends of R-125 and R-134a as whole-number percentages as opposed to tenths of a percent. <u>(GROUND 1(B)): OBVIOUSNESS ALTERNATIVE:</u> In the alternative, I understand that under the law, when a claimed ratio lies within a range disclosed by the prior art, a prima facie case of obviousness exists. Beyond that presumption, one skilled in the art as of the priority date of the patent would easily be able to adjust by routine optimization the ratios of pentafluoroethane and tetrafluoroethane within the range taught by Yoshida to reach a ratio of the claimed composition. As with all blend formulations research, the blends are evaluated at varying concentrations of the components to establish a range of blend properties such as pressure-temperature characteristics, capacity, COP, GWP, etc. For blends of R-125 and R-134a, this research at
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		various concentrations had been done for years before 2002, as shown by Yoshida (and Segami, Radermacher, etc., discussed at Sections VII.B and X. The property changes that would occur as concentrations were adjusted were well known and predictable, and thus one skilled in the art would have a strong expectation of success as adjustments were made to achieve desired performance characteristics. In fact, Yoshida teaches that its working fluid “ha[s] a vapor pressure equivalent to that of R22 at approximately 0 to approximately 50 °C”. (EX1013, ¶ 8; <i>see also</i> ¶ 11). Yoshida also teaches that its working fluid “has a vapor pressure of the same degree as R22 at the use temperature of the device and can be used in a current device as an alternative to R22.” (EX1013, ¶ 22(3)) One skilled in the art would have understood that <i>following Yoshida’s explicit teaching</i> to match the vapor pressure of R-22 for, e.g., an air conditioner designed for R-22 would result in a blend concentration of 59% to 57% pentafluoroethane by weight and of 41% to 43% tetrafluoroethane by weight. This is because Yoshida was pursuing the same goal that the ‘840 Patent pursued. This goal of matching the blend’s vapor pressure to that of R-22 is also what Mr. Ponder touted in his 2017 declaration was supposedly an unexpected result of the claimed blend best approximating “the thermodynamic R-22 pressure-temperature (P-T) characteristics.” EX1002, pp.B0055-B0056. That is to say, approximating the P-T characteristics of R-22 means the same thing as matching the vapor pressure of R-22 in a target temperature range. In addition, matching pressure was generally known in the art. EX1018, <i>Gopalnarayanan</i>,
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		p.94 (“For example, by adjusting the composition of a blend containing a high-pressure and a low- pressure refrigerant, the vapor pressure of the final fluid can be tailored to match that of the CFC or HCFC being replaced.”); EX1005, ‘643 Patent, 1:15-18 (the third-party patent that the ‘840 Patent copied teaches the “refrigerants are mixed in a defined ratio such that the temperature-pressure relationship of the mix approximates that of” R-12). Those skilled in the art would find a range of concentrations that would approximate the vapor pressure of the fluid being replaced, and would have understood how to optimize within that range as is shown, for example, by Yoshida’s successively preferred ranges. The claimed ranges in the ‘840 Patent and its ancestry follow this familiar pattern. For instance, the original claims in the ancestor patent application claimed a range of 55-60% R-125; 45-40% R-134a. <i>See</i> EX1007, <i>File History of App. 10/937,736</i>, at R03828 (listing pending claims). Yoshida is directed to the same problem as the claimed invention (finding a non-ozone-depleting substitute for R-22 that matches R-22’s pressure). Therefore, a skilled artisan would have expected success because Yoshida teaches the narrow range and to optimize for R-22 pressure match, and because the behavior of the blend was well understood and predictable. Further, Yoshida discusses a range of uses for the refrigerant composition, including in refrigerators and air conditioners of various types. Optimizing the refrigerant blend for each of these various uses is within the skill of the art.
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1[f]	and wherein the tetrafluoroethane is 1,1,1,2-tetrafluoroethane.	<u>Ground 1(A)</u>: Yoshida teaches the tetrafluoroethane is 1,1,1,2-tetrafluoroethane. (EX1013, ¶11). <u>Ground 1(B)</u>: Same as Ground 1(A).
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Lim.	'840 Patent, Claims 2, 4, 6, and 8	Yoshida (EX1013)
[pre]	In the apparatus of claim [1/3/5/7],	<u>Ground 1(A&B)</u> : See Claim 1/3/5/7.
[a]	wherein the apparatus is selected from the group consisting of refrigeration equipment, air-conditioning equipment, and HVAC equipment	<u>Ground 1(A)</u>: Yoshida discloses the use of its refrigerant compositions in apparatuses such as “an air conditioner and a refrigerator.” (e.g., EX1013, ¶ 8) I am advised that disclosure in the prior art of any species listed in a Markush genus anticipates the claim limitation. <u>Ground 1(B)</u>: Same as Ground 1(A).

Lim.	'840 Patent, Claims 3, 7, and 11	Yoshida (EX1013)
[pre]	In the apparatus of claim [1/5/9], wherein	See Claim 1/5/9. <u>Ground 1(A)</u>: As explained in this chart, Yoshida anticipates the limitations of claims 3, 7, and 11 because each subpart (denoted a, b, and c) are listed as alternatives, any one of which when met anticipates the claim. Further, alternative limitation [b] does not require any lubricant (as explained below), and thus Yoshida meets the limitation.

		<u>Ground 1(B)</u> : In the alternative, obviousness arguments are presented below.
[a]	[a] the composition is blended with an additive selected from the group consisting of an acrylic polymer, a corrosion inhibitor, a surfactant, a foaming agent, and mixtures thereof,	<u>Ground 1(A)</u>: not applicable to this claim limitation. <u>Ground 1(B)</u>: Based on my experience, the inclusion of acrylic polymers, corrosion inhibitors, surfactants, foaming agents, or mixtures thereof to a refrigerant composition (including an HFC blend) would have been obvious from general knowledge in the art. The ‘840 Patent admits that corrosion inhibitors and acrylic polymers were known in the art. <i>See, e.g.</i>, EX1001, 9:26-28 (“The ROYCO® lubricants mentioned above contain the corrosion inhibitors mentioned above can also contain acrylic polymer.”) The ‘840 Patent also speaks to what was generally known in the field, that a “corrosion inhibitor can be included. (otherwise corrosion will probably occur within 6 months)” <i>Id.</i> at 5:31-32. One skilled in the art would have known from general knowledge to include a corrosion inhibitor with HFC refrigerants, as taught by many pieces of prior art, including art cited by the ‘840 Patent. <i>See, e.g.</i>, EX1034, ‘280 Patent, at col. 11; <i>see also</i> GROUNDS 2&3, below, at this claim limitation.
[b]	[b] or blended with a lubricant wherein the lubricant is present up to 20% by weight of the	<u>Ground 1(A)</u> : This claim limitation does not require any lubricant, as it is specified as “up to about 20% by

	composition on the basis of the combined weights of said pentafluoroethane and said tetrafluoroethane totaling 100%,	weight,” and the language “up to” includes zero as the lower limit. One skilled in the art would understand “up to” to include zero as the lower limit. <u>Ground 1(B)</u> : In the alternative, one skilled in the art also would have known from general knowledge that a variety of lubricants were available for use with R-125 and R-134a and could be blended in the refrigerant composition. <i>See, e.g.</i> , GROUNDS 2&3, below, at this claim limitation.
[c]	or both	<u>Ground 1(A&B)</u> : This limitation is in the alternative and need not be separately met. In addition, one skilled in the art would have known that additives and lubricants could both be included at the same time. <i>See, e.g.</i> , GROUNDS 2&3, below, at this claim limitation.

Lim.	‘840 Patent, Claim 5	Yoshida (EX1013)
5[a]	[a] A method for refilling an apparatus designed for use with a chlorodifluoromethane refrigerant, the method comprising:	<u>Ground 1(A)</u> : See Claim 1[a]. Yoshida teaches its blend “can be used in a current apparatus as an alternative to R22.” EX1013, ¶ 8. Thus, the “current apparatus” must be refilled with the Yoshida blend. <u>Ground 1(B)</u> : In the alternative, it would have been obvious to one skilled in the art based on general knowledge to refill an apparatus designed for R-22 with a replacement refrigerant.

5[b]	(1) selecting a substitute composition designed to be a substitute for the chlorodifluoromethane refrigerant	<u>Ground 1(A&B)</u> : See Claim 1[b]. The claimed “substitute composition designed to be a substitute for the R-22 refrigerant” is the same as the composition used in “substituting the [R-22]” in Claim 1[b]. Yoshida teaches to use (i.e., select) its blend in a current (R-22) apparatus. EX1013, ¶ 8.
5[c]	and designed to achieve a phase change over a range of working temperatures and pressures of the apparatus,	<u>Ground 1(A&B)</u> : See Claim 1[c].
5[d]	the substitute composition consisting of a blend of tetrafluoroethane and pentafluoroethane,	<u>Ground 1(A&B)</u> : See Claim 1[d]
5[e]	wherein said pentafluoroethane is present in an amount of 59% to 57% by weight and said tetrafluoroethane is present in an amount of 41% to 43% by weight of the combined weight of the pentafluoroethane and tetrafluoroethane on the basis of the combined weights of said pentafluoroethane and said tetrafluoroethane totaling 100%,	<u>Ground 1(A&B)</u> : See Claim 1[e]
5[f]	and wherein the tetrafluoroethane is 1,1,1,2-tetrafluoroethane, and	<u>Ground 1(A&B)</u> : See Claim 1[f].
5[g]	(2) supplying the substitute composition under pressure, in a cylinder can fitted with an outlet compatible with a chlorodifluoromethane	<u>Ground 1(A)</u> : Note applicable to this claim limitation.

	recharging manifold of the apparatus.	<u>Ground 1(B)</u>: See claim 1[b]. Thus, Yoshida teaches supplying the substitute composition. The remaining details of the claim limitation would have been obvious to one skilled in the art based on generalized knowledge in the field. First, the ‘840 Patent admits that supplying refrigerant compositions under pressure in a cylinder can fitted with an outlet compatible with an R-22 recharging manifold was known in the art. EX1001, at 2:27-34 (“Refrigerant R-22 (chlorodifluoromethane) recharging typically involves 30 lb. cans or cylinders typically used in the HVAC/R industry. The cylinders are fitted with a dispensing outlet compatible with a commercially available refrigeration manifold. In order to recharge an air-conditioning system, a customer need to only fit the can or cylinder to the manifold and discharge, or “add to” the refrigerant charge directly into the air conditioning system.”) Based on my knowledge and experience, the same cylinders (and the outlets on them) have been used whether they contain R-22 or replacements for R-22. Cf. EX1035, HEATING & COOLING ESSENTIALS, pp. 238-242 (“Refrigerant Cylinders” – “The valve outlet is a ¼” male flare fitting for easy connection to the gauge manifold.”).
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Lim.	‘840 Patent, Claim 9	Yoshida (EX1013)
9[a]	A composition designed to be used as a substitute for R-22 chlorodifluoromethane refrigerant,	<u>Ground 1(A&B)</u> : See Claim 1[b&c].
9[b]	the composition consisting of a blend of tetrafluoroethane and pentafluoroethane,	<u>Ground 1(A&B)</u> : See Claim 1[d]
9[c]	wherein in the composition said pentafluoroethane is present in an amount of 59% to 57% by weight and said tetrafluoroethane is present in an amount of 41% to 43% by weight of the combined weight of the pentafluoroethane and tetrafluoroethane on the basis of the combined weights of said pentafluoroethane, [sic] and said tetrafluoroethane totaling 100%,	<u>Ground 1(A&B)</u> : See Claim 1[e]
9[d]	and wherein the tetrafluoroethane is 1,1,1,2-tetrafluoroethane.	<u>Ground 1(A&B)</u> : See Claim 1[f]

Lim.	‘840 Patent, Claims 10, 12	Yoshida (EX1013)
[pre]	The composition according to claim [9/11],	<u>Ground 1(A&B)</u> : See Claim [9/11].
[a]	wherein the composition is designed for use in an apparatus	<u>Ground 1(A&B)</u> : See Claim 1[a&b&c]
[b]	[the apparatus] selected from the group consisting of refrigeration equipment, air-conditioning equipment, and HVAC equipment,	<u>Ground 1(A&B)</u> : See Claim 2[a].

[c]	the composition designed to undergo a phase change over a range of working temperatures and pressures of the apparatus	<u>Ground 1(A&B)</u> : See Claim 1[c].
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B. Grounds 2 & 3: Yoshida Combined with either (Ground 2) Schnur or (Ground 3) Thomas Renders Obvious Claims 3, 5, 7, and 11.

85. Yoshida combined with either Schnur (EX1015) or Thomas (EX1014) would have rendered claims 3, 5, 7, and 11 obvious as of the priority date.

1. General Reasons to Combine and Expectation of Success

86. In my experience, one skilled in the art was highly motivated to combine references containing teaching that would enable the replacement of CFC and HCFC refrigerants (such as R-11, R-12, R-142b, and R-22) with more ozone-friendly HFCs (such as R-134a and R-125). As discussed above, beginning in the 1980s we (i.e., those skilled in the art) knew that CFCs and HCFCs (like R-22) would need to be replaced with non-ozone depleting refrigerants. Intense worldwide government and market pressures encouraged us to develop non-ozone depleting refrigerants as well as the lubricants that would work with them. In my work in this area, the government and market pressures motivated us to search for and combine multiple developments. Those pressures would have motivated one skilled in the art to combine the references cited in this report as they all relate to solving that problem. For example, one skilled in the art would have looked to

teachings about replacements for CFCs to inform how to replace HCFCs. This is evidenced, for example, by the prior art, which refers to HFC (e.g., R-125 and R-134a) replacements for both CFCs and HCFCs. *See, e.g.*, EX1017, *Takigawa*, 1:21-27; EX1014, *Thomas*, 1:23-33; EX1013, *Yoshida*, ¶3; EX1016, *Powell*, 1:7-40; EX1021, *Segami* at ¶ 4, 15.

87. During my work, I observed that the change to HFCs created at least two broad options well known by 2002. First, some people designed an entirely new refrigerant, which might have different operating temperatures and pressures than R-22, thereby requiring a new system (e.g., a new air conditioner) that could be specifically optimized for the new refrigerant. Alternatively, others designed so-called “drop-in” refrigerants. Under this option, for example, the R-22 in an existing system (e.g., air conditioner) would be removed, and the replacement HFC refrigerant would be “dropped in” to replace the R-22. In this scenario, the replacement refrigerant would need to have operating pressures relatively close to those of R-22 so that the existing system could work with the refrigerant with minimal or no change to system components. Deviating from the pressure-temperature characteristics of R-22 would result in an inefficient or nonfunctional system.

88. In addition, a large issue we faced in the process of switching to HFC refrigerants was the intense market pressure to identify lubricants that would

adequately lubricate the compressor and circulate through the system. If the lubricant gets “stuck” somewhere in the system (for example, in the evaporator), it can reduce heat transfer efficiency and, if the compressor eventually loses too much lubrication, it will fail (like a car engine running without oil). Therefore, we felt intense pressure to find ways to use existing lubricants, to develop new lubricants, or to modify lubricants or refrigerant compositions (including refrigerants and additives) such that the lubricant would travel through the system and return to the compressor. In my experience, this pressure motivated us to look at, modify, and interchange different solutions to the lubricant problem.

89. As shown below, one skilled in the art generally would have expected success when combining and interchanging the teachings of the prior art described below because binary blends of R-125 and R-134a were well-known and well-studied, as was their interactions with many additives and lubricants. Many of the references explicitly state that R-125 and R-134a can be used, and the rich knowledge of those chemicals by 2002 allowed for routine optimization of the ratios in a binary blend as well as, for example the use and optimization of lubricants and additives with the binary blend. The rich knowledge and the explicit teachings would have led one skilled in the art to have been confident of success when combining and interchanging the teachings of the prior art.

2. Reasons to Combine Yoshida (EX1013) and Schnur (EX1015) and Expectation of Success

90. Based on my experience, one skilled in the art would have been motivated to combine Yoshida with Schnur because both are from the same filed of endeavor; that is, both seek to aid in the replacement of chlorine-containing CFC and HCFC refrigerants, which harm the environment/ozone layer, with chlorine-free HFC (hydrofluorocarbon) refrigerants, which do not harm the environment/ozone layer. Schnur includes “compounded lubricants” and “refrigerant working fluids including lubricants according to the invention along with primary heat transfer fluids.” EX1015, *Schnur*, p.1. As shown in the charts, Schnur explicitly states that its invention will work with blends of R-134a and R-125, thereby directly suggesting to combine it with a blend as taught by Yoshida. As shown in the charts, both also specifically point to the application in air conditioners and refrigerators, and both describe their air conditioners and refrigerators as including a compressor and evaporator. Based on my experience, one skilled in the art would have interweaved the information provided by Yoshida and Schnur because they are solving the CFC/HCFC problem for refrigerators and air-conditioners with blends of the same HFCs.

91. In addition, one skilled in the art would have known that the refrigerant blend of Yoshida would, when used in a refrigeration system, generally need to work with a lubricant. As stated, based on my experience, finding

lubricants that worked well in refrigeration systems with HFC refrigerants was a well-known issue in the field by the priority date of the '840 Patent. As shown in the charts below, Schnur seeks to solve the problem of finding lubricants soluble with HFCs (including specifically blends of R-125 and R-134a) and provides many lubricant options, specifically polyol esters, particularly suited for use with R-134a and R-125. A skilled artisan would have immediately seen the option and benefits of using Schnur's polyol ester lubricant option with Yoshida's specific blend to obtain the benefits of Yoshida's specific ratio and to ensure return of the lubricant to the compressor.

92. In sum, starting with the blends taught by Yoshida (i.e., drop-in replacement blends that matched the vapor pressure of R-22 and thus was in the range of 59-57% R-125 and 41-43% R-134a), the combination would result in adding Schnur's polyol ester lubricants (and optional additives) to Yoshida's HFC blend and ratios. One could just have easily started with Schnur, which teaches a broad range of mixtures of R-125 and R-134a, and been motivated to use the specific blend and ratios of R-125 and R-134a taught by Yoshida to achieve its specific benefits (i.e., matching the blend's vapor pressure to that of R-22 for the relevant use temperatures).

93. One skilled in the art would have been confident of success of the combination because Yoshida's refrigerant blend would have needed to work with

a lubricant in the system, and Schnur teaches specific ways of providing that exact aspect with the exact same HFCs, namely, blending polyol ester lubricants into the R-125 and R-134a refrigerants. By 2002, the art has extensively studied polyol esters and their interactions with HFCs, including R-125 and R-134a and had used them successfully. One would have also expected success based on following the explicit teaching. Starting with Schnur, one skilled would have been confident that the specific blends of R-125 and R-134a taught by Yoshida would work well because they were known, specific blends of the refrigerant options Schnur envisioned. Further, Schnur specifically teaches to use POEs that are soluble in blends of R-125 and R-134a, and this was well-known by 2002.

3. Reasons to Combine Yoshida (EX1013) and Thomas (EX1014) and Expectation of Success

94. One skilled in the art would have been motivated to combine Yoshida with Thomas because both are from the same filed of endeavor; that is, both seek to aid in the replacement of chlorine-containing CFC and HCFC refrigerants, which harm the ozone layer, with chlorine-free HFC (hydrofluorocarbon) refrigerants, which do not harm the ozone layer. As the claim charts below show, Thomas explicitly states that its invention will work with blends of R-134a and R-125, thereby specifically suggesting to combine it with a blend as taught by Yoshida. As the claim charts show, both also specifically point to the application in air conditioners and refrigerators containing compressors and evaporators. Based

on my experience, one skilled in the art would have interweaved the information provided by Yoshida and Thomas because they are solving the CFC/HCFC problem for refrigerators and air conditioners with blends of the same HFCs.

95. Further, in my experience, one skilled in the art would have understood that changing the R-22 refrigerant to the R-125/R-134a blend of Yoshida would require evacuating the R-22 from the system and replacing it with the blend, and would have seen that Thomas shows one easy and inexpensive way to do that. In addition, one skilled in the art would have known that the refrigerant blend of Yoshida, when used in a refrigeration system, would need to work with a lubricant. During my time working in the industry, by 2002 it was clear that finding lubricants that worked well and circulated in refrigeration systems with HFC refrigerants was a major and well-known issue with several well-known solutions. As the charts show, Thomas teaches an option to retain or use a traditional mineral oil-based lubricant in the system and add additives (including a lubricant-solubilizer and surfactant) to the refrigerant blend to help the existing lubricant circulate. A skilled artisan would have immediately seen the option and these benefits of using Thomas's lubricant-and-additive option with Yoshida's specific blend.

96. In sum, starting with Yoshida, one skilled in the art would have been motivated by the common problems solved by Thomas, to combine the teachings

to produce a drop-in HFC blend for use in air conditioners and refrigerators that matched the vapor pressure of R-22 (and thus was in the range of 59-57% R-125 and 41-43% R-134a), that worked with traditional mineral-oil based lubricants, and included the lubricants and other additives taught by Thomas. The combination would also have utilized the teachings of Thomas regarding how to fill/refill an apparatus with the refrigerant/lubricant blend. One could just have easily started with Thomas and been motivated to use the specific HFC blend taught by Yoshida to achieve its specific benefits within the solution taught by Thomas.

97. One skilled in the art would have been confident of success in the combination because Yoshida's refrigerant blend would have needed to work with a lubricant in the system, and Thomas teaches a specific way of providing that exact aspect with the exact same HFCs (i.e., using or retaining traditional mineral-oil based lubricants and including additives to ensure oil return with R-125 and R-134a). One would have also expected success based on following Thomas's explicit teaching. Alternatively, starting with Thomas, one would have been confident of success because Thomas broadly discloses blends of R-134a and R-125 and Yoshida's more specific ratios of R-134a and R-125 fall within Thomas's broader disclosure. Further, the blends of R-125 and R-134a had been extensively studied by 2002, including the interactions with the POEs taught by Thomas.

4. Combination

98. The claim charts below details where each challenged claim limitation from the **‘840 Patent** is taught and/or rendered obvious by either Thomas or Schnur. Thomas and Schnur are presented as alternatives. That is, either combine Schnur or Thomas with Yoshida. Thomas and Schnur are only combined with Yoshida as to claims 3, 5, 7, and 11. Nevertheless, all claims of the ‘840 Patent are compared to Thomas and Schnur in the below charts to demonstrate the similarities of the references in terms of interrelated teachings and problems to be solved, further demonstrating reasons to combine them.

99. All cross references are to claim limitations in the charts in this GROUND unless otherwise specified. Combining these claim charts with the claim charts in GROUND 1 demonstrates the obviousness of all relevant claims.

Lim.	‘840 Patent, Claim 1	Yoshida (EX1013) With Either (Ground 2) Schnur or (Ground 3) Thomas
1[a]	1. In an apparatus designed for use with chlorodifluoromethane refrigerant, the improvement comprising,	<u>Ground 2:</u> Schnur teaches that its lubricant can be used with refrigerants in air conditioner and refrigerators with hermetically sealed compressors (abstract) and “refrigerating machinery” (EX1015, pp.13-14). <u>Ground 3:</u> Thomas teaches an apparatus designed for use with chlorodifluoromethane refrigerant. (EX1014, 2:10-64, 6:13-61) (including a specific example of removing R-22 from a system).

1[b]	substituting the chlorodifluoromethane with	<u>Ground 2:</u> Schnur teaches that “chlorine-free heat transfer fluids are desirable in refrigerant systems, because their escape into the atmosphere causes less damage to the environment than the currently most commonly used chlorofluorocarbon heat transfer fluids such as trichlorofluoromethane dichlorodifluoromethane.” (EX1015, p.2) One skilled in the art at the time of the priority date would have understood that the words “such as” means the listed fluids are non-exhaustive and that another common chlorofluorocarbon heat transfer fluid that needed replacing because of its atmospheric effects was chlorodifluoromethane (R-22). The ‘840 Patent admits that R-22 was “until recently ... was the major, if not sole refrigerant, used in residential air-conditioners [and] refrigerators.” <i>Id.</i> at 1:46-50. <u>Ground 3:</u> Thomas teaches substituting (emptying) the chlorodifluoromethane and refilling with a refrigerant composition designed to replace R-22 and to achieve a phase change over working temperatures and pressures of an apparatus. EX1014, 2:10-64, 6:13-61 (including broad discussion of “recharging a refrigerant system that contains a chlorine-containing refrigerant” and introducing a refrigerant that will achieve a phase change, and also giving specific example of substituting R-22 with HFC working fluids that achieve a phase change in the apparatus).
1[c]	a composition designed to achieve a phase change over a range of working temperatures and pressures of the apparatus	<u>Ground 2:</u> See Claim 1[a&b]. The refrigeration and air conditioning systems disclosed in Schnur operate by R-22 (or other refrigerant) achieving a phase change, so any replacement lubricant would also need to achieve a phase change. Schnur’s compressors compress a refrigerant to prepare it for condensation, which

		is a phase change. Schnur specifically teaches a vapor compression cycle, which involves phase changes over the working temperature and pressure of the apparatus. (EX1015, p.22, claims 19-20). <u>Ground 3:</u> See Claim 1[a&b]. The refrigeration and air conditioning systems disclosed in Thomas operate by R-22 (or other refrigerant) achieving a phase change, so any replacement lubricant would also need to achieve a phase change. Thomas discusses the system's evaporator, which is where evaporation (a phase change) occurs. (EX1014, 1:45-47).
1[d]	the composition consisting of a blend of tetrafluoroethane and pentafluoroethane	<u>Ground 2:</u> Schnur teaches refrigerant compositions that can consist of a blend of pentafluoroethane and tetrafluoroethane. (EX1015, pp. 1-2, 13, 17-24) <u>Ground 3:</u> Thomas teaches the refrigerant composition can consist of the refrigerant gases tetrafluoroethane and pentafluoroethane. EX1014, 3:32-40 ("Any of a wide range of non-chlorine-containing refrigerants can be used in the present invention. Examples of refrigerants suitable for use . . . include HFC's such as 1,1,1,2-tetrafluoroethane ("R-134a), pentafluoroethane ("R-125"). . . and mixtures thereof.").
1[e]	wherein said pentafluoroethane is present in an amount of 59% to 57% by weight and said tetrafluoroethane is present in an amount of 41% to 43% by weight of the	Schnur and Thomas do not teach specific ratios or ranges.

	combined weight of the pentafluoroethane and tetrafluoroethane on the basis of the combined weights of said pentafluoroethane and said tetrafluoroethane totaling 100%	
1[f]	and wherein the tetrafluoroethane is 1,1,1,2-tetrafluoroethane.	<u>Ground 2</u>: Schnur teaches 1,1,1,2-tetrafluoroethane. (EX1015, pp.2, 22-24) <u>Ground 3</u>: Thomas teaches 1,1,1,2-tetrafluoroethane. (EX1014, 3:35)

Lim.	'840 Patent, Claims 2, 4, 6, and 8	Yoshida (EX1013) With Either (Ground 2) Schnur or (Ground 3) Thomas
[pre]	In the apparatus of claim [1/3/5/7],	<u>Grounds 2 & 3</u> : See Claim 1/3/5/7.
[a]	wherein the apparatus is selected from the group consisting of refrigeration equipment, air-conditioning equipment, and HVAC equipment	<u>Ground 2</u>: Schnur specifically teaches use in “air conditioners and refrigerators” (EX1015, p.1), “refrigerant machinery” (p.2), “refrigerating machinery” (<i>Id.</i> p.14), and claims use in a refrigerator (<i>Id.</i> p. 24). <u>Ground 3</u>: Thomas teaches “As used herein the term “refrigeration system” refers generally to any system or apparatus, or any part or portion of such a system or apparatus, which employs a refrigerant to provide cooling. Such refrigeration systems include, for example, air conditioners, electric refrigerators, chillers, transport

		refrigeration systems, commercial refrigeration systems and the like.” (EX1014, 2:48-54)
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Lim.	‘840 Patent, Claims 3, 7, and 11	Yoshida (EX1013) With Either (Ground 2) Schnur or (Ground 3) Thomas
[pre]	In the apparatus of claim [1/5/9], wherein	<u>Grounds 2&3</u> : See Claim 1/5/9.
[a]	[a] the composition is blended with an additive selected from the group consisting of an acrylic polymer, a corrosion inhibitor, a surfactant, a foaming agent, and mixtures thereof,	<u>Ground 2</u>: Schnur teaches that the lubricant that is blended with the composition contains “other materials generally denoted in the art as additives, such as ... corrosion inhibitors, detergents, ... antifoaming agents” including mixtures thereof. (EX1015, p.10) Based on my experience, one skilled in the art would understand that detergents are an example of surfactants based on the generally known meaning of the broad term “surfactant,” also called surface-active agent, which is a substance that reduces surface tension of a liquid. Based on my experience, one skilled in the art would understand that a foaming agent and an anti-foaming agent are the same thing because these sorts of additives are overwhelmingly geared toward reducing foaming in a system. <u>Ground 3</u>: Thomas teaches blending the composition with a surfactant (EX1014, <i>passim</i>, e.g., abstract). Thomas also teaches that the

		composition “can include other additives or materials of the type used in refrigerant compositions to enhance their performance in refrigeration systems. For example, the composition can include also ... corrosion inhibitors, viscosity index improvers, pour and floc point depressants, antifoaming agents, ... and the like. Examples of such additives are disclosed in U.S. Pat. No. 5,254,280.” (EX1014, 5:41-53) (emphasis added) Thomas incorporates the ‘280 Patent by reference. (<i>Id.</i> at 4:6-8). The ‘280 Patent (EX1034), and thus Thomas, into which it is incorporated, teaches a variety of additives. (EX1034, ‘280 Patent at 11:45-47).
[b]	[b] or blended with a lubricant wherein the lubricant is present up to 20% by weight of the composition on the basis of the combined weights of said pentafluoroethane and said tetrafluoroethane totaling 100%,	<u>Ground 2:</u> Schnur teaches refrigerant compositions comprising a blend of pentafluoroethane and tetrafluoroethane that further comprise a lubricating oil. (EX1015, pp. 1-2, 13, 17-24) Schnur teaches lubricant amounts of 2%, 4%, 10%, and 15%, and claims lubricants present up to 15%. (<i>Id.</i> pp.14, 22-23) <u>Ground 3:</u> Thomas also teaches the refrigerant composition can include a solubilizing agent, and that, in some embodiments, the solubilizing agent is a lubricant. (EX1014, 4:50-66) (listing, among others, polyalkylene glycol lubricants and polyol esters). Thomas teaches the lubricant can be present in any suitable amount. (<i>Id.</i> 5:54-55). For the solubilizing agent lubricant Thomas teaches up to 30% by weight

		of the refrigerant gases as preferable and 3% to 12% as most preferable. (<i>Id.</i> 5:54-6:6) Thomas elsewhere teaches that the disclosed refrigerant composition can include “lubricants.” (<i>Id.</i> 5:49-52) Under this teaching, Thomas does not limit the amount of the lubricant, and it would have been routine optimization for one skilled in the art to choose the amount of lubricant based on the desired function. One skilled in the art of refrigerant formulations would always evaluate preferred percentage of lubricating oil in the system or the formulation by varying the concentration and evaluating the properties. This optimization process establishes the minimum oil required for the compressors to function while optimizing the refrigeration capacity or otherwise optimizes the amount of oil. With mixtures of R-134a and R-125 being well-known at the time, and with many well-known lubricants available at the time, one skilled in the art would have a reasonable expectation of how the components would interact at different percentages.
[c]	or both	This limitation is in the alternative and need not be separately met. <u>Ground 2</u>: Schnur teaches both. <i>See</i> claim 3[a]. <u>Ground 3</u>: Thomas teaches both. <i>See</i> claim 3[a&b].

Lim.	'840 Patent, Claim 5	Yoshida (EX1013) With Either (Ground 2) Schnur or (Ground 3) Thomas
5[a]	[a] A method for refilling an apparatus designed for use with a chlorodifluoromethane refrigerant, the method comprising:	<u>Grounds 2&3</u> : See Claim 1[a].
5[b]	(1) selecting a substitute composition designed to be a substitute for the chlorodifluoromethane refrigerant	<u>Grounds 2&3</u> : See Claim 1[b].
5[c]	and designed to achieve a phase change over a range of working temperatures and pressures of the apparatus,	<u>Grounds 2&3</u> : See Claim 1[c].
5[d]	the substitute composition consisting of a blend of tetrafluoroethane and pentafluoroethane,	<u>Grounds 2&3</u> : See Claim 1[d]
5[e]	wherein said pentafluoroethane is present in an amount of 59% to 57% by weight and said tetrafluoroethane is present in an amount of 41% to 43% by weight of the combined weight of the pentafluoroethane and tetrafluoroethane on the basis of the combined weights of said pentafluoroethane and said tetrafluoroethane totaling 100%,	<u>Grounds 2&3</u> : See Claim 1[e]
5[f]	and wherein the tetrafluoroethane is 1,1,1,2-tetrafluoroethane, and	<u>Grounds 2&3</u> : See Claim 1[f].

5[g]	(2) supplying the substitute composition under pressure, in a cylinder can fitted with an outlet compatible with a chlorodifluoromethane recharging manifold of the apparatus.	<u>Grounds 2&3</u>: See Claim 1[b]; see also GROUND 1(A&B) at this limitation. Further, as to <u>Ground 3</u>, Thomas teaches, “Any of a wide range of methods for introducing the refrigerant composition to a refrigeration system comprising a hydrocarbon-based lubricant can [be] used in the present invention. For example, one method comprises attaching a refrigerant container to the low-pressure side of a refrigeration system and turning on the refrigeration system compressor to pull the refrigerant into the system. ... Alternatively, a wide range of charging tools, known to those of skill in the art, are commercially available. Accordingly, in light of the above disclosure, those of skill in the art will be readily able to introduce non-chlorine compositions into refrigeration systems according to the present invention without undue experimentation.” (EX1014, 6:13-30) This teaches one skilled in the art to supply the substitute composition under pressure from a cylinder can fitted with an outlet, because, as the ‘840 Patent admits, pressurized cylinder cans with outlets were known in the art.
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Lim.	‘840 Patent, Claim 9	Yoshida (EX1013) With Either (Ground 2) Schnur or (Ground 3) Thomas
9[a]	A composition designed to be used as a substitute for R-22	<u>Grounds 2&3</u> : See Claim 1[b&c].

	chlorodifluoromethane refrigerant,	
9[b]	the composition consisting of a blend of tetrafluoroethane and pentafluoroethane,	<u>Grounds 2&3</u> : See Claim 1[d]
9[c]	wherein in the composition said pentafluoroethane is present in an amount of 59% to 57% by weight and said tetrafluoroethane is present in an amount of 41% to 43% by weight of the combined weight of the pentafluoroethane and tetrafluoroethane on the basis of the combined weights of said pentafluoroethane, [sic] and said tetrafluoroethane totaling 100%,	<u>Grounds 2&3</u> : See Claim 1[e]
9[d]	and wherein the tetrafluoroethane is 1,1,1,2-tetrafluoroethane.	<u>Grounds 2&3</u> : See Claim 1[f]

Lim.	'840 Patent, Claims 10, 12	Yoshida (EX1013) With Either (Ground 2) Schnur or (Ground 3) Thomas
[pre]	The composition according to claim [9/11],	<u>Grounds 2&3</u> : See Claim [9/11].
[a]	wherein the composition is designed for use in an apparatus	<u>Grounds 2&3</u> : See Claim 1[a&b&c]
[b]	[the apparatus] selected from the group consisting of refrigeration equipment, air-conditioning equipment, and HVAC equipment,	<u>Grounds 2&3</u> : See Claim 2[a].
[c]	the composition designed to undergo a phase change over a	<u>Grounds 2&3</u> : See Claim 1[c].

	range of working temperatures and pressures of the apparatus	
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x. THERE ARE NO UNEXPECTED RESULTS

100. I understand that when a prima facie case of obviousness is made based on a prior art disclosing a broader range than the claimed range, an applicant or patent holder can argue the narrower claimed range exhibits unexpected results, which may in some cases render the claims nonobvious. The above obviousness analysis was completed considering whether there were any unexpected results of the claimed blend. Because there are no unexpected results, my opinion on obviousness remains unchanged.

101. None of the art discussed herein was before the Patent Examiner. Based on a review of the prosecution history of the '840 Patent and its family, it seems plain that Owner may argue against obviousness by asserting unexpected results. As shown in GROUND 1 at claim 1[e], Yoshida explicitly teaches to match the P-T characteristics of the blend of R-125 and R-134a to that of R-22 for the range of temperatures encountered by an air conditioner or other apparatus. The P-T behavior of R-22 was well-known for decades before 2002. As shown further below, for any blend of R-125 and R-134a, the P-T characteristics were well-known and followed predictable patterns. Further, applicants repeatedly stated to the Patent Office that the claimed blend best matched its vapor pressure to that of

R-22. If what applicants told the Patent Office is correct, then following Yoshida's explicit teaching would lead one skilled in the art directly to the claimed blend.

102. During prosecution of the '840 Patent and earlier family patents (and the previous Inter Partes Review briefing regarding the '179 Patent) the applicants attempted to argue around the prior art reference called Takigawa (EX1017). *See, e.g.*, EX1007, at R03758-R03759 (12-17-2007 Office Action); *Id.* at R03986-R03995 (BPAI Decision); *Id.* at R04053-R04069 (Denial of Request for Rehearing). The Examiner stated that Takigawa made out a prima facie case of obviousness during prosecution of the '179 Patent and '949 Patent. *See, e.g.*, EX1008 at R05027-R05028, R05063-R05065, R05111-R05113, R05144-R05146; EX1009 at R05452-R05453. The Examiner also stated that this made out a prima facie case of obviousness during prosecution of the '840 Patent. EX1002 at B0075-76. In response, the applicant argued that several "unexpected" results came from making the small change from Takigawa's 60/40% blend to the claimed 58/42% blend of R-125 and R-134a. EX1002 at B0045-B0062.

103. Importantly, however, Takigawa did not teach to match the R-125/R-134a blend's vapor pressure to that of R-22. Yoshida, in contrast, teaches that explicitly. There can be no unexpected result from following Yoshida's explicit teaching in this regard.

104. Further, the characteristics of the full range of blends of R-125 and R-134a were well-known and easily calculated by 2002. By way of background, by the time of the priority date of the '840 Patent, refrigerants R-134a and R-125 were not new chemical entities. These chemical entities date back to at least the 1930s when the DuPont chemical company and General Motors developed a large class of halogenated chemicals, i.e. CFCs, HCFCs, and HFCs, as safer and higher performing refrigerants. These refrigerants were marketed under the FREON brand and included R-11, R-12, and R-22. R-22 was first commercialized in 1936 but didn't gain widespread use until the 1950s in air conditioner systems. A study by York Research Labs in 1944 considered a total of 91 chemicals, which included R-125 and R-134a. R-134a was mentioned as a refrigerant in US patent 2,885,427 in 1959. Therefore, the refrigerants were not new.

105. Similarly, blends of these refrigerant materials were also not new. During the 1980s, the US National Bureau of Standard (NBS), now known as the National Institute of Standards and Technology (NIST), conducted a large research effort which included blends of halogenated refrigerants, including blends with R-134a and R-125 refrigerants. The properties of these materials were studied extensively. The adoption of the Montreal Protocol in 1987, which launched a worldwide effort to eliminate ozone depleting CFCs, created a tremendous need to identify replacements for R-11, R-12 and eventually R-22.

106. In the 1980s, NBS/NIST developed databases of refrigerant properties. Also in the 1980s, NBS/NIST coded computer methods to calculate the properties of refrigerants and refrigerant mixtures based on well-known equations of state (EOS) theories. An equation of state is a thermodynamic equation used in physics and chemistry relating state variables, which describe the state of matter under a given set of physical conditions, such as pressure, volume, temperature, or internal energy. Equations of state are useful in describing the properties, including pressure-temperature relationships, of pure substances and mixtures in liquid, gas, and solid states.

107. In 1989, NBS/NIST released these methods and databases available as version 1.0 of REFPROP (Refrigerant Properties, although in 2002, in recognition of many non-refrigerant fluids being added to the program, the acronym was revised to stand for REference Fluid PROPERTIES). See EX1030, McLinden, p.706. This first release included fifteen of the most studied refrigerants, including, R-11, R-12, R-22, R-134a and mixture parameters for binary blends. Throughout the 1980s and 1990s, additional refrigerants and mixture information would be added, including R-125. REFPROP became a leading and well-utilized tool throughout the 1990s to predictively model the properties of refrigerants and blends of refrigerants.

108. An additional software package from NIST that works with REFPROP is CYCLE_D. The CYCLE_D predictive model simulates vapor compression refrigeration cycles in various systems that use pure refrigerants or blends of refrigerants. Calculations are based on refrigerant properties as represented in REFPROP. Simulation results are presented in terms of coefficient of performance (COP), volumetric capacity, thermodynamic parameters, and thermodynamic charts. Version 1.0 of CYCLE_D, authored by J. Chi, D.A. Didion, and P.A. Domanski, was developed in 1992. EX1040, CYCLE_D, Version 6. These research tools were used by most research groups, including my own at AlliedSignal/ Honeywell, working on new refrigerant technologies throughout the 1980s and 1990s.

A. Better Approximation of the Pressure-Temperature Characteristics of R-22

109. Again, it is important to stress that Takigawa was silent about matching the P-T characteristics of its blends to that of R-22. Yoshida, in contrast, specifically teaches to match the R-125/R-134a blend's P-T characteristics to that of R-22 for the range of temperatures encountered by an air conditioner or other apparatus. EX1013, ¶8. Because the P-T behavior of R-22 and blends of R-125 and R-134a were well-known and followed predictable patterns, following Yoshida's explicit teaching would lead one skilled in the art directly to the claimed blend. In other words, selecting the R-125/R-134a blend that matched R-22's P-T

characteristics at a given temperature was easy and predictable, and the results would have been easily calculable and foreseeable to a person having ordinary skill in the art. There is nothing unexpected about the P-T characteristics of any particular blend of R-125 and R-134a within the range taught by Yoshida. This can be demonstrated several ways.

110. First, applicants' own expert admitted as much. Earlier during prosecution of one of the precursors to the '840 Patent, the applicants had to fix what they asserted was a typographical error. As originally filed, the application had allegedly accidentally switched the percentages of R-125 and R-134a, such that instead of referring to a blend of 58% R-125 and 42% R-134a, it referred to a blend of 58% R-134a and 42% R-125. The applicants sought to fix this error (in some places). *See* EX1007 at R03665-3668 (8-13-2007 Preliminary Amendment). The patent Examiner rejected the attempted correction as impermissibly adding "new matter." *See id.* at R03731-R03732.

111. The applicants responded to the rejection arguing that a person skilled in the art would recognize the "switching" error ***because the person skilled in the art would know how the pressure-temperature relationship changes with differing ratios of R-125 and R-134a.*** *Id.* at R03742-R03744. The response included a declaration of Mr. Gbur, which stated as follows:

6. Based on my background and experience, it is my opinion that others skilled in the art of refrigerant compositions would also recognize these obvious errors in Figures 1 and 2, and in paragraphs [0054-0057] and how the descriptions and text should read. It is also my opinion that one skilled in the art of refrigerant compositions would recognize that the heading P(60-40) in Table 2 represents 60% pentafluoroethane and 40% tetrafluoroethane, the heading P(58-42) represents 58% pentafluoroethane and 42% tetrafluoroethane, and the heading P(55-45) represents 55% pentafluoroethane and 45% tetrafluoroethane.

7. With reference to Figure 1, for example, it is my opinion that one skilled in the art of refrigerant compositions would recognize that as the concentration of pentafluoroethane drops in a composition of pentafluoroethane and tetrafluoroethane, the Pressure vs. Temperature profile curve would likewise drop because one skilled in the art would recognize that lowering the concentration of pentafluoroethane in such a composition would generally cause the vapor pressure of the composition at a given temperature to decrease as the amount of pentafluoroethane is decreased and not increase. Thus one skilled in the art of refrigerant compositions would recognize that the top curve in Figure 1 represents the Pressure vs. Temperature profile for a composition of pentafluoroethane and tetrafluoroethane having 60% pentafluoroethane, the next curve down would represent the profile for such a composition having 58% pentafluoroethane, and the third curve down would represent the profile for such a composition having 55% pentafluoroethane, as represented by the key in Figure 1. Likewise one skilled in the art would recognize that the Pressure vs. Temperature data

the middle three columns in Table 2 reflects a 60% pentafluoroethane composition in the left column of the three columns, labeled P(60-40), decreasing to 58% pentafluoroethane and then to 55% pentafluoroethane in the right column of the three columns consistent with the drop in pressures in the columns from left to right.

Id. at R03748-R03749 (underlining added).

112. Mr. Gbur's Declaration shows that one skilled in the art would **expect** the change in the temperature-pressure characteristics as concentrations of R-125 and R-134a are changed. As confirmed by Mr. Gbur, matching R-22's vapor pressure was easy and predictable because the change in P-T characteristics (i.e., vapor pressure) as the percentages of R-125 and R-134a were changed was an anticipated and expected change.

113. Second, P-T behaviors are not unexpected as can be seen with the simple use of the boiling points of R-125 and R-134a, which allows one skilled in the art to predict the direction of the shift in the pressure vs. temperature (P-T) curve as percentages of R-125 and R-134a change. By definition, the normal boiling point of a chemical is the temperature on the P-T curve at which the vapor pressure is at 1 atmosphere of pressure (approx. 14.7 psig). The normal boiling point of R-125 is -55.3° F. The normal boiling point of R-134a is -15.3° F. Therefore, since R-134a has a higher boiling point (and thus a lower corresponding vapor pressure), the P-T curve for pure R-134a will be shifted to the right of R-125

on a standard P-T curve. The P-T curves for the mixtures of R-125/R-134a would shift from that of the pure R-125 curve to the right as the concentration of R-125 decreases and R-134a concentrations increased. Therefore, one skilled in the art would easily know how to change the proportions of R-125 and R-134a in a binary blend to move the vapor pressure up or down (and, for example, to match the pressure of R-22) at a given temperature. This concept was well known in the prior art. *See, e.g.*, EX1018, *Gopalnarayanan*, p.94 (“For example, by adjusting the composition of a blend containing a high-pressure and a low-pressure refrigerant, the vapor pressure of the final fluid can be tailored to match that of the CFC or HCFC being replaced.”).

114. Arriving at the claimed range of R-125/R-134a was a predictable application of the basic science described in the previous paragraph. The vapor pressure of R-22 at all relevant temperatures was known for decades, and the vapor pressure of all blends of R-125/R-134a was known or easily and accurately calculable well before 2002. For example, the prior art disclosed the bubble point of 50/50% and 70/30% by mass blends of R-125/R-134a. *See, e.g.*, EX1027, *Widiatmo*, 270 (reporting bubble point pressures of compositions of 10, 30, 50, 70, and 93 mass % R-125, balance R-134a). Knowing the vapor pressure of a 50/50% blend, one could easily compare it to the pressure of R-22 at the same temperature and know whether to increase or decrease the percentage of R-125 in order to

match to R-22. Taking Widiatmo's data (bubble point vapor pressure of a 70/30% blend and a 50/50% blend), one could easily interpolate between the 50/50% and 70/30% to provide an initial estimate of the concentration that would match R-22's known vapor pressure. In fact, in the related Patent Family Litigation, Mr. Ponder acknowledged that the basic science would have established the interpolation of the 58/42% ratio blend from a 50/50% and 60/40% blend during deposition testimony:

Q: And so if you take the mixture up to 60 percent 125 and measure the pressure, you would expect, would you not, that if you took some of the 125 out of the mixture, the pressure would go down?

MR. STALEY: Objection. Calls for speculation.

THE WITNESS: In theory, correct.

EX1023, *Ponder Deposition Excerpts*, at p. 214.

115. Third, as explained above just before this subsection (§§104-108), EOS and programs like REFPROP were available well before 2002 and predicted and described with accuracy the P-T curves (i.e., data or behavior) for the full range of R-125/R-134a blends. These equations and software were based on mountains of tests and data describing the behavior of R-125/R-134a blends. Arriving at vapor pressure and other properties of the claimed ratio (or any other ratio) would have been easily calculated using the publicly available research tools such as REFPROP, and thus matching them to R-22 would have been trivial. The

results of the EOS and REFPROP calculations ***define what is expected.***

Remarkably, the P-T data in Table 2 of the patent and the P-T data in Mr. Ponder's 2017 Declaration (EX1002, pp.B0055-B0056) ***were generated using exactly these types of tools.***³ ***That is, the very data Mr. Ponder described as unexpected was knowingly generated by software that defines what is expected.***

116. An additional point regarding the applicant's use of REFPROP to calculate the P-T data in Table 2: It is apparent to me that the '840 Patent falsely describes the data from Table 2 as based on "tests" of actual mixtures of R-125, R-134a, and a lubricant. EX1001, 8:14-22. I have been advised that the use of past-tense language in patents signifies research actually completed. It is my opinion that one skilled in the art would understand this portion of the patent to be referring to an actual experiment, not a REFPROP (or similar software) calculation.

Normally, it might be reasonable to interpret past-tense language as referring to either an actual experiment or a simulation/computer calculation (like REFPROP).

In this instance, however, the patent describes mixing the ROYCO 2302 lubricant

³ Mr. Ponder testified in his deposition that Table 2 of the Patent was created with REFPROP. EX1023, *Ponder Deposition*, p. 43. (Mr. Ponder stated it was either "reflink" or REFPROP. I do not believe there is a program called reflink. There is a program called REFLEAK, but it would not supply the P-T data.) Mr. Ponder also testified that he did not remember who created the P-T comparison Figure in his 2017 declaration. *Id.* at 201-202. However, the P-T comparison Figure in the 2017 declaration simply compares the P-T characteristics of a 60/40 blend and a 58/42 blend to R-22. Table 2 of the patent provides the P-T data for the 60/40 and 58/42 blend, and R-22's P-T data was well known. Unless the P-T data for the 60/40 and 58/42 blend in the 2017 declaration differs significantly from that in the patent (which would be unusual and would indicate one or the other was incorrect), one can surmise that the Figure in the declaration shows results substantially similar to those that would have been generated by REFPROP.

with the refrigerant blend before recording the data into Table 2. *Id.* at 8:19-22 (“For Table 2, different percentages of 1,1,1,2-tetrafluoroethane and pentafluoroethane—by weight—**were mixed with the lubricant** to show the pressure temperature relationships of the various invention combinations.”) (emphasis added). In truth, it was not possible to use REFPROP to generate results of a refrigerant blend’s P-T characteristics *with a lubricant included*. That is to say, REFPROP does not (and did not at any time) have the capability of entering the ROYCO 2302 lubricant (or any other lubricant) as a mixture component. Therefore, one skilled in the art would understand this portion to be referring not to a simulation, but an actual experiment. In fact, however, as described above, Mr. Ponder has admitted that the data was based on a simulation.

117. Fourth, as referenced above, publicly available actual lab data reported in research publications showed the P-T characteristics of blends of R-125 and R-134a. *See, e.g., EX1027, Widiatmo*. Therefore, the actual (as opposed to EOS) data for various concentrations of R-125/R-134a blends was known and would easily have been compared to R-22’s known vapor pressure to find the R-125/R-134a blend that best matched R-22’s vapor pressure.

118. In sum, starting with the range taught by Yoshida, the way and amount by which the P-T characteristics of any R-125/R-134a blend change with changing concentrations was well-known, predictable, and expected, and it was

routine for one skilled in the art to match the P-T characteristics of an R-125/R-134a blend to R-22's vapor pressure.

B. Coefficient of Performance (COP)

119. As discussed, the Coefficient of Performance (“COP”) of a refrigerant composition is an important characteristic, which describes its efficiency, or the ratio of heat extracted to the work required to extract the heat. During prosecution, applicants pointed to COP as an important characteristic of its claimed blend. EX1002, B0056-B0058.

120. As discussed, the claimed ranges of R-125/R-134a blends fall within the narrow range of blends taught by Yoshida. One skilled in the art would have easily calculated the COP of any of specific blend within the range taught by Yoshida or claimed by the ‘840 Patent; there is nothing unexpected about the COP of any of the blends.

121. First, it is important to realize that both Yoshida and the ‘840 Patent teach to match the vapor pressure of the R-125/R-134a blend to that of R-22. Once a particular ratio is arrived at by following that teaching, the COP of that blend will be dictated by the ratio (the percentages of R-125 and R-134a). This is a known and expected fact.

122. Second, one skilled in the art would have known how to make theoretical-cycle calculations using programs like REFPROP and CYCLE-D,

which existed for years before 2002 and were based on a multitude of data gathered by studying blends of R-125 and R-134a. These calculations, based on theoretical cycles, show the expected COP of any specific blend of R-125/R-134a at any relevant temperature of interest under the theoretical conditions supplied by the software. In fact, applicants appears to have relied on CYCLE_D to calculate the COP of the claimed blend.⁴ As discussed, these programs define what is expected, not unexpected.

123. Third, the prior art showed the relationship between COP and percentages and showed to one skilled in the art that in general, an R-125/R-134a blend with less R-125 will have a better COP than one with more R-125; for example, a 55/45 blend of R-125/R-134a would have a better COP than (i.e., outperform) a 60/40 blend. It also showed the amount of COP change as

⁴ Mr. Ponder testified that he believed Jim Calm was the basis for the figure and related text regarding COP that appear in his 2017 declaration. EX1023, *Ponder Deposition*, pp. 214-215. Mr. Ponder did not testify that Jim Calm used CYCLE_D (which in turn relies on REFPROP), but I have compared the figure to a figure appearing in a report from Jim Calm prepared for Mr. Ponder, which describes a very similar figure as being prepared using CYCLE_D, the standard software used to generate these data, EX1036, *Calm 2013 Report*, pp. 8-9. This report is publicly available on Patent Owner's website (<https://www.choicerefrigerants.com/resources>). Based on my comparison, I believe it is very likely that the same CYCLE_D program was used. I recognize the data regarding COP in Mr. Calm's 2013 report indicates it was generated using version 5.0 of CYCLE_D, issued in 2011. Nevertheless, CYCLE_D has been available since 1992, and version 3 was available in March 2003 with substantially similar data and EOS. Version 3 of CYCLE_D and REFPROP would have generated substantially similar plots and concentration effects, which included data for R-125 and R-134a refrigerants and their blends. See EX1037, Domanski et al., *NIST Vapor Compression Cycle Design Program*, NIST (2003) (describing CYCLE_D version 3.0), available at https://tsapps.nist.gov/publication/get_pdf.cfm?pub_id=100984. ***It is remarkable to me that anyone would point to data knowingly generated by software that defines what is expected as instead indicating what is unexpected.***

concentrations change. The earliest published data of this relationship of which appears in Segami (EX1021, discussed previously), which published in 1988. Segami teaches a binary blend of R-125 and R-134a. Segami calculated and reported the COP of blends of R-125 and R-134a at different percentages (note that Segami shows the ratio of R-134a/R-125 rather than R-125/R-134a):

Table 2 (Evaporation Temperature: -15°C, Condensation Temperature: 30°C, Degree of Supercooling: 5°C)

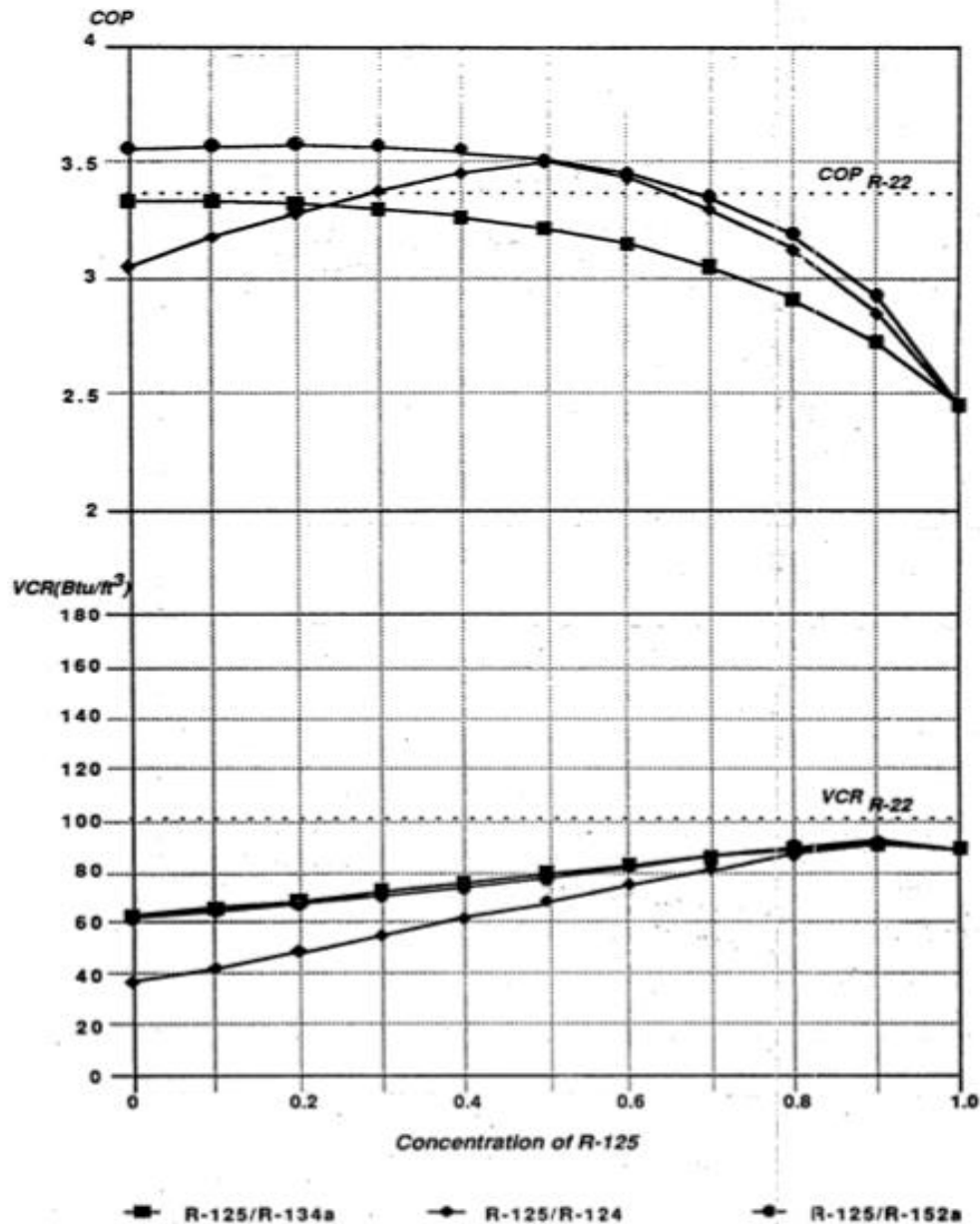
Molar Ratio of R-134a/R-125	100/0	90/10	80/20	70/30	60/40	10/90	0/100
Coefficient of Performance (-)	4.80	4.85	4.85	4.81	4.75	4.45	4.41
Refrigeration Capacity (Kcal/m ³)	271	296	321	347	375	535	554

See id. at Table 2. One can see the trend that as R-125 increases from 20% to 90% (i.e., left to right on the graph), the COP decreases.

124. A few years later, in 1992, a second publication calculated and reported the relationship between COP changes in percentages of a binary refrigerant mixture of R-125 and R-134a. *See* EX1022, Radermacher & Jung, p.33. Drs. Radermacher and Jung calculated their data in the same way Mr. Ponder did, using theoretical cycle analyses. The results of their calculations, showing the same

trend, are reproduced below (the rectangular data points on the top half of the image show calculated COP of the binary mixture of R-125 and R-134a):

Exhibit 9: Cooling COP and Volumetric Capacity for Binary Refrigerant Mixtures.



Id. at p. 33.

125. Additional prior art, such as U.S. Patent No. 6,606,868 (“Powell”) (EX1016) also shows the relationship between COP and the percentages of R-125 and R-134a in binary mixtures. *See, id.* at Tables 1-3.

126. Each of these prior art references shows, over the percentages relevant (i.e., near 50-70% R-125 and balance R-134a), that the COP of binary mixtures of R-125 and R-134a decreases as the percent of R-125 increases, and by how much. The prior art shows this was entirely expected. There is nothing unexpected about the calculated COP of the claimed ratios.

127. There is also nothing unexpected about the fact that a blend with more R-125 performs relatively worse at higher temperatures compared to a blend with less R-125.

128. The critical temperature of a substance is the temperature at and above which vapor of the substance cannot be liquefied, no matter how much pressure is applied. The COP of a fluid suffers as it approaches its critical temperature. Therefore, one would prefer a refrigerant with a higher critical temperature. The critical temperature of R-125 is 66.0°C (150.8°F) and that of R-134a is 101.1°C (213.9°F). This means that pure R-125 cannot act as a vapor-compression refrigerant above its critical temperature of 150.8°F. R-134a has a higher critical temperature and can function as a refrigerant at higher temperatures. Higher concentrations of R-125 in a blend with R-134a will predictably degrade the

refrigerant blend performance at higher temperatures resulting in a lower COP. That is, the blend with more R-125 will have a lower COP at all temperatures in the range, but the effect will grow at higher temperatures. See EX1038, McLinden & Didion, *CFCs – Quest for Alternative Refrigerants*, 29-12 ASHRAE J. 32, 36 (1987) (“The coefficient of performance (COP), however, is increased for refrigerants with higher critical temperatures. Or equivalently, the COP drops as the temperature of the condenser approaches the critical temperature of the refrigerant.”).

C. Global Warming Potential (GWP)

129. The GWP of a blend is another important characteristic, and one to which applicants pointed during prosecution. EX1002, at B0046 (*Office Action Response Dated 12-6-21*, at p. 6); see also EX1008, at R05197-R05198; EX1011, p.20.

130. As with COP and P-T, there was nothing unexpected about the GWP of any specific blend or blends of R-125/R-134a.

131. The prior art relied on by the Patent Examiner, Takigawa, was silent as to GWP. In contrast, Yoshida specifically discusses the importance of a low GWP. EX1013, ¶9.

132. The concepts of global warming as a consequence of chemicals in the atmosphere dates back to an 1896 claim by Swedish chemist Svante Arrhenius that

fossil fuel combustion would increase the carbon dioxide concentrations in the atmosphere and result an increase in the atmosphere's temperature. Although the concept of global warming was established, the United Nations Intergovernmental Panel on Climate Change (IPCC), established in 1988, began to tabulate the "Global Warming Potential" (GWP) of various chemicals as compared to Carbon Dioxide. By definition, the GWP of carbon dioxide was set at 1, and all other chemicals were assigned a GWP based on how much thermal energy the chemical would hold in the atmosphere relative to carbon dioxide.

133. As shown for example by Radermacher & Jung's work, even in the early 1990s those skilled in the art were well aware of the importance of GWP for blends of HFCs and how to calculate the GWP of any studied blend, including blends of R-125 and R-134a. EX1022, p. 48-51. Depending on the methods used to establish a GWP, the GWP for a specific chemical may vary. However, the general trends of a GWP for each method are comparable. Using current standard reporting values, the GWP for HFC R-125 is 3,500. The GWP for HFC R-134a is 1,430. When blending chemicals together, the GWP for the blend is simply the sum of the individual component's mass fraction multiplied by that component's GWP. Therefore, the GWP for a 58%/42% blend of R-125/R-134a would be calculated as: $(0.58 \times 3,500) + (0.42 \times 1,430) = 2,630$. Adjusting the concentrations/ratios of each component would result in an easily predicted GWP.

134. One skilled in the art following Yoshida's teaching to adjust the R-125/R-134a blend to match its vapor pressure to R-22 would have arrived at the claimed ratios. Those ratios would have had specific GWPs dictated by their concentrations. One skilled in the art would have known how and how much the GWP would change for any given concentration of R-125/R-134a. There is nothing unexpected about it.

D. Conclusion as to Alleged Unexpected Results

135. Based on my analysis, there is nothing unexpected about claimed ranges of the '840 Patent as compared to the ranges disclosed by Yoshida. One skilled in the art would have known the effects of changes in concentrations on the relevant properties. These properties followed the science and were well-understood, predictable, and expected by one skilled in the art.

XI. RESERVATION OF RIGHTS

136. My opinions set forth herein are based upon the information I have considered to date. Depending on new information learned during the proceedings and in light of any additional evidence, testimony, or other information that may be provided to me after the date of this report, I may edit, add to, or otherwise refine the topics described here. I reserve the right to supplement my opinions based on new information.

XII. CONCLUSION

137. For the reasons stated, it is my opinion that the prior art discussed herein anticipates or would have rendered obvious to one skilled in the art the claims of the '840 Patent. Further, the '840 Patent does not disclose any unexpected results.

138. I declare that all statements made herein of my knowledge are true, and that all statements made on information and belief are believed to be true. I further declare that all statements made herein were made with the knowledge that willful false statements and the like are punishable by fine or imprisonment or both, under Section 1001 of Title 18 of the United States Code.

Dated: February 20, 2023


Dr. Michael Koehler