UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

AROMA360, LLC,
PETITIONER,

v.

AIR ESSCENTIALS, INC.
PATENT OWNER.

SUPPLEMENTAL DECLARATION OF DR. CHRISTOPHER WHITE

I. INTRODUCTION

1. I, Dr. Christopher White, submit this supplemental declaration in support of Petitioner's Replies to Patent Owner's Responses in *Inter Partes* Review Proceeding Numbers IPR 2025-00705, -00706, and -00707 respectively challenging United States Patent Numbers 9,527,094; 10,583,449; and 10,092,918. I also make this supplemental declaration in support of Petitioner's Oppositions to Patent Owner's Motions to Amend in *Inter Partes* Review Proceeding Numbers IPR sur2025-00705, -00706, and -00707 respectively seeking to amend certain claims in United States Patent Numbers 9,527,094; 10,583,449; and 10,092,918. I have been retained in this matter on behalf of Petitioner Aroma360, LLC. I am being compensated at my usual and customary rate for my time. Such compensation, however, does not influence my opinion nor does the outcome of this proceeding impact my compensation.

2. I have been asked to provide this supplemental declaration to respond to certain issues raised by Patent Owner's expert, Dr. Gerald Micklow. I make this supplemental declaration based upon my personal knowledge. I am over the age of 18 and am competent to make this declaration.

3. I maintain and affirm that I agree with all my opinions as set forth in my declarations previously provided in IPR2025-00705, -00706, and -00707 (Initial

Declarations). I set forth my qualifications to opine as to the opinions of a person of ordinary skill in the art in my Initial Declarations.

4. In addition to the materials reviewed in preparing my Initial Declarations, I have also reviewed the declarations of Dr. Gerald Micklow submitted in IPR2025-00705, -00706, and -00707 as well as a transcript of his deposition to prepare this supplemental declaration. I have also considered the publications of:

- H. M. Taylor and S. Karlin, *An Introduction to Stochastic Modeling*, Orlando, FL: Academic Press, 1984 ("Taylor").
- R. A. Mugele and H. D. Evans, "*Droplet size distribution in sprays*," Industrial & Engineering Chemistry, vol. 43, no. 6, pp. 1317–1324, 1951 ("Mugele")

II. OPINIONS IN SUPPORT OF PETITIONER'S REPLY TO PATENT OWNER'S RESPONSE AND DR. MICKLOW'S TESTIMONY IN SUPPORT THEREOF

A. Uniform Distribution

5. I have reviewed Dr. Micklow's declaration and deposition transcript. It is my opinion that Dr. Micklow's testimony is technically inaccurate and quantifies the fluid dispersion through droplet size distribution rather than a droplet diameter as specified in Patent Owner's Patents.

6. A uniform distribution is a well-established and fundamental concept in probability theory that describes a random variable for which all outcomes within

a specified interval are equally likely. *See* Taylor at 37. Mathematically, a random variable x is uniformly distributed over the interval [a, b], where a < b, if it has the probability density function shown below:

$$p(x) = \begin{cases} \dfrac{1}{b-a}, & a \le x \le b, \\ 0, & \text{otherwise.} \end{cases}$$

7. This definition is independent of application context, device design, or engineering constraints.

8. Dr. Micklow's testimony conflates a statistical definition with application-specific design considerations, which are conceptually distinct.

B. Uniform Particle Size Distribution

9. As described above, a droplet size distribution is related, but not equivalent, to the parties stipulated construction of the term "fluid dispersion." Thus, it is also my opinion that analyzing the claims of the challenged patent and the disclosures of the prior art in terms of uniform spray distributions would alter agreed to scope of the claims.

10. A uniform particle size distribution would be understood to mean that particle size, treated as a random variable, has equal probability across a defined interval. This definition follows directly from the standard uniform distribution described above and does not depend on device configuration, cost, or operational environment. Importantly, it is possible to have a uniform droplet size distribution

comprised of droplets of different sizes so long as the collection has equal probability across the defined interval.

11. One example of a discrete uniform particle size distribution consists of a distribution containing particle sizes ranged from 1 to 10 microns with equal counts for each particle size. In this example, each size occurs with equal probability, and thus $P\ (X = x) = 1/10$. If the distribution comprises 100 total particle, there is an equal probability that 10 particles will be 1 micron, 10 particles will be 2 microns, 10 particles will be 3 microns, and so on up to 10 microns.

12. It is my opinion that Dr. Micklow's testimony relying on context dependence reflects a misunderstanding of the distinction between the statistical definition and engineering application. For clarity, discrete and continuous uniform distributions are distinct but related concepts. A discrete distribution restricts values to countable outcomes, while a continuous distribution allows values over an interval. A standard continuity correction can be applied to reconcile the two representations without altering the fundamental principle of equal likelihood.

13. In his deposition, Dr. Micklow discussed the Sauter mean radius but did not provide a formal definition. For technical clarity, the appropriate metric is the Sauter Mean Diameter (SMD), defined as:

$$SMD = \frac{\sum_{i=1}^{N} d_i^3}{\sum_{i=1}^{N} d_i^2}$$

where d_i is the diameter of the i^{th} droplet and N is the total number of droplets in the spray population.

14. The SMD represents the diameter of a sphere with the same volume-to-surface-area ratio as the droplet population. It is particularly relevant for evaporation and mass transfer processes, which depend on surface area while being constrained by total volume. Importantly, the SMD is not equivalent to the arithmetic mean, nor does it correspond to the most probable droplet size. It is a derived metric that emphasizes larger droplets due to the cubic dependence on diameter in the numerator.

15. The example I provided above also serves to illustrate the distinction between different statistical measures of particle size. For the distribution consisting of equal numbers of particles at sizes from 1 to 10 microns, the arithmetic mean diameter is 5.5 microns. However, the SMD is larger (7.8571 microns) due to the increased weighting of larger particles in the cubic term of the numerator. This simple example demonstrates that the SMD does not represent a typical or most frequent particle size, but rather a surface-area-weighted characteristic diameter that reflects the underlying physics of mass transfer.

16. I understand that Dr. Micklow characterizes a typical droplet size distribution as 1) a bell-type curve and 2) that two standard deviations define a uniform distribution. I disagree as the first assertion does not describe the statistical

behavior of physical droplet populations. The second assertion that two standard deviations define a uniform distribution is mathematically incorrect. A bell-shaped curve corresponds to a Gaussian (Normal) distribution, which is symmetric about its mean and defined by its mean (μ) and variance (σ^2). By its functional form, a Gaussian distribution permits values below the mean and, mathematically, extends to negative values. This is incompatible with droplet diameters, which are strictly positive.

17. For reference, consider again the example provided above assuming a set of particles with sizes uniformly distributed between 1 and 10 microns, with equal counts at each size. This example represents a uniform distribution, not a Gaussian distribution. It is flat (not bell-shaped), as each size occurs with equal probability. This example highlights two important distinctions between a uniform distribution and a Gaussian distribution. First, a uniform distribution and a Gaussian distribution are fundamentally different statistical models. Second, the use of "two standard deviations" to define a "uniform" distribution is inconsistent, as standard deviation is a descriptor of spread about a mean in a non-uniform distribution.

18. Even in this idealized uniform case, physically meaningful metrics such as the SMD are biased toward larger particles due to surface-area and volume scaling. This demonstrates that physically relevant measurements do not behave symmetrically, even when the underlying distribution is artificially uniform. In real

atomization processes, droplet size distributions are not uniform and are not symmetric. Instead, they are strongly skewed toward smaller diameters, with a long tail of larger droplets that contain a disproportionate fraction of the total mass.

19. Accordingly, Dr. Micklow's characterization of droplet size distributions as Gaussian—and his conflation of Gaussian and uniform concepts—is not supported by established fluid mechanics or statistical theory.

20. Instead, a person of skill in the art would understand that droplet size distributions are accurately modeled using logarithmic-probability equations, most notably the log-normal and Upper Limit Log-Normal (ULLN) distributions. These forms arise naturally from multiplicative breakup processes in fluid atomization, as established in the literature. *See* Mugele at 1324. Such distributions are inherently asymmetric, strictly positive, and consistent with both the physics of droplet formation and experimental observations.

III. OPINIONS IN SUPPORT OF PETITIONER'S OPPOSITION TO PATENT OWNER'S CONTINGENT MOTIONS TO AMEND

21. I have reviewed Patent Owner's Contingent Motions to Amend in *Inter Partes* Review Proceeding Numbers IPR2025-00705, -00706, and -00707 respectively seeking to amend certain claims in United States Patent Numbers 9,527,094, 10,583,449, and 10,092918.

22. Patent Owner's Motions to Amend seek to substitute proposed claims for challenged independent claims. For the reasons

23. Patent Owner's Motions to Amend seek to substitute proposed claims for challenged independent claims. For the reasons discussed below, it is my opinion that the Motions to Amend do not confer patentability over the asserted prior art.

A. Patent Owner's Contingent Motion to Amend in *Inter Partes* Review Proceeding Number IPR2025-00705 (the '094 Patent)

24. Patent Owner's Motion to Amend with respect to the '094 Patent seeks to substitute proposed claim 21 for challenged claim 7.

25. After reviewing Patent Owner's Motion to Amend, it is my opinion that the intrinsic record lacks objective criteria for the claimed "so as to maximize" functional requirement. "Maximizing" flow disruption is not a technical term known to ordinary artisans. Moreover, whether an inlet/baffle arrangement "maximizes" flow disruption is inherently dependent on physical geometry and operating conditions (e.g., inlet orientation, spacing, chamber size, flow rate, and pressure drop), yet the '918 patent does not disclose the structural or operational parameters needed to determine which arrangements meet that requirement across its full breadth. Ex. 1001, 7:61–65, 8:10–20; Figs. 1–2.

26. After reviewing Patent Owner's Motion to Amend, it is my opinion that a POSITA reviewing the intrinsic record would not be able to determine, with reasonable certainty, whether the claim term "silencer chamber" refers to a physically bounded subcomponent distinct from the recited "silencer assembly," or instead refers to the same overall structure as the silencer assembly (i.e., is

coextensive with it). The specification provides only a brief description and figure labels, but it does not define the structural boundaries of the "silencer chamber" relative to the "silencer assembly" (for example, where the chamber begins and ends or what physical surfaces delimit it). Ex. 1001, 7:49–53; Figs. 1–2.

27. To the extent the only way to give content to "silencer chamber" is to define it using non-structural, flow-based concepts (e.g., a control volume, an assumed flow region, or other fluid-dynamics abstractions), that does not provide objective notice of what physical structure the claims require. In my opinion, when the patent does not specify the physical boundaries of the "silencer chamber," and those boundaries must be inferred from operating conditions or analytical choices rather than from identified structure, the intrinsic record has not provided the objective, structural boundaries that § 112(b) requires for reasonable certainty. Ex. 1001, 7:49–53; Figs. 1–2.

28. In my opinion, Sevy discloses a bounded, staged flow path that functions as a chambered "silencer" or separator region in which atomized material enters, encounters internal plate/deflector structure, and only a desired fraction proceeds to discharge while larger droplets are intercepted and returned. Sevy describes a separator plate/structure arranged in the flow path such that droplets impact and agglomerate on the plate and surrounding surfaces and then drop back

toward the reservoir, while finer material continues through the outlet path. Ex. 1009 ¶¶[0068]–[0074], [0082]–[0084].

29. A POSITA would understand Sevy's separator-plate region as defining a chambered inlet-side region with a disruptive structure disposed within it and a downstream outlet path. Sevy further explains that the flow must "twist and turn sufficiently" through the separator structure for larger droplets to be removed and returned, which indicates the incoming flow is directed into and through the obstructing/deflecting structure to increase disruption (and droplet interception) before discharge. Ex. 1009 ¶¶[0068]–[0074], [0082]–[0084]. In my opinion, even though Sevy does not use the exact term "silencer chamber," it discloses the same operative configuration of a chambered path with an inlet-side flow path, internal disruptive structure, and a downstream discharge path. Ex. 1009 ¶¶[0068]–[0074], [0082]–[0084].

30. In my opinion, Goubet expressly discloses a baffle structure formed by chambered enclosures and an interconnecting passage. Goubet states that the diffuser head includes "at least two concentric circular enclosures, an outer enclosure 12 and an inner enclosure 13, communicating with each other via a passage 14," and that "said two enclosures and said passage form at least one baffle." Ex. 1016, 2:16–19. Goubet further discloses an inlet (15) into the outer enclosure and an outlet (16) from the inner enclosure. Ex. 1016, 2:20–25; Fig. 3.

31. Goubet also describes how the fluid dispersion travels through this structure and is disrupted by repeated impacts before exiting. Goubet explains that droplets enter the outer enclosure, pass through passage 14 into the inner enclosure, strike surrounding walls and undergo “many shocks,” which causes the droplets to break into microdroplets before exiting through outlet 16. Ex. 1016, 4:26–5:6. In my opinion, this disclosure corresponds to a chambered inlet / baffle / outlet arrangement of the type recited by the amended claim language. Ex. 1016, 2:16–19, 2:20–25, 4:26–5:6; Fig. 3.

32. In my opinion, Goubet renders obvious any suggestion that the amended limitations require a specially named or specially shaped “silencer chamber,” because Goubet discloses the same operative structure and function using different labels. The ’918 patent describes a silencer assembly in which “a baffle” is disposed “in a silencer chamber” between an inlet and an outlet. Ex. 1001, 7:49–53. Goubet likewise discloses at least two concentric enclosures communicating via a passage, with the enclosures and passage forming a baffle, and with an inlet into the outer enclosure and an outlet from the inner enclosure. Ex. 1016, 2:16–25. Goubet further explains that droplets travel through this chambered path, undergo repeated impacts (“many shocks”), are broken into microdroplets, and then exit through the outlet—i.e., the same silencing/droplet-conditioning function recited in the amended claim language. Ex. 1016, 4:26–5:16; *see also* Ex. 1001, 7:49–8:2.

33. In my opinion, Goubet teaches the functional relationship recited in amendment (4). Goubet discloses that passage 14 connects outer enclosure 12 to inner enclosure 13 and is "substantially diametrically opposed" to inlet 15, and that the opening leading to outlet 16 is likewise "substantially diametrically opposed" to passage 14. Ex. 1016, 2:20–25. Goubet explains that, "[t]hus, due to the particular circular shape and the specific arrangement of the inlet, passage, and outlet," droplets follow "a very particular path" such that droplet size is reduced "as much as possible." Ex. 1016, 2:26–30.

34. In operation, droplets entering the silencer region are forced into this chambered, baffled path: they enter through inlet 15 into outer enclosure 12, then are routed through passage 14 into inner enclosure 13, collide with surrounding walls and undergo "many shocks," and then exit toward outlet 16. Ex. 1016, 4:26–5:4; Fig. 3. A POSITA would understand that, in this disclosed configuration, the upstream inlet arrangement (including inlet 15 and the diametrically opposed placement of passage 14) directs the flow into and through the baffle-forming enclosures and passage so that disruption and droplet breakup are increased—consistent with Goubet's stated objective of reducing droplet size "as much as possible" before discharge. Ex. 1016, 2:20–30, 4:26–5:4, 5:12–16; Fig. 3.

35. In my opinion, Gao discloses a staged flow path that includes a disruptive structure (baffle 3) and a downstream discharge path through through hole

4 and atomizing gas outlet 2. Ex. 1013 ¶¶[0019]–[0025]. Gao explains that a high-speed gas-liquid mixture is ejected and impacts an inner wall in the lower cavity region, producing micron-sized fine particles, and that the smallest particles then drift upward and out through through hole 4 and atomizing gas outlet 2 with the rising gas flow. Ex. 1013 ¶[0025]. Gao further discloses baffle 3 positioned in the upper portion of the cavity/cover region such that the rising flow must pass around the baffle and through the through hole before discharge. Ex. 1013 ¶[0019], ¶[0025]; Fig. 1.

36. A POSITA would understand Gao's disclosed configuration as defining a chambered flow region containing a disruptive structure (baffle 3) and a downstream outlet path (through hole 4 to gas outlet 2), where the rising flow is directed into and through the obstructing structure before discharge, increasing disruption of the flow. Ex. 1013 ¶¶[0019]–[0025]; Fig. 1. Even though Gao does not use the term "silencer chamber," it discloses the same operative configuration of a chambered path with an internal disruptive element and a downstream discharge path. *Id*.

B. Patent Owner's Contingent Motion to Amend in *Inter Partes* Review Proceeding Number IPR2025-00706 (the '449 Patent)

37. Patent Owner's Motion to Amend with respect to the '449 Patent seeks to substitute proposed claims 20 for challenged claim 1 and proposed claim 21 for challenged claim 7.

38. In my opinion, a person of ordinary skill in the art would understand that, where an atomizer/diffuser design allows liquid droplets to agglomerate and drip back toward the reservoir, it is a routine and predictable engineering refinement to add a drip-return tube or drain at the chamber/reservoir interface to direct the return flow, reduce mess and pooling, and improve repeatability, without changing the device's atomization principle of operation. Such a return feature would also be expected to reduce unintended wetting of adjacent internal components, thereby improving reliability and longevity (e.g., by mitigating corrosion or residue buildup).

39. A POSITA would understand that the Venturi (educting) effect in twin-fluid atomizers requires a high-velocity gas stream created by a constriction or jet (the "throat" region) that produces a localized pressure drop. That pressure drop draws liquid through a nearby inlet opening into the gas stream, where the liquid and gas initially mix and atomization begins. Structures that produce this effect therefore include (i) a defined air-flow path with a constricted region or jet, (ii) a liquid inlet positioned to communicate with the low-pressure region created by the air flow, and (iii) a downstream mixing/discharge region where the entrained liquid and air continue to mix before exit.

40. Sevy discloses this same educting configuration. Sevy describes air being delivered through a channel toward an orifice and into a mixing region that is open to a siphon tube. Ex. 1009 ¶¶79–82; Pet. 27–30. Sevy further explains that

reduced pressure draws liquid from a reservoir through a siphon tube to the vicinity of an air jet at orifice, where the liquid mixes with the high-speed air stream before the mixture exits through an exit orifice. Ex. 1009 ¶¶79–82; Pet. 27–30. A POSITA would understand that this is a Venturi-style eductor arrangement in which the air jet creates suction at the fluid inlet and entrains liquid into the air stream; and that, at minimum, this disclosure renders obvious positioning the fluid inlet relative to the air-flow path so that compressed air flows over (or across) the inlet opening and into the mixing region. Accordingly, a POSITA would find it obvious to arrange (or, to the extent needed, modify) the relative placement of the siphon-tube opening and the air-flow path at orifice 118 so that compressed air flows over (or across) the fluid-inlet opening and into mixing cavity 116, because that is the predictable configuration required for suction-based entrainment and mixing in the disclosed eductor architecture. Ex. 1009 ¶¶79–82; Pet. 27–30.

41. Goubet discloses the structural and functional prerequisites for a Venturi/educting effect. Goubet describes a diffusion chamber including a compressed-air inlet, a venturi cone, and an oil inlet at the upper end of a dip tube connected to essential oil in a reservoir, with compressed air entering through an air inlet channel. Ex. 1016, 3:31–4:2, 4:15–22; Fig. 2. Goubet expressly explains that when compressed air flows into the diffusion chamber, essential oil is drawn into the chamber “by the vacuum created,” confirming that the air-flow geometry generates

suction at the oil inlet and entrains oil into the mixing region. Ex. 1016, 4:19–22. Figure 2 depicts the air-flow path (arrows F) through the venturi region and past the dip-tube inlet into a downstream region of chamber 5. Ex. 1016, Fig. 2. Thus, a POSITA would understand that Goubet's disclosed venturi geometry necessarily requires, and therefore at minimum renders obvious, positioning the dip-tube fluid inlet relative to the air-inlet path so that compressed air flows over (or across) the fluid-inlet opening and into the mixing region where entrainment and mixing occur. Ex. 1016, 4:15–22; Fig. 2.

C. Patent Owner's Contingent Motion to Amend in *Inter Partes* Review Proceeding Number IPR2025-00707 (the '918 Patent)

42. Patent Owner's Motion to Amend with respect to the '918 Patent seeks to substitute proposed claim 16 for challenged claim 1 and proposed claim 17 for challenged claim 5.

43. Substitute claim 16 adds a new limitation requiring "a mixing chamber beginning at said atomizer air inlet channel and increasing in dimension as the compressed air flows past said fluid inlet." (PO Mot. to Amend 11–12.)

44. Patent Owner's Motion further states that Petitioner alleges the challenged claims are unpatentable on four grounds: (1) obviousness over Goubet; (2) obviousness over Goubet in view of Kaiser; (3) obviousness over Gao-2; and (4) obviousness over Gao-2 in view of Goubet. (PO Mot. to Amend (Responsive to Ground of Unpatentability).)

45. Goubet discloses a diffuser in which diffusion chamber 5 includes a compressed-air inlet 6, a venturi cone 7, and an oil inlet formed by the upper end 10 of dip tube 8 connected to essential oil 3 in reservoir 2. (Ex. 1016, 3:31–4:2; Fig. 2.) Goubet further discloses that compressed air penetrates the diffuser head via air inlet channel 9 connected to diffusion chamber 5. (Ex. 1016, 4:15–16.) Goubet explains that when compressed air flows into diffusion chamber 5, essential oil is drawn into the chamber "by the vacuum created," and air and oil are mixed in diffusion chamber 5 to form a flow of oil droplets. (Ex. 1016, 4:19–22.) Figure 2 depicts the compressed-air flow path (arrows F) flowing through the venturi region past the dip-tube inlet (10) and into a downstream region of diffusion chamber 5 that is larger than the constricted venturi/throat region near the oil inlet. (Ex. 1016, Fig. 2.)

46. Gao-2 discloses an aroma diffuser with an atomization core (32) that "mixes airflow with an essential oil to form a fragrant mist." (Ex. 1042, Abstract.) Gao-2 describes airflow entering via air inlet channel 311, passing through vent hole(s) 3215, flowing through guide grooves 3225 associated with atomization rotating core 322, and being discharged through spray outlet 3231. (Ex. 1042 ¶[0038]; Figs. 9–10.) Gao-2 also discloses a liquid suction hole 3224 through which essential oil is drawn under negative pressure, and states that the essential oil "then mixes with the airflow and is atomized at the outlet of the liquid suction hole 3224" before discharge through spray outlet 3231. (Ex. 1042 ¶[0036]; Figs. 9–10.) Gao-2

further explains that multiple guide grooves 3225 surround the outlet region and cooperate with the cap structure to form part of the airflow channel and facilitate atomization (including cyclone formation), and that airflow "flows through the guide grooves 3225" before mist is sprayed from the spray outlet. (Ex. 1042 ¶¶[0037]–[0038].) Gao-2 also describes mist outlet 351 as "a stepped hole that is smaller at the top and larger at the bottom." (Ex. 1042 ¶[0034].).

IV. PERJURY STATEMENT

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

Respectfully submitted,

Christopher White
____
Christopher White, Ph.D.

Dated: 04/15/2026