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LASER SPALLATION TECHNOLOGIES, LLC

**IN THE UNITED STATES DISTRICT COURT
FOR THE CENTRAL DISTRICT OF CALIFORNIA
WESTERN DIVISION**

LASER SPALLATION
TECHNOLOGIES, LLC,
a California company

Plaintiff,

v.

THE BOEING COMPANY, a
Delaware corporation,

Defendant.

Case No. 2:23-cv-02294-AB-SK

**DECLARATION OF VIJAY GUPTA
IN SUPPORT OF PLAINTIFF'S
RESPONSE TO DEFENDANT'S
MOTION TO DISMISS PLAINTIFF'S
SECOND AMENDED COMPLAINT**

Judge: Hon. André Birotte Jr.

Date: February 2, 2024

Time: 10:00 a.m.

Courtroom: 7B

1 1. I, Vijay Gupta, Ph.D. declare as follows:

2 2. I submit this declaration in support of the Response of Laser Spallation
3 Technologies, LLC (“LST”) to the Motion to Dismiss of The Boeing Company
4 (“Boeing”) in the above-captioned action. The facts stated herein are true based on my
5 own personal knowledge or knowledge obtained through my employment at UCLA,
6 conversations with other persons, and my review of personal records and records kept
7 as part of my employment by UCLA. If called upon to testify, I could and would
8 competently testify thereto.

9 3. I have reviewed: (1) LST’s Second Amended Complaint and supporting
10 exhibits and declarations, and (2) Boeing’s Motion to Dismiss and attached exhibits
11 and declarations (Dkt. 78 through 78-7).

12 4. I am currently a Full Tenured Professor of Mechanical and Aerospace
13 Engineering at the University of California Los Angeles (“UCLA”). I also hold
14 appointments as a Full Professor in the Materials Science and Engineering Department
15 and Biomedical Engineering Department at UCLA. I have a Ph.D. in Mechanical
16 Engineering and an M.S. in Structural Engineering, both from the Massachusetts
17 Institute of Technology (“MIT”). After finishing my Ph.D. in 1990, I joined the
18 faculty at Dartmouth College as an Assistant Professor and was promoted to the rank
19 of Full Professor, with tenure, at UCLA in 1995, directly from the Assistant Professor
20 rank, without undergoing the usual Associate Professor step. At age 31, I became the
21 youngest Full Professor with tenure in the United States, only 5 years after receiving
22 my Ph.D. degree.

23 In April 2018, I was given the status of “Distinguished Professor” by the
24 Regents of the University of California, which is the highest rank bestowed on a Full
25 Professor in the University of California System.

26 5. My research has covered a wide range of areas, including interface
27 science and engineering, composite materials, aircraft structures, applied mechanics,
28

1 fracture mechanics, mechanical engineering design, manufacturing, and
2 biomechanics—both experimentally as well as through mechanistic computer modeling.
3 I am widely acknowledged as the leading experimentalist in the field of solid
4 mechanics, notably in the areas of mechanical characterization of joints and interfaces,
5 and mechanical behavior and reliability of aerospace structures made using composite
6 materials, where I have made sustained and pioneering contributions. My research has
7 been widely disseminated in these areas, with over 150 papers published in leading
8 technical journals, conference proceedings and books. I have also given over 200
9 principal keynote lectures in governmental agencies, companies, and national and
10 international conferences and symposia in nearly all industrial countries. I also hold 4
11 United States Patents, with several others pending, with one widely used in the
12 semiconductor industry.

13 6. Measurement and control of the tensile strength of an interface or a joint
14 between two different materials is key to developing reliable components in a variety
15 of industries such as aircraft engines, paint, microelectronics, aerospace structures, and
16 civil construction. My group is best known for developing novel techniques to
17 measure the tensile strength of joints and interfaces. Notable among these is a laser
18 spallation experiment that uses a laser-generated stress wave to pry off an interface.
19 The work on this technique started as part of my Ph.D. thesis at MIT between 1985
20 and 1989, and a commercial version of this tool, with additional features, was
21 developed in 1992 during my tenure at Dartmouth College. This major development
22 in the field of adhesion science and technology was recognized by the U.S. Patent and
23 Trademark Office by granting a U.S. Patent No. 5,438,402 (“the ’402 Patent”). This
24 technique has been virtually used by all major semiconductor companies in the world
25 for characterization of adhesion in devices and packages. It has been transferred to or
26 used for product development in Intel Corporation, Texas Instruments, Hitachi,
27 Freescale Semiconductor, On Semiconductor, and Dow Corning Corporation. This
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1 technology has also been widely used in other industrial sectors, such as, in automobile
2 (Ford, GM, Delco), television (LG Gould), biomedical (Baxter Corporation), aircraft
3 engines (Pratt and Whitney, Westinghouse Corporation), paint (Du Pont, Boeing), and
4 Dentistry.

5 7. In the late 1990s, the aerospace industry had the need to test composite
6 joints which required higher stress wave amplitudes of the interrogating stress pulse in
7 the laser spallation tool. At the same time, the microelectronics industry was
8 manufacturing high density nanoscale chips and packages and needed to test the
9 adhesion properties in such nanoscale structures.

10 8. I recognized these needs in the industry, and I worked to develop a
11 method and apparatus that modified the stress wave profiles of the '402 patent by
12 using a glass element that resulted in sharper stress wave profiles and much higher
13 interface stress amplitudes as needed to test nanoscale structures and composite joints,
14 especially those between thicker composite sections.

15 9. I collaborated with Vassilli Kireev on these subjects, and our work led to
16 the issuance of U.S. Patent No. 7,487,684 ("the '684 Patent"), which is directed to an
17 apparatus and method for propagating a stress wave to the coating/substrate interface
18 to generate a tensile stress between the substrate and the coating.

19 10. The mathematical calculations, stress analyses, and related testing
20 activities of Boeing that were identified in LST's Second Amended Complaint are not
21 "precursor" calculations or merely "integrally connected" to the infringement. Rather,
22 they are, by themselves, infringing acts. They read on one or more of the claims of the
23 '684 Patent because the mathematical work done by Boeing's engineers is not merely a
24 precursor, but is required to practically perform the method claimed in the '684 Patent.
25 I described this in detail in my declaration in support of the Second Amended
26 Complaint. *See* Dkt. 75 at ¶¶ 46-53.

11. Even if Boeing itself does not perform all of the acts needed to infringe one of more of the claims of the '684 Patent, Boeing is performing the essential steps of its mathematical calculations, stress analyses and testing activities, thereby supplying this critical information to the other entity or entities that are completing the infringement.

12. On or about November 22, 2021, I had a meeting with Mr. Edward Beres of UCLA's Technology Development Group, and Mr. Marc Piehl of Boeing, where we discussed the '684 Patent. The entire purpose of the meeting was in fact to discuss the '684 technology and to answer any technical questions that Boeing's engineers may have with regards to the '684 technology. Shortly before the meeting, email messages were exchanged between Mr. Beres and Mr. Piehl where information about the '684 Patent was shared via a link. A snapshot from this email exchange is reproduced below. Therefore, the statement in Mr. Piehl's declaration where he states that he was not aware of the '684 Patent is untrue.

From: Beres, Edward [<mailto:edward.beres@tdg.ucla.edu>]
Sent: Tuesday, October 19, 2021 10:44 AM
To: Piehl (US), Marc J <Marc.J.Piehl@boeing.com>
Cc: Hatakeyama (US), Jason <jason.hatakeyama@boeing.com>; Magid, Helen <hmagid@support.ucla.edu>
Subject: [EXTERNAL] RE: UCLA new technology and possible Boeing interest (2003-126)

EXT email: be mindful of links/attachments.

Thank you for the introduction, Helen.

Marc – I'm glad to have the opportunity to connect with you. The technology that Helen mentioned is described on our [website](#), which includes a link at the bottom of the page to the patent that describes it in more detail. I think it would be most helpful for you to speak with the inventor, Prof. Vijay Gupta. If you'll provide a few times when you'd have 30 minutes or so for a discussion with him, I'd be glad to set up a call or video conference.

Thanks for your interest in UCLA technologies. I'm looking forward to helping you explore this opportunity.

Ed Beres
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UCLA Technology Development Group
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Los Angeles, CA 90095-7191
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1 13. During the 2021 presentation that I gave to Boeing, I know that the '684
2 Patent was specifically mentioned because I recall mentioning it, and most
3 importantly, the entire purpose of the meeting was to discuss the '684 Patent! I made a
4 presentation, which discussed the '684 Patent technology.

5 14. I have read the declaration of Mr. Richard Bossi. On paragraph 14 of his
6 declaration, he states that "Until learning of this lawsuit, I was unaware of U.S. Patent
7 No. 7, 487, 684." This cannot be true. Mr. Bossi is the named inventor on U.S. Patent
8 No. 8,714,016 that was issued on May 6, 2014. The very face of Mr. Bossi's '016
9 patent cites my '684 patent. In my experience of obtaining several U.S. patents, it is
10 routine for the inventors to distinguish their works by reading cited prior art and that is
11 the basis on which they seek to obtain a patent for their inventions.

12 15. In fact, Mr. Richard Bossi was aware of the '684 technology much before
13 that. I discussed the glass element during our meeting as he was seeking to enhance the
14 tensile stress at the composite joints, with limited laser power, I explained to him how
15 this could be done with the work that was ongoing in our lab at UCLA notably, by
16 using the glass element.

17 16. In paragraph 13 of his declaration. Mr. Bossi claims that his 2008 FAA
18 JAMS presentation was not associated with any laser bond inspection technology
19 effort and contained no reference to it. Page 9 of his presentation is entitled: "Focus on
20 certification of bonded composite structure-Bond design, Manufacture, In-service
21 issues and QA/NDE." It is well known that certification of bonded composite
22 structure at Boeing is performed by using the Laser Bond Inspection technique. In an
23 article published in CompositesWorld on 2/8/2022, entitled Laser bondline inspection
24 becomes a reality, and authored by Jeff Sloan, Mr. Marc Piehl, the same Boeing
25 employee referenced above, is cited where he claims that LBI is how Boeing develops
26 all certifications: "When you step back and look at LBI," he says, "it's truly the Holy
27 Grail of bonding because once you bond things together, you are relying on process
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1 control to ensure a good bond. That's how we developed all of our certifications, and
2 then we use damage arrestment on top of that, to show that we can stop any damage
3 that occurs. So, LBI is the ultimate in process control because it proof tests parts at the
4 end of the process and picks up problems immediately. It gives us a leg up on
5 increasing the design space and increasing the reliability of bonded structures as we
6 move forward." Mr. Piehl is further cited in the same article with regards to readiness
7 of the LBI technology, which I quote- "Storage and Piehl report that LBI has been
8 matured to a TRL of 6-7 and that it can and should be considered right now for use in a
9 production environment. Piehl notes that Boeing has invested heavily in proving the
10 viability of LBI and has developed significant intellectual property around the
11 technology." This directly contradicts the statement made by Mr. Thai Nguyen, who
12 on paragraph 14 of his declaration claims that LBI technology is not ready for use. It
13 is noteworthy that Mr. Piehl is directly involved with the development of LBI
14 technology within Boeing and Mr. Nguyen is not.

15 17. Based on my discussions with Boeing personnel, I believe that Richard
16 Bossi, and Marc Piehl knew of the '684 Patent technology as early as 2004, yet Boeing
17 has performed activities and continues to perform activities that read on the claims of
18 the later issued '684 Patent.

19 18. In its Motion to Dismiss, Boeing argues that LST's theories are
20 inconsistent regarding how the "glass element" limitation is met by Boeing's activities.
21 However, LST's theories are well-supported and consistent because each of the
22 materials identified by LST as a "glass element" functions as required by the claims of
23 the '684 to be a "glass element." In particular, the language of the '684 Patent
24 describes the "glass element" as "disposed on the second side of the substrate and
25 axially spaced along the first axis" and "configured to propagate a stress wave to the
26 coating/substrate interface to generate a tensile force between the substrate and the
27 coating," and it "may comprise Pyrex, soda lime, quartz, borosilicate or similar
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1 material.” This description is met by Boeing’s activities because Boeing uses
2 materials similar to these to propagate a stress wave to the coating/substrate interface
3 to generate a tensile force between the substrate and the coating.

4 19. In its Motion, Boeing focuses on “Boeing’s use of the LBID.” However,
5 in my declaration in support of the Second Amended Complaint, I made clear that
6 Boeing’s infringing activity is not limited to Boeing’s use of “the LBID,” but includes
7 the mathematical work and calculations essential to the method claims of the ’684
8 Patent. *See* Dkt. 75 at ¶¶ 46-53.

9 20. Contrary to Mr. Bossi’s statements, he told me that he travelled to
10 California to participate in laser bond inspection projects. Without him having to tell
11 me, I know that he travelled to California to participate in such projects because he
12 told me that the wave mechanics simulation which was presented in his 2004 Society
13 for the Advancement of Material and Process Engineering (SAMPE) paper was
14 conducted by the engineers and software developed in the Huntington Beach facilities.
15 He had also mentioned that the ongoing laser ultrasound work at these facilities
16 provided him insights that are needed for developing Boeing’s LBI method. *See* Dkt.
17 75 at ¶ 41.

18 21. Boeing’s U.S. Patent No. 9,784,668, if practiced by Boeing, meets all of
19 the claim elements of at least one claim of the ’684 Patent because it describes a
20 method for testing bonds by directing a tensile pulse into a test object where the
21 internal bond to be tested is located, just as described in Claim 13 of the ’684 Patent.

22 22. Boeing’s ’433 patent describes the use of “glassy materials,” like
23 “acrylic,” “polycarbonate,” “quartz” and “sapphire” that meet the “glass element” term
24 of the ’684 Patent because each of these materials is “disposed on the second side of
25 the substrate and axially spaced along the first axis,” is “configured to propagate a
26 stress wave to the coating/substrate interface to generate a tensile force between the
27 substrate and the coating,” and is a “similar material” to Pyrex, soda lime, quartz, or
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1 borosilicate, as described by the '684 Patent, which modifies the stress wave profile in
2 a manner that ultimately enhances the tensile stress at the test interface.

3 23. Similarly, the “thermochromatic energy-absorbing material” recited in
4 Boeing’s ‘670 patent meets the “glass element” term of the ‘684 Patent because the
5 material is “disposed on the second side of the substrate and axially spaced along the
6 first axis,” is “configured to propagate a stress wave to the coating/substrate interface
7 to generate a tensile force between the substrate and the coating,” and is a “similar
8 material” to Pyrex, soda lime, quartz, or borosilicate, as described by the ‘684 Patent,
9 which modifies the stress wave profile in a manner that ultimately enhances the tensile
10 stress at the test interface.

11 24. I have read the declaration of Dr. Andrea Koumvakalis, who is the named
12 inventor on Boeing’s ‘155 patent, along with Anthony Kay and Alan Stewart. Dr.
13 Koumvakalis acknowledges that she along with Anthony Kay worked on this
14 technology from their offices and laboratories located in Southern California. On
15 paragraph 10 of her declaration she states that,

16
17 “Before being asked to sign this declaration, I had no knowledge of “laser bond
18 inspection” or laser bond inspection tools or devices or that Boeing did anything
19 relating to these topics. Needless to say, I have never been involved in Boeing’s work
20 on these topics and am not aware of any Boeing employees in California who were.”
21

22 This statement cannot be true as Dr. Andrea Koumvakalis signed another sworn
23 statement while filing her ‘155 patent acknowledging that she had read the patent
24 application and the claimed technology represented her work. I cite from the ‘155
25 patent below:

26 Column 12, ll. 37-44: “The confinement of the energy assists in more efficiently
27 producing a shockwave that induces structural changes in the workpiece, such as
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1 imparting compressive residual stresses within the workpiece. According to yet some
2 implementations, the workpiece is made from a composite material and the laser
3 processing system is used to inspect the workpiece.”
4

5 Column 4, ll.66-Col. 5, ll. 3: “Similarly, in certain implementations, depending on the
6 characteristics of the combined laser beam pulse 124, inspecting the workpiece 120
7 can include generating a shockwave through the workpiece such as for a laser bond
8 inspection process.”
9

10 The ‘155 patent uses the exact same words-Laser bond inspection-which Dr.
11 Koumvakalis in her current declaration claims that she had no knowledge of before
12 signing her declaration !

13 25. I have independently analyzed the technology claimed and described in
14 the ‘155 patent and have concluded that it infringes the ’684 Patent, and is not merely
15 “integrally connected” to the ’684 Patent, because the intensity, duration and spatial
16 profile of the laser pulse employed in the ’155 Patent depend upon the details of the
17 part to be inspected, including its geometry, material, and most importantly, the depth
18 at which the test joint is located. These features control the wave scattering losses that
19 ultimately must be accounted for in the design of the initial laser pulse that generates
20 the compressive stress wave at the surface of the workpiece being inspected.

21 Accordingly, after a range of such structures have been analyzed for losses, the
22 controllers claimed in the ’155 Patent can be designed. Thus, Boeing practicing the
23 technology of the ’155 Patent would likely infringe one or more claims of the '684
24 Patent.

25 26. In summary, by her own declaration, Dr. Koumvakalis acknowledges she
26 worked on the ‘155 technology along with Anthony Kay from Boeing’s Southern
27 California offices and laboratories. Based on ‘155 specification that work relates to
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1 laser bond inspection method. My independent analysis confirms that the '155
2 technology infringes at least one method claim of the '684 patent.

3 27. I have read the declaration of Thai Nguyen. In paragraph 6 of his
4 declaration, he describes the job duties of a customer support airframe structural
5 analysis engineer. When a Boeing aircraft sustains damage to its structure, the engineer
6 analyzes the damage as reported by the customer and determines the nature and extent
7 of any repairs Boeing or the customer may need to conduct. Most structural damage in
8 an airframe made using composite materials is in the form of delamination or
9 separation between composite plies or at joints as those are the areas where the highest
10 stresses are concentrated. The repairs suggested by Boeing's engineers are to either
11 replace that part using a joint with adequate strength or use of an epoxy material that
12 would restore the joint to its original design strength. Boeing, by its own admission,
13 has carried out thousands of laser spallation tests by using the Laser Bond Inspection
14 tool that is based on the '684 technology and has already determined the design joint
15 strength and the type of epoxy that would be needed to restore the damaged joint to its
16 original strength. Regardless of where such LBID tests were performed, the fact
17 remains that Boeing's customer support airframe structural analysis engineer is using
18 information that was obtained by infringing the '684 patent to support Boeing's
19 customers from its Southern California Offices.

1
2 I declare under penalty of perjury under the laws of the United States of
3 America that the foregoing facts are true and correct, based on my knowledge,
4 understanding, information, and belief.

5
6 Dated: 1/5/2024

7
8 By: 
9 Vijay Gupta