

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

RUNWAY SAFE GROUP AB,
Petitioner,

v.

EARTHSTONE INTERNATIONAL LLC,
Patent Owner.

IPR2019-01624
Patent 9,637,246 B2

Before GEORGE R. HOSKINS, MICHAEL L. WOODS, and
JASON W. MELVIN, *Administrative Patent Judges*.

MELVIN, *Administrative Patent Judge*.

JUDGMENT
Final Written Decision
Determining All Challenged Claims Unpatentable
Denying Patent Owner's Motion to Amend
35 U.S.C. § 318(a)

I. INTRODUCTION

Petitioner, Runway Safe Group AB, filed a Petition (Paper 1, “Pet.”) requesting *inter partes* review of claims 1–19 (“the challenged claims”) of U.S. Patent No. 9,637,246 B2 (Ex. 1001, “the ’246 patent”). Patent Owner, Earthstone International LLC, filed a Preliminary Response. Paper 5. We instituted review. Paper 9 (“Institution Decision” or “Inst.”).

Patent Owner filed a Response. Paper 15 (“PO Resp.”). Petitioner filed a Reply. Paper 21 (“Pet. Reply”). Patent Owner filed a Contingent Motion to Amend. Paper 14 (“MTA”). Petitioner filed an Opposition to the Contingent Motion to Amend. Paper 22 (“MTA Opp.”). As Patent Owner requested, we provided Preliminary Guidance concerning the Contingent Motion to Amend. Paper 23 (“Prelim. Guidance MTA”). Patent Owner did not file a sur-reply to Petitioner’s Reply, a revised motion to amend, or a reply to Petitioner’s Opposition to the Contingent Motion to Amend; Petitioner did not file a reply to the Preliminary Guidance. *Cf.* Paper 10, 8 (Due Date 3, permitting the above papers). We held a hearing on December 16, 2020, and a transcript appears in the record. Paper 28 (“Tr.”).

This is a final written decision as to the patentability of the challenged claims and the proposed substitute claims. For the reasons discussed below, we determine Petitioner has shown by a preponderance of the evidence that each of the challenged claims is unpatentable. We also determine that Petitioner has shown each of Patent Owner’s proposed substitute claims is unpatentable and therefore deny Patent Owner’s Contingent Motion to Amend.

A. RELATED MATTERS

The parties agree that no judicial proceeding involves the '246 patent and that IPR2019-01490 ("the 1490 IPR") involves related U.S. Patent No. 9,382,671 ("the '671 patent"; Ex. 1013).¹ Pet. vi; Paper 4.

B. THE '246 PATENT

The '246 patent relates to "an arrestor bed for slowing an aircraft overrunning a runway." Ex. 1001, code (57). It describes that the "Federal Aviation Administration (FAA) generally requires a runway safety area (RSA) of 1000 feet extending beyond the end of the runway." *Id.* at 1:32–34. Because many airports cannot accommodate such an extension, "[s]horter arrestor beds with tailored failure mode properties have become the common solution," creating a "need for an easily produced arrestor bed material that is heat and chemically resistant and fails with a[n] incompressible crushing mode to controlledly slow down oncoming aircraft." *Id.* at 1:42–60.

To that end, the patent describes the production of foamed glass, which it describes as "an established lightweight ceramic material." *Id.* at 2:48–49, 2:36–6:5. The '246 patent describes a number of uses for the foamed glass material, including aircraft arrestor beds. *Id.* at 6:6–11:59. It states that "arrestor beds 350 are typically formed from a foamed glass composite material 360 including foamed glass bodies 295 suspended or enclosed in a (typically ceramic) structural matrix 370." *Id.* at 7:2–5; *accord id.* at 7:30–35 ("[T]he arrestor beds 350 are typically constructed of foamed glass bodies 285 and/or aggregate 305 (more typically closed cell foamed

¹ The '246 patent issued from an application that was a continuation-in-part of the application that resulted in the '671 patent; thus, the '671 patent is the '246 patent's parent and appears as Exhibit 1013.

glass aggregate 305 and/or bodies 285) in a thin ceramic or structural matrix 370, wherein the surface 375 of the arrestor bed 350 is matrix material 370.”). Notwithstanding those statements about typical construction, the Specification states that “arrestor beds 350 may be produced by paving an area immediately beyond the end of a runway 349 with foamed glass aggregate 285 to define a bed 351, and covering the bed 351 with a layer of cementitious material 353 to define a composite bed 350.” *Id.* at 7:51–55.

Petitioner asserts that the claims of the ’246 patent are not entitled to a priority date preceding the ’246 patent’s actual filing date, because the challenged claims contain limitations without earlier written-description support. Pet. 5–8. Patent Owner does not contest this issue. *See* PO Resp. 4.

C. CHALLENGED CLAIMS

Challenged claim 1 is independent and is reproduced below:

1. A method of producing an arrestor bed for slowing an aircraft overrunning a runway, comprising:
 - a) paving an area immediately beyond the end of a runway with foamed glass aggregate to define a bed; and
 - b) covering the bed with a layer of cementitious material to define a composite bed.

Ex. 1001, 12:9–14. Challenged claim 4 is independent and is reproduced below:

4. A method of fabricating an aircraft arrestor bed, comprising:
 - a) introducing a structural matrix material to plurality of foamed glass aggregate bodies to define an admixture;
 - b) forming the admixture of foamed glass aggregate bodies and structural matrix material into an arrestor bed adjacent the end of a runway; and

- c) covering the arrestor bed with a layer of covering material;
- wherein the arrestor bed is at least about 50 volume percent foamed glass aggregate;
- wherein the foamed glass bodies have crushing failure modes;
- wherein the foamed glass aggregate have strengths of at least 50 PSI; and
- wherein the arrestor bed will preferentially crushingly fail instead of slide over itself under the compressive and torsional loads produced by an aircraft rolling over the runway safety area.

Id. at 12:29–47. Challenged claim 8 is independent and is reproduced below:

- 8. A method of making a foamed glass composite engineered material arresting system for aircraft arrest, comprising:
 - a) paving an area immediately beyond the end of a runway with foamed glass aggregate to define a bed; and
 - b) covering the bed with a layer of cementitious material to define a composite bed;
- wherein the foamed glass body is incompressible with a crushing failure mode.

Id. at 12:63–13:4. The other challenged claims depend, directly or indirectly, from claims 1, 4, or 8. *Id.* at 12:15–14:21.

D. PRIOR ART AND ASSERTED GROUNDS

Petitioner asserts the following grounds of unpatentability:

Claim(s) Challenged	35 U.S.C. §	References
1–19	103	ACRP ²

² ACRP Report 29, titled Developing Improved Civil Aircraft Arresting Systems (Ex. 1008).

Claim(s) Challenged	35 U.S.C. §	References
5, 12	103	ACRP, Narmo ³
13	103	ACRP, Hojaji ⁴
5, 13, 18	103	ACRP, Narmo, Ramsey ⁵
1–19	103	Angley, ⁶ Hojaji
1–19	103	Angley, Hojaji, Schirtzinger ⁷

Pet. 11, 48. Petitioner also relies on the Declaration of Marc Zupan, Ph.D. (Ex. 1002). *See* Pet. 11 (“Petitioner also provides the declaration of Dr. Marc Zupan . . . in support of these Grounds.”).

II. ANALYSIS

A. LEVEL OF ORDINARY SKILL IN THE ART

Petitioner asserts a person of ordinary skill in the art would have “obtained a civil engineering, mechanical engineering, or a material science degree or equivalent and accrued about four years of practical experience with energy absorbing materials.” Pet. 8–9. Patent Owner does not dispute that definition. *See* PO Resp. 6. We adopt Petitioner’s definition.

B. CLAIM CONSTRUCTION

For an *inter partes* review petition filed after November 13, 2018, we construe claim terms “using the same claim construction standard that would be used to construe the claim in a civil action under 35 U.S.C. 282(b).”

³ US 2012/0057931 A1, published Mar. 8, 2012 (Ex. 1012).

⁴ US 4,430,108, issued Feb. 7, 1984 (Ex. 1014).

⁵ US 2007/0194476 A1, published Aug. 23, 2007 (Ex. 1011).

⁶ US 5,885,025, issued Mar. 23, 1999 (Ex. 1016).

⁷ US 3,066,896, issued Dec. 4, 1962 (Ex. 1009).

37 C.F.R. § 42.100(b) (2019). Beyond the terms discussed below, no further claim construction is required to resolve the unpatentability questions here. *See Nidec Motor Corp. v. Zhongshan Broad Ocean Motor Co.*, 868 F.3d 1013, 1017 (Fed. Cir. 2017); *Vivid Techs., Inc. v. Am. Sci. & Eng'g, Inc.*, 200 F.3d 795, 803 (Fed. Cir. 1999).

1. “composite bed”

The parties dispute the construction for “composite bed.” Petitioner submits we should construe the term as “a bed having a cemen[t]itious cover atop the bed” such that it includes “both a bed and a cemen[t]itious top.” Pet. 9–10. Petitioner relies on only the claim language, in that claim 1 recites “covering the bed [of foamed glass aggregate] with a layer of cementitious material to define a composite bed.” Ex. 1001, 12:12–14; *see* Pet. 9. Petitioner submits that the “action of ‘covering’ defines a composite bed comprising the bed and the cover, in whatever form the cover takes.” Reply 4 (citing Ex. 1001, 12:13–14, 13:1–2; Ex. 1038, 110:8–13).

Patent Owner relies on its declarant to argue that “composite bed” means “a region, laying approximately flat, on or in the earth, consisting of composite material.” PO Resp. 13. According to Patent Owner, the Specification supports such a construction because it assigns reference numeral 350 to “composite bed” in Figure 2B and depicts the region as including “composite material 360.” *Id.* at 10.⁸

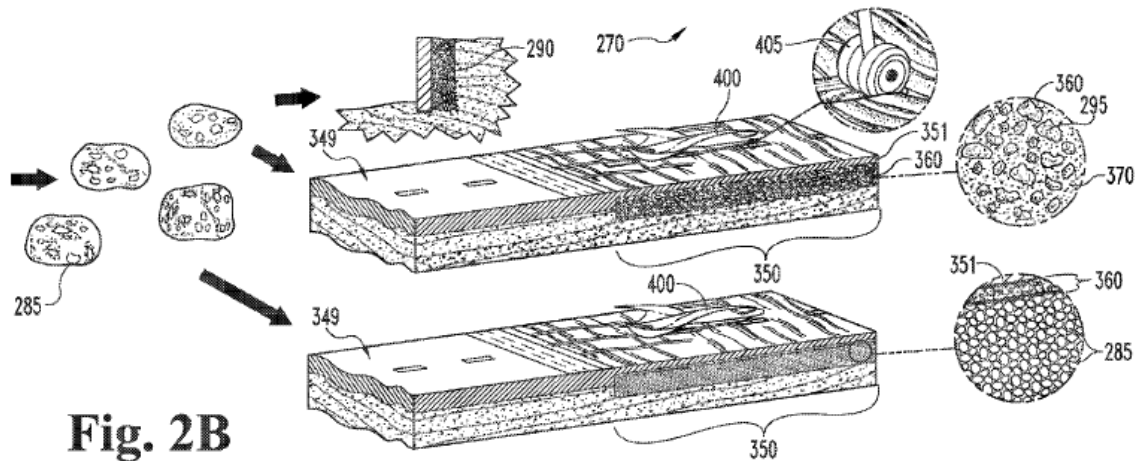
⁸ In this way, Patent Owner asserts this proceeding is different from IPR2019-01490, which construed very similar language in the ’671 patent, the parent of the ’246 patent. *See* IPR2019-01490, Paper 49, 24–30 (PTAB Feb. 17, 2021); *supra* note 1. The ’671 patent’s Figure 2B includes only the first of two depictions for the arrestor bed appearing in the ’246 patent’s Figure 2B, discussed below. Ex. 1013, Fig. 2B.

Patent Owner cites nearly an entire column of the written description to argue that a composite material would “occur between a top layer of cement 351 and above a bed of foamed glass aggregate 285, as occurs when cement is poured onto a bed of foamed glass aggregate and penetrates at least partially therethrough.” *Id.* (citing Ex. 1001, 7:2–61, Fig. 2B). According to Patent Owner, Petitioner’s construction “would include the mere stacking of a cement slab or cement board on top of a bed of foamed glass aggregate” but such a construction is incorrect because a “composite” must be “a single material formed from the intermingled combination of two or more constituent materials, wherein the constituent materials retain their chemical and/or physical properties and the composite material benefits from the combination with properties of its own.” *Id.* at 10–11 (citing Ex. 2007, 12:1–17). Patent Owner summarizes that “‘composite material’ is a broad term covering any material that is a composite, and ‘composite bed’ is a narrower subset of the same, identifying beds that are made of or define composite materials.” *Id.* at 5.

The claim language recites “paving an area . . . with foamed glass aggregate to define a bed” and “covering the bed with a layer of cementitious material to define a composite bed.” *E.g.*, Ex. 1001, 12:9–14. That language defines a “composite bed” as resulting from covering the foamed glass aggregate with cementitious material. Beyond that relationship, we are left to consider whether the Specification or some other evidence supports limiting the claims as Patent Owner seeks.

The Specification does not contradict or further restrict the claims. Patent Owner correctly asserts that Figure 2B designates a section of

constructed arrestor bed as reference numeral 350; an excerpt of that figure is reproduced below:



Id., Fig. 2B (excerpt). Figure 2B depicts runway 349 with aircraft 400 on a runway portion designated as arrestor bed 350, with one embodiment of arrestor bed 350 comprising composite material 360 including structural matrix material 370 and foamed glass aggregate bodies 295, and a second embodiment of arrestor bed 350 comprising bed 351, composite material 360, and foamed glass bodies 285. *Id.* at 7:2–60. The Specification refers to reference numeral 350 as: “arrestor bed” (*e.g.*, 7:2, 7:23, 7:30, 7:34–35, 7:36, 7:51, 7:59–60, 8:1, 8:6); “composite arrestor bed” (7:25, 7:55); “composite bed” (7:55); or “bed” (7:14–16). The mixed usage of labels for reference numeral 350 does not establish a strong connection with a particular meaning. Moreover, Figure 2B shows reference numeral 350 as indicating the overall constructed arrestor bed, without limitation to a particular portion. *Id.*, Fig. 2B.

Patent Owner, however, asserts that the inclusion of “composite material 360” in both arrestor bed embodiments depicted in Figure 2B requires that an arrestor bed contain “composite material.” PO Resp. 10. We

do not agree. The written description uses permissive, not mandatory, language to state that “arrestor beds 350 are *typically* formed from a foamed glass composite material 360 including foamed glass bodies 295 suspended or enclosed in a (typically ceramic) structural matrix 370.” Ex. 1001, 7:2–5 (emphasis added). Figure 2B is not to the contrary, and appears to depict constructions the applicant deemed typical.

In light of the nonlimiting language used to describe typical construction, and the lack of any explanation for the two embodiments in Figure 2B, we decline to view the figure as imposing a requirement beyond the claim language. The Specification uses the term “composite bed” with language matching the claim language. *Id.* at 7:51–55 (“In operation, arrestor beds 350 may be produced by paving an area immediately beyond the end of a runway 349 with foamed glass aggregate 285 to define a bed 351, and covering the bed 351 with a layer of cementitious material 353 to define a composite bed 350.”). Nothing about that description states that a composite bed must be formed of a composite material. Thus, even if we were to accept Patent Owner’s position on the definition of a “composite material,” that would not impact the proper construction for “composite bed.” *See* PO Resp. 12 (citing Ex. 2007 ¶ 12). Patent Owner does not identify any other aspect of the Specification supporting its desired construction. *See id.* at 10–11.

Patent Owner argues that the Specification “contemplates the composite material 360 to occur between a top layer of cement 351 and above a bed of foamed glass aggregate 285, as occurs when cement is poured onto a bed of foamed glass aggregate and penetrates at least partially therethrough.” *Id.* at 10 (citing Ex. 1001, 7:2–61, Fig. 2B (lower

embodiment)). According to Patent Owner, in both the premixed embodiment and the dual-deposition embodiment, “composite bed 350 is shown to be at least partially composed of composite material 360.” *Id.* (citing Ex. 1001, Fig. 2B). In that regard, Patent Owner seeks to incorporate infiltration into the claim construction—the idea that covering foamed glass aggregate with a layer of cementitious material will result in the cementitious material penetrating the aggregate and bonding its pieces to form a composite material. *Id.* at 12–13 (citing Ex. 2007 ¶ 12). Patent Owner’s declarant, however, agreed that whether infiltration occurs depends on properties including the cement’s type and viscosity and the type of aggregate. Ex. 1038, 75:4–18, 94:5–95:7, 96:6–98:3; 120:19–121:22, 122:11–14 (confirming his answers regarding the ’671 patent would be the same for the ’246 patent). Thus, infiltration is not an inherent property of covering the aggregate with cementitious material. Because it lacks any discussion regarding how to achieve infiltration (*see* Ex. 1038, 96:6–21), the Specification does not support incorporating infiltration into the claims.

Patent Owner argues that the “composite bed” must be made of composite material because if it were not, it would fail with a sliding mode, rather than a crushing mode. Tr. 25:2–26:2, 27:13–28:7; PO Resp. 15–16 (“The aggregate and covering material are crushed and not merely displaced or compressed.”). The crushing requirement expressly appears in certain claims. *See* Ex. 1001, 12:15–14:8 (claims 2, 4, 8, and 14). Patent Owner argues that the crushing requirement in turn demands a composite material. *See* Tr. 24:14–16. We, however, credit the testimony of Petitioner’s declarant, who states that even loose aggregate will fail with at least some degree of crushing. Ex. 1002 ¶ 67. Thus, we do not agree that any

requirement for a crushing failure mode in the claims dictates that the claimed arrestor beds be made from a composite material.

Patent Owner's direct reliance on its declarant fares no better. *See* PO Resp. 13. That testimony states that "one of ordinary skill in the art would define 'composite bed' as follows: a region, laying approximately flat, or on in the earth, consisting of composite material." Ex. 2007 ¶ 11. It goes on to state that "[t]he term 'composite bed' as used in claim 1 of the '246 patent would thus refer to a region comprised of a foamed glass aggregate with a layer of cementitious material formed on top." *Id.* That latter statement does not limit the claimed "composite bed" to Patent Owner's proposed construction. Moreover, the declarant's assertions that do support Patent Owner's construction fail to identify Specification support or otherwise explain why the claimed "composite bed" must consist of composite material. *See id.* Because the declaration does not explain why the proposed construction arises from the Specification or otherwise should be applied to the claim language, we give it minimal weight.⁹

We do not adopt Patent Owner's construction. We conclude that the claim language is sufficiently clear and does not require an express construction. To avoid any doubt, we interpret "composite bed" as the bed created by covering a layer of foamed glass aggregate with cementitious material.

⁹ We note further that Patent Owner provides a number of charts and attributes them to its declarant. PO Resp. 12–18 (citing Ex. 2007). The cited declaration does not include those charts, and we therefore give them little weight.

2. “around”

Claim 5 recites several weight percentages for the composition of the claimed foam glass bodies, expressed as “around” a certain weight percentage. Ex. 1001, 12:48–57 (reciting “wherein the foamed glass bodies have compositions in the range around 70 weight percent SiO₂, around 13 weight percent Na₂O and around 10 weight percent CaO with the remainder being other metal oxides”).

Petitioner argues that the composition recited in claim 5 finds support only in Table 2. Pet. Reply 16–17 (citing Ex. 1001, 11:8–13). Based on the numbers in that table, Petitioner submits that claim 5’s “around” quantities must allow for 1.5% variance in order to encompass the weight percentages in Table 2. *Id.* at 18.

Patent Owner does not contest Petitioner’s construction for “around” and we determine that Petitioner’s construction is supported by the intrinsic record as asserted. Accordingly, “around” permits a 1.5% variance from the recited numeric value.

C. UNPATENTABILITY OVER ACRP

Petitioner asserts that all the challenged claims are unpatentable as obvious over ACRP alone. Pet. 20–44.

1. Claim 1

ACRP describes development of arresting systems to mitigate overruns when an aircraft requires more than the available runway area during takeoff or landing. Ex. 1008, 11. It notes that the FAA “requires that all runways have a Runway Safety Area (RSA) beyond the normal runway surface, typically with a length of 1,000 ft.” *Id.* ACRP states that FAA

standards required an “Engineered Material Arresting System (EMAS)” but that then-existing EMAS technology had various issues and concerns. *Id.* Thus, ACRP sought to “advance the development of alternative civil aircraft arresting systems to safely decelerate aircraft that overshoot the runway” by “evaluat[ing] alternatives to the current EMAS technology, with the goal of finding options that might offer better performance, lower cost, or higher durability.” *Id.* According to ACRP, only one manufacturer offered an approved EMAS design, which used “4-ft by 4-ft blocks of cellular (foamed) cement” with the tops of the joints sealed against rain and the blocks stacked to build adequate depth. *Id.* at 12. ACRP notes that there were two generations of that existing system, the first using “painted cement board tops for the individual blocks and caulking to seal the joints in between” and the newer design using “plastic tops, which do not require painting, and silicone tape to seal the joints.” *Id.* ACRP considers that existing design as the baseline against which to consider alternatives. *Id.*

As one alternative, ACRP considers an arrestor using an aggregate foam bed. *Id.* at 15–16. Petitioner asserts that ACRP teaches “paving an area immediately beyond the end of a runway with foamed glass aggregate to define a bed.” Pet. 24 (quoting Ex. 1001, 12:11–14; citing Ex. 1008, 18 (Fig. S-5)). ACRP’s Figure S-5 is reproduced below:

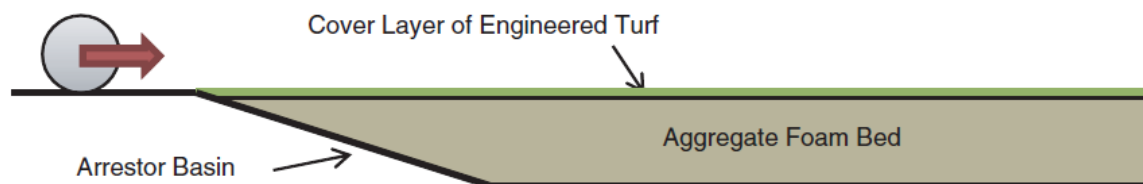


Figure S-5. Aggregate foam arrestor concept.

Ex. 1008, 18 (Fig. S-5). Figure S-5 depicts an arrestor basin filled with aggregate foam bed and covered with a layer of engineered turf. In Petitioner's view, the depiction of a rolling wheel in Figure S-5 shows that the disclosed bed is immediately beyond the end of a runway. Pet. 25 (citing Ex. 1008, 114 (discussing the impact of arrestor beds on short landings, where an aircraft touches down on the arrestor bed rather than the runway)).

Petitioner further argues that, to the extent ACRP does not expressly disclose placing arrestor beds immediately beyond the end of a runway, doing so would have been obvious because "space at the airport can be reduced and the distance of overrun before stopping can be minimized." Pet. 25. Other than as discussed below regarding "composite material," Patent Owner does not contest that the "paving an area immediately beyond the end of a runway with foamed glass aggregate to define a bed" language reads on ACRP's disclosures. We agree with Petitioner's assertions regarding the aggregate bed.

Petitioner asserts further that ACRP renders obvious "covering the bed with a layer of cementitious material to define a composite bed." *See id.* at 26–27. Here, Petitioner points out that ACRP "recognizes that concerns with arrestor beds include accounting for vehicular overrun onto the bed, such as 'fire-truck overrun.'" *Id.* at 26 (quoting Ex. 1008, 33). Petitioner also identifies that ACRP discusses durability concerns with then-existing arrestor beds, which airport operators had stated were "susceptible to being damaged by airport operations vehicles." *Id.* (quoting Ex. 1008, 42). ACRP notes that those durability complaints related to the painted cement boards topping the first-generation product. Ex. 1008, 42.

Petitioner reasons that because ACRP recognizes that work trucks may exert more pressure on the ground surface than traditional EMAS material strength, “the benefit of having a sturdier topper as opposed to a thin layer of plastic was known” to skilled artisans. Pet. 26–27; *see also* Ex. 1008, 60 (Table 7-3, noting that “Current EMAS material” was a cellular cement), 62 (noting that Table 7-4 relates to the “compressive strength of the current EMAS cellular cement”), 63 (Table 7-4, showing that pressure from work trucks could exceed the strength of existing EMAS material). Petitioner asserts further that “ACRP discloses the use of a cemen[t]itious topper in foamed glass arrestor beds, and notes that cement is a known material that has been used for tops of arresting beds before.” Pet. 22 (citations omitted) (citing Ex. 1008, 12, 24, 30, 33, 58). According to Petitioner, ACRP states that decision makers can “select the arrestor [material] option that best fits with the budgetary, climate, and space constraints of the facility.” *Id.* (quoting Ex. 1008, 167). Thus, explains Petitioner, skilled artisans would have had reason to modify the foamed-glass-aggregate arrestor beds discussed in ACRP to arrive at the claimed invention. *Id.* at 22, 26–27.

Patent Owner argues that ACRP teaches away from covering arrestor beds with cement because ACRP states that an older design using “painted cement board tops” led to durability concerns. PO Resp. 18–19 (citing Ex. 1008, 12, 30, 58); *see* Ex. 1008, 42 (describing durability concerns with existing designs). We find that ACRP’s discussion of durability concerns does not rise to a teaching away. Rather, ACRP summarizes the durability comments and states that “[a]dherence of paint should be improved” and that the “method of taping and caulking to seal tops of bed blocks could be

improved.” Ex. 1008, 42. Those comments do not implicate whether ACRP’s designs would work as intended, and instead, they relate to operators’ maintenance cost. We conclude that the durability comments would not lead skilled artisans away from using ACRP’s design with cement toppers, as Patent Owner asserts.

Next, based on its claim-construction position, Patent Owner argues that ACRP does not disclose a composite bed as claimed because “covering one material with another does not yield a composite, as the two materials must exhibit connectivity and must intermingle to yield a single, composite material.” PO Resp. 19 (citing Ex. 2007). As discussed above, we do not limit the claims to require a composite material. *See supra* at 7. Thus, Patent Owner’s argument is not persuasive. The assembly ACRP discloses with a foamed glass aggregate bed covered by cement topper boards satisfies claim 1’s limitations as properly construed.

Patent Owner does not challenge obviousness over ACRP on any other basis. *See* Paper 10, 8 (“Patent Owner is cautioned that any arguments for patentability not raised in the response may be deemed waived.”). Considering Petitioner’s submissions in light of the record, we are persuaded that Petitioner has provided an adequate reason that skilled artisans would have combined the ACRP teachings as asserted and that claim 1 would have been obvious over ACRP for the reasons given by Petitioner.

2. Claim 4

Independent claim 4 requires, in relevant part, “introducing a structural matrix material to plurality of foamed glass aggregate bodies to define an admixture.” Ex. 1001, 12:31–32. Petitioner points to ACRP’s discussion of arrestors using crushable aggregates with a binder. Pet. 31–32

(citing Ex. 1008, 60). As one such option, ACRP considers “ceramic glass aggregate,” defined as “[c]rushable ceramic glass aggregate connected with a phosphate cement binder.” Ex. 1008, 60. Petitioner reasons that skilled artisans would have had reason to use such a composition in light of ACRP’s note that “[l]oose gravel poses ingestion hazard for aircraft.” Pet. 32 (quoting Ex. 1008, 60).

Patent Owner argues that ACRP does not disclose or suggest a composite material formed “with respective foamed glass aggregate bodies covered by an[d] suspended in matrix material to yield a matrix composite.” PO Resp. 19. The basis for Patent Owner’s argument, however, is not explained. To the extent that Patent Owner argues ACRP does not disclose a composite material of foamed glass aggregate bodies suspended in matrix material, we do not agree. Indeed, ACRP addresses alternative arrestors and lists a subcategory of “Crushable Aggregates with Binder” containing “Crushable ceramic glass aggregate connected with a phosphate cement binder,” which is further characterized as “a pour-in-place crushable material.” Ex. 1008, 60 (Table 7-3). Thus, we find that ACRP discloses paving an arrestor bed with foamed glass aggregate suspended in matrix material.¹⁰

To the extent Patent Owner focuses on covering the composite material with a cementitious layer, we find that ACRP renders that claim element obvious. Petitioner asserts that ACRP renders obvious “covering the

¹⁰ If we were to construe the claims as Patent Owner seeks, such that claim 1 requires a composite material containing foamed glass aggregate and a binder, ACRP’s disclosure discussed here would satisfy that aspect of claim 1.

arrestor bed with a layer of covering material” because “ACRP recognizes the need to cover and seal the material used in the arrestor bed” and specifically discloses a “painted cement board top.” *See* Pet. 32 (citing Pet. 26–27 (citing Ex. 1008, 12, 24, 30, 58, 63)). We agree with Petitioner. ACRP instructs skilled artisans that arrestor beds required a top covering to prevent damage from airport vehicles and protect the arrestor bed. Ex. 1008, 12, 24, 30, 58, 63. That instruction provides a sufficient reason that skilled artisans would have arrived at the arrangement of claim 4.

We have reviewed the parties’ contentions and the full record and conclude that Petitioner has proven claim 4 would have been obvious over ACRP by a preponderance of the evidence. *See* Pet. 20–27, 31–34.

3. Other challenged claims

Petitioner provides additional contentions regarding ACRP’s disclosures relevant to claims 2, 3, and 5–19. Pet. 27–44. Patent Owner does not separately challenge those contentions, arguing that Petitioner fails to show unpatentability for the same reasons Patent Owner raises for claim 1. PO Resp. 19; *see* Paper 10, 8. We have reviewed the parties’ contentions and the full record and conclude that Petitioner has proven claims 2, 3, and 5–19 would have been obvious over ACRP by a preponderance of the evidence for the reasons provided by Petitioner. *See* Pet. 27–44.

D. UNPATENTABILITY OF CLAIMS 5, 12, 13, AND 18 OVER COMBINATIONS INCLUDING ACRP

1. Compositional and quantitative requirements

Claim 5 depends from claim 4 and recites quantitative values for the volume of foamed glass bodies in a composite bed, along with their structure, crush strength, density, and composition. Ex. 1001, 12:48–57.

Claim 12 depends from claim 8 and recites quantities for crush strength and density of the foamed glass bodies. *Id.* at 13:17–20. Claim 13 depends from claim 8 and recites weight-percentage compositions for the foamed glass bodies. *Id.* at 13:21–14:3.

Petitioner raises several grounds to address the additional limitations of claims 5, 12, and 13, beyond addressing those limitations with ACRP alone. *See* Pet. 44–50. According to Petitioner, Narmo “discloses the specific densities of foamed glass,” in claims 5 and 12, and that using glass with those values would have been obvious to skilled artisans. *Id.* at 45–46 (citing Ex. 1002 ¶¶ 64–69, 70–72, 79–80). Narmo discloses “[a]rresting beds for decelerating vehicles, especially passenger air-crafts unable to stop on available run-way.” Ex. 1012, code (57). Narmo discloses that “soda-lime glass or soda-glass” may be used for its foamed glass aggregate. *Id.* ¶ 17. It further discloses the crush strength of several foamed-glass-aggregate compositions. *Id.* ¶ 60 (Table 1).

Petitioner asserts that Narmo discloses exemplary foamed glass compositions that ACRP identifies as suitable for its arrestor beds. Pet. 45. Because ACRP indicates that designers should “select the arrestor option that best fits with the budgetary, climate, and space constraints of the facility,” Petitioner argues that skilled artisans would have had reason to consider Narmo’s examples. *Id.* (citing Ex. 1008, 167).

Patent Owner argues that Narmo fails to disclose “foamed glass bodies having a crush strength of 50PSI to 200PSI and made of 70 wt.% silica, 13 wt.% soda and 10 wt.% calcia as required by claim 5.” PO Resp. 20. Patent Owner argues also that, for claim 12, “Narmo does not add the requisite combination of foamed glass density between 100 and

180 kg/m³ along with foamed glass crush strength of at least 100 PSI.” *Id.* (converting, approximately, the claimed densities to different units). We do not agree, as Narmo discloses compositions in the claimed range. Ex. 1012 ¶ 60 (Table 1) (disclosing “Compression resistance” above 0.78 MPa (equivalent to 113 psi) for a composition with 180 kg/m³ density).

As to the composition weight percentages, Petitioner asserts that the ’246 patent discloses using “recycled or post-consumer waste glass” and shows the composition of such glass. Pet. Reply 16–17 (citing Ex. 1001, 11:8–13, Table 2). In this regard, Petitioner supports its proposed construction for the “around” claim language permitting a 1.5% variance. *See supra* at 13. Petitioner submits that reciting the composition of a material that had been “unchanged for hundreds of years” did not distinguish the recited composition. Pet. Reply 17. Thus, according to Petitioner, the known composition of recycled glass renders obvious the claimed composition for that glass. *Id.* at 17–20; *see also* Pet. 36 (citing Ex. 1002 ¶ 73; Ex. 1019, 1:21–45).

We agree with Petitioner. Although Patent Owner asserts that the prior art does not disclose the “specific foamed glass composition” recited in claim 13, for example (PO Resp. 21), Petitioner has shown that the ’246 patent relied on a long-existing, known glass composition. *See* Pet. 36; Pet. Reply 17 (citing Ex. 1038, 41:14–25, 42:10–44:13, 45:2–12; Ex. 1037 ¶¶ 26–30). And Patent Owner’s declarant agreed that the claimed composition is the same as traditional soda-lime glass. Ex. 1038, 27:20–30:5 (addressing the ’671 patent, which contains the same relevant disclosure as the ’246 patent). Thus, the record supports our determination that the

challenged claims are obvious over ACRP alone.¹¹ The additional evidence Petitioner identifies in Hojaji, Ramsey, and other references further supports that conclusion. Pet. 47 (citing Ex. 1014, 3:40, 6:3–11, 18:60–66, 23:8–15; Ex. 1002 ¶¶ 82–83), 50 (citing Ex. 1011; Ex. 1002 ¶ 87); Pet. Reply 19 (citing Ex. 1034, 72); *see also* Ex. 1038, 42:10–44:13 (Patent Owner’s declarant, stating that the claimed composition and the idea of modifying the composition to control melting point has been known for at least 100 years).

We conclude that Petitioner has shown by a preponderance of the evidence that claims 5, 12, and 13 would have been obvious over ACRP combined with Narmo (claims 5 and 12), combined with Hojaji (claim 13), or combined with Narmo and Ramsey (claims 5 and 13).

2. Claim 18

Claim 18 depends from claim 15, which depends from claim 8. Claim 15 recites that claim 8’s “composite bed is a concrete defined by foamed glass bodies suspended in a cementitious matrix” and claim 18 recites that “the cementitious matrix is Portland cement.” Ex. 1001, 14:9–11, 14:18–19.¹² Patent Owner argues that the claim language captures Patent Owner’s sought construction for “composite bed” in that it requires glass bodies suspended in cementitious matrix. PO Resp. 21–22.

¹¹ Although this point raises issues regarding ACRP’s disclosures, and thus is relevant to unpatentability over ACRP alone, we address Petitioner’s evidence here to follow how Patent Owner raises the issue in the Response.

¹² Although this dispute for claim 18 arises in Patent Owner’s challenge to the ground including Narmo and Ramsey (*see* PO Resp. 21–22), the disputed aspects relate to ACRP’s disclosures, not to those of Narmo or Ramsey. Petitioner relies on Ramsey only for the limitation added by claim 18. *See* Pet. 50.

Petitioner relies on its contentions for claim 4 to assert that the limitations of claim 15 would have been obvious over ACRP. Claim 4 recites forming an admixture of structural matrix and foamed glass aggregate bodies, then forming that admixture into an arrestor bed. Ex. 1001, 12:29–35. Petitioner’s contentions assert that ACRP discloses that approach through using crushable aggregates in binder as a paving material. Pet. 31–32 (citing Ex. 1008, 60). We discuss these contentions above and determine that they support obviousness as asserted. *See supra* at 17–19 (discussing claim 4 as obvious over ACRP alone).

Like claim 1, claim 8 requires “paving an area immediately beyond the end of a runway with foamed glass aggregate to define a bed” and then “covering the bed with a layer of cementitious material to define a composite bed.” Ex. 1001, 12:63–13:2. By taking the approach disclosed by ACRP, as identified by Petitioner, the initial paving step would use an admixture of crushable glass aggregate in cementitious binder. We do not interpret claim 8 to require (nor has Patent Owner argued claim 8 requires) paving with foamed glass that is uncombined with a binder. In short, claim 8 is consistent with initially paving using an admixture of foamed glass aggregate in a binder. Thus, claim 8’s and claim 15’s language read on the approach Petitioner identifies.

We conclude that Petitioner has shown by a preponderance of the evidence that claim 18 would have been obvious over ACRP, Narmo, and Ramsey.

E. UNPATENTABILITY OVER ANGLEY AND HOJAJI

Petitioner asserts all challenged claims are unpatentable over the combination of Angley and Hojaji. Pet. 51–66.¹³ Angley discloses vehicle arresting beds using blocks or aggregate of cellular concrete. Ex. 1016, 1:11–14, code (57). Petitioner asserts that skilled artisans “would have been motivated to have replaced the foamed concrete of Angley with the then existing known foamed glass material as an alternative foamed material.” Pet. 53. In Petitioner’s view, Hojaji “confirms that foamed glass has long been known in the building industry.” *Id.* (citing Ex. 1014, 1:36–38 (“Foam glass has long been known as a potential substitute for conventional insulation and acoustic materials for the building industry.”)). Petitioner provides contentions showing how the combination of Angley and Hojaji discloses or renders obvious each limitation of claims 1–19. *Id.* at 51–66.

Patent Owner argues first that “[n]either Angley nor Hojaji teaches an aircraft arrestor bed made of a foamed glass aggregate suspended in a structural/cement matrix composite material as required by independent claims 1, 4, and 8.” PO Resp. 23. That argument relies on the claim-construction position advanced by Patent Owner, which we do not adopt. *See* Tr. 30:9–12 (agreeing that the Angley–Hojaji combinations turn “primarily” on Patent Owner’s proposed claim construction). Thus, Patent Owner’s argument based on “composite material” is not persuasive.

¹³ Petitioner’s ground including Schirtzinger relies on that additional reference only to “confirm that a [person of ordinary skill in the art] would have understood foamed glass to be a viable alternative to other foamed materials in the runway arrestor bed context and that the claimed crush strength were well known to a [person of ordinary skill in the art].” Pet. 66. Thus, that additional ground largely parallels the ground based on Angley and Hojaji.

Patent Owner argues further that “[n]either Angley nor Hojaji teaches covering foamed glass aggregate with a cementitious or ceramic material to yield an aircraft arrestor bed (composite or not).” PO Resp. 23. We do not agree. Petitioner explains how Angley discloses a “cement top layer ‘having a thickness not exceeding ten percent of average thickness of said bed and a strength to support a pedestrian.’” Pet. 53 (quoting Ex. 1016, Claim 1, 4:51–53). Petitioner supports that the “cemen[t]itious hardcoat layer permits a firetruck or other rescue vehicle to drive atop the arrestor bed.” *Id.* (quoting Ex. 1016, 9:22–26; Ex. 1002 ¶ 100). We agree with Petitioner and find that Angley discloses covering foamed glass aggregate with a cementitious material to yield the composite bed as claimed.

Patent Owner does not challenge any other aspect of Petitioner’s Angley–Hojaji contentions. *See* Paper 10, 8. We have reviewed the parties’ contentions and the full record and conclude that Petitioner has proven by a preponderance of the evidence that claims 1–19 would have been obvious over Angley and Hojaji. *See* Pet. 51–66.

F. UNPATENTABILITY OVER ANGLE, HOJAJI, AND SCHIRTZINGER

Petitioner asserts that Schirtzinger confirms that skilled artisans would have understood the applicability of foamed glass to arrestor beds, further motivating the use of Hojaji’s materials in Angley’s arrestor beds. Pet. 66–67. Schirtzinger discloses arrestor beds using a foamed glass product with a flexible cover. Ex. 1009, 1:10–14, 9:16–43.

Patent Owner argues that the claims do not read on Schirtzinger because it does not disclose a composite material for the arrestor bed. PO Resp. 24. As noted before, that argument depends on a claim construction we do not adopt. *See supra* at 12. Moreover, however,

Petitioner relies on Schirtzinger as further motivating the use of Hojaji's material with Angley's arrestor bed. Pet. 67. As we conclude that Petitioner has carried its burden for the Angley–Hojaji ground, Schirtzinger's disclosures only further that conclusion, and we additionally conclude that the claims would have been obvious over Angley, Hojaji, and Schirtzinger, for the reasons given by Petitioner. *Id.* at 66–67.

III. PATENT OWNER'S MOTION TO AMEND

Patent Owner requests that, if we find any of the challenged claims unpatentable, we grant entry of proposed substitute claims 20–22. MTA 1.

A. APPLICABLE LAW

In an *inter partes* review, amended claims are not added to a patent as of right, but rather must be proposed as a part of a motion to amend. 35 U.S.C. § 316(d). The Board must assess the patentability of proposed substitute claims “without placing the burden of persuasion on the patent owner.” *Aqua Prods., Inc. v. Matal*, 872 F.3d 1290, 1328 (Fed. Cir. 2017) (en banc); *see also Lectrosonics, Inc. v. Zaxcom, Inc.*, IPR2018-01129, Paper 15 at 3–4 (PTAB Feb. 25, 2019) (precedential). Thus, the petitioner, not the patent owner, “bears the burden of proving that the proposed amended claims are unpatentable by a preponderance of the evidence.” *Bosch Auto. Serv. Sols., LLC v. Matal*, 878 F.3d 1027, 1040 (Fed. Cir. 2017) (as amended on rehearing, *Bosch Auto. Serv. Sols., LLC v. Iancu*, No. 2015-1928 (Fed. Cir. Mar. 15, 2018) (Order on Petition for Panel Rehearing)); *Lectrosonics*, Paper 15 at 3–4.

In determining whether a petitioner has proven unpatentability of the proposed substitute claims, the Board focuses on “arguments and theories

raised by the petitioner in its petition or opposition to the motion to amend.” *Nike, Inc. v. Adidas AG*, 955 F.3d 45, 51 (Fed. Cir. 2020). Ultimately, the Board determines whether the proposed substitute claims are unpatentable by a preponderance of the evidence based on the entirety of the record, including any opposition made by the Petitioner. *See Lectrosonics*, Paper 15 at 4.

Notwithstanding the foregoing, Patent Owner’s proposed substitute claims 20–22 must meet the statutory requirements of 35 U.S.C. § 316(d) and the procedural requirements of 37 C.F.R. § 42.121. *Lectrosonics*, Paper 15 at 4–8. Accordingly, Patent Owner must demonstrate: (1) the amendment proposes a reasonable number of substitute claims; (2) the amendment responds to a ground of unpatentability involved in the trial; (3) the proposed claims are supported in the original disclosure (and any earlier filed disclosure for which the benefit of filing date is sought); and (4) the amendment does not seek to enlarge the scope of the claims of the patent or introduce new subject matter. *See* 35 U.S.C. § 316(d); 37 C.F.R. § 42.121.

B. PROPOSED SUBSTITUTE CLAIMS

Proposed claim 20 would replace claim 1 and recites:

20. A method of producing an arrestor bed for slowing an aircraft overrunning a runway, comprising:
 - a) paving an area immediately beyond the end of a runway with foamed glass aggregate; and
 - b) suspending the foamed glass aggregate in cementitious material to define a composite bed.

MTA 22. Proposed claim 21 would replace claim 4 and recites:

21. A method of fabricating an aircraft arrestor bed, comprising:

- a) introducing a structural matrix material to plurality of foamed glass aggregate bodies to define an admixture;
 - b) forming the admixture of foamed glass aggregate bodies and structural matrix material into an arrestor bed adjacent the end of a runway; and
 - c) covering the arrestor bed with a layer of covering material;
- wherein the arrestor bed defines respective foamed glass aggregate bodies suspended in a matrix of structural matrix material;
- wherein the arrestor bed is at least about 50 volume percent foamed glass aggregate;
- wherein the foamed glass bodies have crushing failure modes;
- wherein the foamed glass aggregate have strengths of at least 50 PSI; and
- wherein the arrestor bed will preferentially crushingly fail instead of slide over itself under the compressive and torsional loads produced by an aircraft rolling over the runway safety area.

Id. Proposed claim 22 would replace claim 8 and recites:

22. A method of making a foamed glass composite engineered material arresting system for aircraft arrest, comprising:
- a) paving an area immediately beyond the end of a runway with foamed glass aggregate to define a bed; and
 - b) covering the bed with a layer of cementitious material to define a composite bed;
- wherein the foamed glass body is incompressible with a crushing failure mode; and
- wherein the composite bed defines foamed glass aggregate bodies suspended in cement.

Id. at 23.

C. STATUTORY AND REGULATORY REQUIREMENTS

1. Reasonable Number of Claims
35 U.S.C. § 316(d)(1)(B); 37 C.F.R. § 42.121(a)(3)

“There is a rebuttable presumption that a reasonable number of substitute claims per challenged claim is one (1) substitute claim.”
Lectrosonics, Paper 15 at 4–5 (citing 37 C.F.R. § 42.121(a)(3)). Patent Owner proposes three substitute claims for three challenged claims (*see* MTA 2) and thus proposes a reasonable number of substitute claims.

2. Respond to a Ground of Unpatentability
37 C.F.R. § 42.121(a)(2)(i)

Patent Owner contends that the proposed substitute claims respond to a ground of unpatentability because Petitioner asserts the prior art discloses elements of the original independent claims, which the motion seeks to amend by adding new elements. MTA 3. Petitioner challenges this as to proposed substitute claim 21, which Petitioner asserts does not alter the scope of original claim 4. MTA Opp. 4. We address that argument below, in connection with obviousness. *See infra* at 45. Applying 37 C.F.R. § 42.121(a)(2)(i) to Patent Owner’s motion as a whole, we conclude proposed substitute claims 20 and 22 satisfy the regulation and thus the amendment responds to a ground of unpatentability.

3. Scope of Amended Claims
35 U.S.C. § 316(d)(3); 37 C.F.R. § 42.121(a)(2)(ii)

“A substitute claim will meet the requirements of § 42.121(a)(2)(i) and (ii) if it narrows the scope of at least one claim of the patent, for example, the challenged claim it replaces, in a way that is responsive to a

ground of unpatentability involved in the trial.” *Lectrosonics*, Paper 15 at 6–7.

Patent Owner asserts that the proposed substitute claims “retain all the elements of the respective original claims and do not enlarge the scope of the respective original claims in any way.” MTA 3.

a. Proposed substitute claim 20

Proposed substitute claim 20 eliminates terms included in claim 1: “to define a bed,” “covering the bed,” and “with a layer of.” MTA 22. Thus, the claims do not retain all the elements of the original claims. We identified this issue to Patent Owner in our Preliminary Guidance, but Patent Owner did not file a revised motion to amend. *See* Prelim. Guidance MTA 5. The changes to claim 1’s language leave the sequence of claim steps ambiguous, whereas the antecedent basis in claim 1 requires that step “a” be completed before step “b.” Further, step “b” in proposed substitute claim 20 appears to allow for defining a composite bed without covering the area paved with foamed glass aggregate. If a proposed claim encompasses a new “process that would not have been covered by the original claims,” that proposed claim expands the scope of the original claim. *In re Cuozzo Speed Techs., LLC*, 793 F.3d 1268, 1283 (Fed. Cir. 2015), *aff’d sub nom. Cuozzo Speed Techs., LLC v. Lee*, 136 S. Ct. 2131 (2016). Thus, we conclude that proposed claim 20 would broaden the scope of original claim 1 and therefore does not comply with the statutory requirements. *See* MTA Opp. 2–4.

b. Proposed substitute claims 21 and 22

Proposed substitute claims 21 and 22 comply with the statutory requirement regarding claim scope, in that they retain the limitations of the original claims they are to replace.

4. New Matter or Written Description
35 U.S.C. § 316(d)(3); 37 C.F.R. § 41.121(b)(1)

a. Proposed substitute claim 20

Patent Owner asserts that support for this claim is found in U.S. Application No. 14/966,487 (“the ’487 application,” from which the ’246 patent issued), at 17:21–18:12, 18:21–19:2, and Fig. 2B.¹⁴ MTA 6–7. Patent Owner also proposes that the “suspending” step of proposed claim 20 be construed as infiltration. *Id.* at 11.

At Patent Owner’s first cited portion, the ’487 application states “[i]n some embodiments, the foamed glass bodies 285 may also be used as aggregate 305 in traditional concrete,” “[m]oreover, the arrestor beds 350 are typically constructed of foamed glass bodies 285 and/or aggregate 305 (more typically closed cell foamed glass aggregate 305 and/or bodies 285) in a thin ceramic or structural matrix 370, wherein the surface 375 of the arrestor bed 350 is matrix material 370,” and “[t]he matrix 370 may be concrete, asphalt, or the like.” Ex. 1030, 29:20–22, 30:5–9. The second cited portion states “[i]n operation, arrestor beds 360 may be produced by paving an area immediately beyond the end of a runway with foamed glass

¹⁴ Patent Owner’s citations to Ex. 1030 are to the pages of the original Specification, not to the pages of Ex. 1030. *See, e.g.*, MTA. 6. Our citations to Ex. 1030 will be to the pages of Ex. 1030.

aggregate 285 to define a bed, and covering the bed with a layer of cementitious material to define a composite bed 360.” *Id.* at 30:22–31:2.

Petitioner argues that Patent Owner has not identified support in the original disclosure for the limitation “suspending the foamed glass aggregate in cementitious material to define a composite bed” because the passages cited by Patent Owner “do not describe covering foamed glass to form a composite; in fact, PO’s declarant confirmed that there is no disclosure of this concept.” MTA Opp. 7 (citing Ex. 1038, 94:13–95:7, 96:6–98:3).

Petitioner states “[t]he passages merely mention[] the idea of using foamed glass and structural matrix material to form a composite arrestor bed, either layered or pre-mixed.” *Id.* at 7–8 (citing Ex. 1030, 29–31).

Petitioner also cites Patent Owner’s proposed claim construction for claim 20, arguing “[t]he concept of fluid cement ‘infiltrating the foamed glass bodies to create a composite suspended in the continuous matrix of cementitious material’ is entirely absent” and “[t]he specification includes three examples of how to make ‘a composite material,’ none of which disclose the infiltration of paved foamed glass with liquid cement.” *Id.* at 8 (citing MTA 11; Ex. 1030, 21–23, 24:10–13; Ex. 1001, 4:4–41; Ex. 1038, 98:4–99:2, 126:13–17; 135:20–138:3).

We agree with Patent Owner, except as to claim construction. Proposed substitute claim 20 differs from proposed substitute claim 22 in that proposed substitute claim 20 does not state that the suspension of foamed glass aggregate in cementitious material is produced by covering foamed glass aggregate with cementitious material. *See* MTA 22. Proposed substitute claim 20 merely states that foamed glass aggregate is paved and suspended in cementitious material to define a composite bed. *Id.*

Accordingly, under the proper construction, proposed substitute claim 20 does not add new matter and complies with the statutory requirement.

The '487 application, however, does not provide support for infiltration as part of covering foamed glass aggregate with cementitious material and, therefore, does not support Patent Owner's infiltration claim construction. As such, we do not adopt Patent Owner's proposal to interpret the "suspending" step of proposed substitute claim 20 to mean "[i]nfiltrating the foamed glass bodies with the fluid cementitious material to create a composite consisting of foamed glass bodies suspended in the continuous matrix of cementitious material." *Id.* at 11. If one were to construe proposed substitute claim 20's language to mean "suspending the foamed glass aggregate in cementitious material" occurs simply by covering the aggregate with cementitious material, proposed substitute claim 20 would add new matter, as described below regarding proposed substitute claim 22.

b. Proposed substitute claim 21

Patent Owner identifies support for the elements of proposed substitute claim 21. MTA 7–9. Petitioner does not specifically challenge Patent Owner's assertion in that regard.

We conclude Patent Owner has identified original disclosure that provides support for proposed substitute claim 21. The '487 application provides support for an arrestor bed that includes foamed glass bodies or aggregate in a structural matrix (i.e., an admixture that is also a suspension of aggregate in the matrix material), which may be concrete, and for the surface of arrestor bed (i.e., a covering) being the matrix material. Ex. 1030, 30:5–9. The '487 application also describes a bed immediately beyond the end of a runway. *Id.* at 30:22–31:2.

c. Proposed substitute claim 22

Patent Owner posits “that pouring cement onto the layer of foamed glass defining the bed will cause infiltration of at least a portion of the bed with cement that, when cured, will yield a matrix composite with foamed glass aggregate bodies suspended in the cement matrix.” MTA 5; *see* Ex. 2007 ¶ 10 (Helgeland Declaration interpreting the proposed claims). Patent Owner asserts that support for the limitation is provided in the ’487 application at 17:15–18:12, 18:5–9, 18:21–19:6, and Fig. 2B. MTA 9–10. Patent Owner also proposes that the “covering” step of proposed substitute claim 22 be construed as infiltration. *Id.* at 15.

Petitioner argues that “[t]he ’246 Patent does not describe any infiltration of liquid cement into a bed of foamed glass” and “the only runway arrestor beds arguably described in the ’246 Patent require the mixture of foamed glass bodies into a cementitious material before paving the bed.” MTA Opp. 4 (citing Ex. 1001, 4:4–41) (emphasis omitted). According to Petitioner, “[t]he MTA fails to identify support for the idea of forming a composite bed by covering a bed with a cementitious material as construed by PO.” *Id.* at 8. Petitioner further asserts that “PO’s declarant confirms the ’246 Patent does not describe this infiltration concept, noting that the patent only describes premixing foamed glass and cement to create a composite material.” *Id.* at 4 (citing Ex. 1038, 94:13–95:7, 96:6–98:3, 126:13–17, 135:20–136:11, 125:13–126:17, 135:20–138:3).

We conclude Patent Owner has not shown that the original disclosure provides support for proposed substitute claim 22. Patent Owner’s citations are to a description of an embodiment where foamed glass bodies are “for incorporation into aircraft or vehicular arrestor beds 350.” Ex. 1030, 28:17–

19. As stated in the '487 application, “arrestor beds 350 are typically formed from a foamed glass composite material 360 including foamed glass bodies 295 suspended or enclosed in a (typically ceramic) structural matrix 370.” *Id.* at 29:4–6. This neither explicitly states nor necessarily discloses that the composite is produced by covering the foamed glass bodies as asserted by Patent Owner, i.e., by pouring cement over foamed glass bodies so the cement infiltrates the foamed glass bodies. *See* MTA 15. Rather, this disclosure indicates the arrestor bed utilizes a composite material, which the '487 application describes only as being premixed foamed glass and, e.g., cement, which is made into a composite before creating the arrestor bed rather than made *in situ* by sequentially depositing glass bodies and, e.g., cement. *See* Ex. 1030, 20:15–23:8, Figs. 1–2B. The Specification further describes that foamed glass bodies are “incorporated into a typically incompressible structural matrix 370, such as a polymer based, fibrous, cementitious, or like matrix material” or “may also be used as aggregate 305 in traditional concrete.” *Id.* at 29:16–20. These examples also describe mixing glass bodies with matrix material before applying the mixture to form an arrestor bed structure, where the arrestor bed is “constructed of foamed glass bodies . . . in a thin ceramic or structural matrix.” *Id.* at 30:5–9. The Abstract of the '487 application also states that a foamed glass body is positioned in a bed and “at least partially surrounded with a structural matrix material to define a composite bed portion” but still fails to describe that a covering step creates the composite. *Id.* at 48.

By not describing forming a matrix by covering foamed glass bodies with a cementitious matrix material, but rather describing only a composite mixture created before its application, the original disclosure of the

'246 patent does not adequately describe the process of proposed substitute claim 22 so that one of ordinary skill in the art would have recognized the subject matter of the proposed claim to be the invention or that the inventors had possession of the method of claim 22 at the time of filing. Patent Owner directs us to no other disclosure that corresponds to the covering of foamed glass bodies to yield a composite matrix as claimed. The '487 application instead describes that “foamed media are typically incorporated into the cement (and aggregates, if needed) after the water has been added” and that “[t]he resulting mixture . . . is pressure or gravity formed into a slab (or other coherent shape) or direct cast into a prefabricated form.” *Id.* at 22:4–8. Thus, proposed substitute claim 22 would add new matter and therefore does not comply with the statutory requirements.

D. PATENTABILITY OF THE PROPOSED SUBSTITUTE CLAIMS

1. Enablement

Patent Owner asserts that the meaning of “covering the bed with a layer of cementitious material to define a composite bed” in proposed substitute claim 22 is “[i]nfiltrating the foamed glass bodies with the fluid cementitious material to create a composite consisting of foamed glass bodies suspended in the continuous matrix of cementitious material.” MTA 11, 15 (citing Ex. 2007).

Petitioner argues that “Mr. Helgeland confirmed there also are certain properties that would need to be manipulated in order to arrive at a suitable level of infiltration, properties that are not disclosed in the '246 Patent.” MTA Opp. 9 (citing Ex. 1038, 75:4–18, 94:5–95:7, 96:17–98:3, 120:19–121:22, 122:11–14). Petitioner further asserts that “Mr. Helgeland was able to confirm the existence of these properties, but even his 35 years of

experience in the industry were not enough for him to be able to describe how to prepare such cement or whether such a composition could even be created” and that “Dr. Zupan confirmed this, as well as what he would expect to have seen if that what was indeed enabled.” *Id.* at 9–10 (citing Ex. 1038, 78:25–79:17, 120:19–121:22; Ex. 1037 ¶¶ 24–25).

We note that, when asked at his deposition whether the ’671 patent describes “how you can control whether or not you get even infiltration throughout an arrestor bed versus uneven or different infiltration,” Mr. Helgeland explained that

it talks about mixing prior to putting it in the bed. So in that case it would be -- it would take care of the -- the infiltration issue, right. But in terms -- in terms of the -- the requirements and stuff like that, ***no, I don’t think that anything else is -- like that is described.***

Ex. 1038, 120:19–121:10 (emphasis added). Although Mr. Helgeland’s discussion regarded the ’671 patent, which issued from an application that was the parent to the ’487 application, we discern no disclosure in the ’246 patent that cures the enablement deficiencies in its parent. *See id.* at 122:11–14. Therefore, no record evidence establishes that a skilled artisan would understand a “layer of cementitious material” may cover a bed of foamed glass aggregate to yield a “composite bed” that is defined by “foamed glass aggregate bodies suspended in cement,” as is recited by Patent Owner’s proposed substitute claim 22. MTA 23.

Mr. Helgeland, during his deposition, explained that “[i]f [the cementitious material] didn’t infiltrate” the foamed glass bodies upon covering, it could not “yield a composite defining the foamed glass bodies in a cement matrix.” Ex. 1038, 71:4–8; MTA Opp. 4, 7–8. Mr. Helgeland

confirmed that there are “very important” properties that must be considered to determine “whether or not there is infiltration down through the aggregate,” including “the degree of -- of porosity there is or the viscosity of the cement, the type of cement, the type of aggregate,” and Mr. Helgeland also expressed that one would “need to control the fluidity of the cement in order to ensure that complete infiltration throughout the bed” occurred, and professed that “that could all be engineered,” but conceded, “that’s outside of my realm of expertise.” Ex. 1038, 75:4–18, 88:20–89:1; *see also id.* at 120:19–121:19 (Mr. Helgeland explaining that he does not know how to control infiltration of cement in an arrestor bed and the ’671 patent only described pre-mixing the matrix components). This is essentially the extent of Mr. Helgeland’s explanation as to how the claimed covering of foamed glass bodies with a layer of cementitious material would yield a cement matrix, with no explanation as to what knowledge a person of ordinary skill in the art would have brought to the task. And, as noted above, Mr. Helgeland concedes that the Specification does not discuss this concept. *Id.* at 94:23–98:3.

Thus, Patent Owner’s declarant appears to rely on some basic knowledge of the person of ordinary skill in the art for the disclosure of the elements of proposed substitute claim 22. However, the declarant does not provide any explanation as to the scope or details of such knowledge. “To be enabling, the specification of a patent must teach those skilled in the art how to make and use the full scope of the claimed invention without ‘undue experimentation.’” *Genentech, Inc. v. Novo Nordisk, A/S*, 108 F.3d 1361, 1365 (Fed. Cir. 1997) (quoting *In re Wright*, 999 F.2d 1557, 1561 (Fed. Cir. 1993)). Factors relevant to a determination of whether undue

experimentation would be necessary include: (1) the quantity of experimentation necessary, (2) the amount of direction or guidance presented, (3) the presence or absence of working examples, (4) the nature of the invention, (5) the state of the prior art, (6) the relative skill of those in the art, (7) the predictability or unpredictability of the art, and (8) the breadth of the claims. *In re Wands*, 858 F.2d 731, 737 (Fed. Cir. 1988).

Here, essentially no direction or guidance for the disputed claimed subject matter is provided and no working examples relating thereto are provided in the '487 application or the '246 patent's Specification. There is no evidence regarding how much experimentation would be necessary to practice the invention; the prior art does not expressly address forming a matrix, as claimed, by the methodology claimed; and there is little to no evidence in the record regarding the predictability of the art. The breadth of the claims is a neutral factor, or suggests non-enablement because the proposed claims encompass subject matter that the Specification fails to describe (infiltration by covering aggregate with a cementitious layer). Weighing these factors, based on the present record, supports that undue experimentation would be necessary to achieve the claimed invention.

Therefore, based on the record, Petitioner's argument is persuasive that, to the extent proposed substitute claim 22 requires infiltration of foamed glass aggregate bodies by a cementitious material that covers the already-paved area of foamed glass aggregate, the '246 patent does not provide sufficient enabling disclosure for proposed claim 22 under 35 U.S.C. § 112.

Petitioner presents the same enablement arguments for proposed substitute claim 20 as for proposed substitute claim 22. MTA Opp. 9–10.

However, Petitioner’s basis for this assertion regarding proposed substitute claim 20 is based largely on Patent Owner’s indication that the claim language requires infiltration of the glass bodies, as with proposed substitute claim 22. MTA 11, 15. The language of proposed substitute claim 20, however, differs from that of proposed substitute claim 22, in that proposed substitute claim 20 does not require that covering the aggregate bed with a cementitious layer is what suspends the aggregate in cementitious material. *See supra* at 33. Additionally, we do not adopt Patent Owner’s proposed “infiltration” construction for the “suspending” step of proposed claim 20. *Id.* at 15, 22–23; *see also supra* at 33. Therefore, we find Petitioner has not established that proposed substitute claim 20 lacks enablement.

As with our conclusion regarding new matter above, if the language of proposed substitute claim 20 were interpreted to require infiltration, then we would reach the same conclusion for proposed substitute claim 20 as for proposed substitute claim 22 discussed above, with respect to enablement.

2. Written Description

Petitioner argues that proposed substitute claims 20 and 22 lack written-description support, citing its arguments that those claims would add new matter. MTA Opp. 10. For the reasons discussed above regarding new matter, we agree as to claim 22 but not as to claim 20. *See supra* at 31–36. We note in this regard that Petitioner has shown by a preponderance of the evidence that proposed substitute claim 22 lacks adequate written description support. *See* MTA Opp. 4–8.¹⁵

¹⁵ As noted elsewhere, we would reach this conclusion for proposed substitute claim 20 if construing it to read on infiltration.

3. Indefiniteness

Although Petitioner does not assert proposed substitute claim 20 is indefinite, we determine the evidence is “readily identifiable and persuasive such that the Board should take it up in the interest of supporting the integrity of the patent system, notwithstanding the adversarial nature of the proceedings.” *Hunting Titan, Inc. v. DynaEnergetics Europe GmbH*, IPR2018-00600, Paper 67, 13 (PTAB July 6, 2020) (designated precedential). The evidence relevant to this issue is nothing more than the language of the proposed substitute claim, and the ’246 patent Specification. We addressed this issue in our Preliminary Guidance to allow Patent Owner the opportunity to present proposed substitute claims in a revised motion to amend that do not suffer from the same potential infirmity. Prelim. Guidance MTA 15 (citing Notice, 84 Fed. Reg. 9,499–500). Patent Owner declined to do so.

Proposed substitute claim 20 recites the steps of “a) paving an area immediately beyond the end of a runway with foamed glass aggregate” and “b) suspending the foamed glass aggregate in cementitious material to define a composite bed.” MTA 22. It is unclear whether the composite bed is defined by the “suspending” step alone or whether the composite bed is defined by a combination of the “paving” and “suspending” steps. Stated otherwise, it is unclear whether proposed substitute claim 20 requires paving with only foamed glass aggregate and separately applying cementitious material to define the composite bed, or whether the claim also encompasses premixing the foamed glass aggregate and cementitious material before the paving step so the foamed glass aggregate is suspended in cementitious material. The uncertain claim scope renders proposed substitute claim 20

indefinite because the claim does not “inform those skilled in the art about the scope of the invention with reasonable certainty.” *Nautilus, Inc. v. Biosig Instruments, Inc.*, 572 U.S. 898, 910 (2014).

As to proposed substitute claim 21, Petitioner argues the limitation “the runway safety area” of proposed substitute claim 21 lacks antecedent basis, rendering the claim indefinite. MTA Opp. 10. This argument is persuasive because “runway safety area” does not appear previously before and it is unclear if “runway safety area” refers to the previously recited “aircraft arrestor bed” or a different structure. Accordingly, proposed substitute claim 21 is indefinite.

4. Obviousness over Ramsey and Valentini

Petitioner asserts that proposed substitute claims 20–22 would have been obvious over a combination of Ramsey and Valentini¹⁶. MTA Opp. 10–22. Valentini incorporates by reference the entirety of Narmo (Ex. 1012). Ex. 1036 ¶¶ 3, 48; MTA Opp. 11.

Petitioner asserts that a skilled artisan would have been motivated to combine Valentini and Ramsey because Valentini discloses using foamed glass aggregate in arrestor beds, using binders to stabilize the aggregate, and composites composed of binder and aggregate, but lacks specificity about the binder or producing foamed glass, or the details of the composite material of, e.g., Figures 11A and 11B. MTA Opp. 13–15 (citing Ex. 1037 ¶¶ 54–63). Petitioner asserts that Ramsey fills in these gaps, confirming that foamed glass aggregate and Portland cement can be used as a composite material. *Id.* Petitioner asserts that the combination of these disclosures

¹⁶ US 2013/0020437 A1 (published Jan. 24, 2013) (Ex. 1036).

would have been “nothing more than an arrangement of known materials performing in a predictable manner” and that success in the combination would have been reasonably expected. *Id.* at 15.

Petitioner also identifies where Valentini (including Narmo) and Ramsey teach each element or step of proposed claims 20–22. *Id.* at 15–22.

Petitioner asserts “Valentini describes the use of foamed glass aggregate in arrestor beds . . . the use of binders (e.g., ‘means for stabilizing location of the aggregate,’ . . .) and depicts such composite materials comprising binder and aggregate,” and “Ramsey confirms that foamed glass aggregate and Portland cement can be used to create a composite material.” MTA Opp. 13–14. In addition, Petitioner asserts “Valentini discloses forming arrestor beds at or near the end of a runway” and “discloses the application of both a foamed glass layer followed by cement atop the foamed glass layer (Fig. 11A) and the paving of an area with a composite material comprising foamed glass aggregate and a binder material (Fig. 11B).” *Id.* at 15. Petitioner asserts that Valentini’s disclosure of using an aggregate slurry having foamed glass bodies as casting material and a covering thereover of shot-crete discloses “suspending the foamed glass aggregate in cementitious material to define a composite bed.” *Id.* at 17–21 (citing Ex. 1036 ¶¶ 33, 47, Figs. 11A, 11B; Ex. 1037 ¶¶ 56–58).

Valentini’s Figure 11A illustrates a “solid part” being dumped from a truck into a form, i.e., paving with this “solid part,” followed by a worker covering the solid part with a binder by spraying from a hose to “cast in place” a bed. Ex. 1036 ¶¶ 33, 47, Fig. 11A. Valentini’s Figure 11B shows another variant of the cast-in-place process where the aggregate and binder is pre-mixed in a shot-crete truck (a cement truck) and dropped together in

place to form a bed. *Id.* ¶¶ 33, 47, Fig. 11B. Valentini discloses that the aggregate in such embodiments includes “particles of foam glass,” which may be used to form a bed. *Id.* ¶¶ 3–5, 42. Valentini’s Figure 11B indicates that the binder can be “shot-crete,” which Petitioner’s witness indicates is a “cementitious material that has higher flowability for improved pumping.” Ex. 1036, Fig. 11B; Ex. 1037 ¶¶ 37–39, 56 (citing Ex. 1040, 4–5).

Based on Figures 11A and 11B of Valentini, we are persuaded by Petitioner’s argument that, “[u]nder both possible interpretations of this claim [20] element [“suspending the foamed glass aggregate in cementitious material to define a composite bed], one where a bed of foamed glass is laid down and cement is poured atop the foamed glass, and one where a mixture of foamed glass and cement is formed, and that is used to pave an area, the *Valentini* and *Ramsey* [combination] render[s] this limitation obvious.” MTA Opp. 16–17. Petitioner points to the same disclosure of the prior art as disclosing the respective limitation of proposed substitute claims 21 and 22. *Id.* at 19–22. Petitioner also provides a reason with rational underpinning as to why a person of ordinary skill in the art would have combined Ramsey and Valentini as asserted. *Id.* at 13–15; *see KSR Int’l Co. v. Teleflex Inc.*, 550 U.S. 398, 418 (2007). In particular, because Valentini does not provide details about creating foamed glass or what type of binder would be used with the foamed glass, Ramsey’s teachings would naturally inform skilled artisans “that foamed glass aggregate and Portland cement can be used to create a composite material.” MTA Opp. 14 (citing Ex. 1011 ¶ 13). Petitioner supports that the claimed arrangement is a predictable use of known elements.

Accordingly, we conclude that the proposed substitute claims would have been obvious over Ramsey and Valentini.

We note that Petitioner argues that proposed substitute claim 21 does not respond to a ground of unpatentability because “[t]he admixture formed in claim 4 by ‘introducing a structural matrix material to plurality of foamed glass aggregate bodies’ necessarily results in foamed glass aggregate bodies suspended in a matrix of structural matrix material,” so the limitation added in proposed substitute claim 21 “does not alter the scope as compared to Claim 4 at all.” MTA Opp. 4. Above, we apply 37 C.F.R. § 42.121(a)(2) to the motion as a whole and therefore determine proposed substitute claims 20 and 22 satisfy the regulation. *See supra* at 29. We agree with Petitioner, however, that the added limitation “wherein the arrestor bed defines respective foamed glass aggregate bodies suspended in a matrix of structural matrix material” in proposed substitute claim 21 does not narrow the claim scope because claim 4 already requires “introducing a structural matrix material to plurality of foamed glass aggregate bodies to define an admixture.” MTA 19, 22 (claims appendix); *see* MTA Opp. 4. An admixture of structural matrix material and foamed glass aggregate bodies already results in foamed glass aggregate bodies suspended in a matrix of structural matrix material, as recited in proposed substitute claim 21. Because proposed substitute claim 21 recites the same claim scope as original claim 4, which it would replace, the proposed substitute claim would also be unpatentable over the prior art for the same reasons as the original claim.

IV. CONCLUSION¹⁷

In summary:

Claims	35 U.S.C. §	Reference(s)/Basis	Claims Shown Unpatentable	Claims Not Shown Unpatentable
1–19	103	ACRP	1–19	
5, 12	103	ACRP, Narmo	5, 12	
13	103	ACRP, Hojaji	13	
5, 13, 18	103	ACRP, Narmo, Ramsey	5, 13, 18	
1–19	103	Anglely, Hojaji	1–19	
1–19	103	Anglely, Hojaji, Schirtzinger	1–19	
Overall Outcome			1–19	

Revised Motion to Amend Outcome	Claims
Original Claims Cancelled by Amendment	
Substitute Claims Proposed in the Amendment	20–22
Substitute Claims: Motion to Amend Granted	
Substitute Claims: Motion to Amend Denied	20–22
Substitute Claims: Not Reached	

¹⁷ Should Patent Owner wish to pursue amendment of the challenged claims in a reissue or reexamination proceeding subsequent to the issuance of this decision, we draw Patent Owner’s attention to the April 2019 *Notice Regarding Options for Amendments by Patent Owner Through Reissue or Reexamination During a Pending AIA Trial Proceeding*. See 84 Fed. Reg. 16,654 (Apr. 22, 2019). If Patent Owner chooses to file a reissue application or a request for reexamination of the challenged patent, we remind Patent Owner of its continuing obligation to notify the Board of any such related matters in updated mandatory notices. See 37 C.F.R. § 42.8(a)(3), (b)(2).

V. ORDER

Upon consideration of the record, it is:

ORDERED that, claims 1–19 of the '246 patent are unpatentable;

FURTHER ORDERED that, Patent Owner's Contingent Motion to Amend is denied; and

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

IPR2019-01624
Patent 9,637,246 B2

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