

IN THE UNITED STATES DISTRICT COURT
FOR THE DISTRICT OF MINNESOTA

Case No. 1:23-cv-01194-JFM

DUESENFELD GmbH,
Plaintiff,
vs.
ASCEND ELEMENTS, INC.,
Defendant.

REMOTE VIDEOTAPED DEPOSITION OF
WALTER VAN SCHALKWIJK, PhD

DATE: February 6, 2025
TIME: 9:10 a.m. (Eastern)
PLACE: Veritext Virtual Videoconference

Reported By: Christine K. Herman, RPR, CRR
Job #7139923

Page 2 1 A P P E A R A N C E S 2 (all appearing remotely via Zoom) 3 4 ON BEHALF OF THE PLAINTIFF: 5 ROBINS KAPLAN LLP 6 By: Samuel J. LaRoque, Esq. 7 Bryan J. Mechell, Esq. 8 800 LaSalle Avenue, Suite 2800 9 Minneapolis, MN 55402 10 slaroque@robinskaplan.com 11 bmechell@robinskaplan.com 12 612-349-8500 13 14 ON BEHALF OF THE DEFENDANT: 15 GISH PLLC 16 By: Josef Schenker, Esq. 17 Conor McDonough, Esq. 18 41 Madison Avenue, Floor 31 19 New York NY 10010 20 josef.schenker@gishpllc.com 21 conor.mcdonough@gishpllc.com 22 212-518-2000 23 ALSO PRESENT: 24 Vani Dantam 25 Dave Young - Videographer	Page 4 1 P R O C E E D I N G S 2 3 THE VIDEOGRAPHER: Good morning. 4 We're going on the record at 8:22 a.m. on 5 February 6, 2025. 6 Please note this deposition is being 7 conducted virtually. Quality of recording 8 depends on the quality of camera and Internet 9 connection of participants. What is seen from 10 the witness and heard on the screen is what will 11 be recorded. Audio and video recording will 12 continue to take place unless all parties agree 13 to go off the record. 14 This is Media Unit 1 of the 15 video-recorded deposition of Walter 16 van Schalkwijk, taken by -- taken in the matter 17 of Duesenfeld GmbH vs. Ascend Elements, 18 Incorporated. 19 My name is Dave Young. I'm the 20 videographer. Our court reporter is Christine 21 Herman. We are both representing Veritext Legal 22 Solutions. 23 I am not related to any party in this 24 action, nor am I financially interested in the 25 outcome.
Page 3 1 INDEX: 2 3 PAGE: 4 WITNESS: WALTER VAN SCHALKWIJK 5 Examination by Mr. LaRoque 6 6 7 8 EXHIBITS MARKED: 9 EXHIBIT 2025 51 10 Graph of Water boiling point as function 11 of absolute pressure 12 PREVIOUSLY MARKED EXHIBITS REFERENCED: 13 EXHIBIT 1003 12 14 EXHIBIT 1006 91 15 EXHIBIT 1010 78 16 EXHIBIT 1011 24 17 18 19 Certificate of Court Reporter 115 20 Certificate of Witness 117 21 22 REPORTER'S NOTE: All quotations from exhibits 23 are reflected in the manner in which they were 24 read into the record and do not necessarily 25 indicate an exact quote from the document.	Page 5 1 If there are any objections to this 2 proceeding, please state them at the time of 3 your appearance. 4 Will counsel now state their 5 appearances and affiliations for the record, 6 beginning with the noticing attorney. 7 MR. LaROQUE: Sam LaRoque, on behalf 8 of the patent owner, Duesenfeld GmbH. With me 9 is Bryan Mechell, appearing on the Zoom, from my 10 law firm, Robins Kaplan; and also Vani Dantam, 11 who's an expert retained by the patent owner in 12 this proceeding. 13 MR. SCHENKER: For Ascend Elements, 14 petitioner, this is Josef Schenker, from 15 Gish PLLC. With me is Conor McDonough, from 16 Gish PLLC. 17 THE VIDEOGRAPHER: And will the court 18 reporter please swear in the witness, and then 19 we can proceed. 20 Whereupon, 21 WALTER VAN SCHALKWIJK, PhD, 22 a witness in the above-entitled matter, 23 after having been first duly sworn, 24 deposes and says as follows: 25 EXAMINATION

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Page 6 1 BY MR. LaROQUE: 2 Q Good morning, sir. 3 A Good morning. 4 Q Can you state your full name for the 5 record, please? 6 A Walter Arthur van Schalkwijk. 7 Q Thank you, Dr. van Schalkwijk. 8 And where are you this morning? 9 A I am in the offices of Gish. 10 Q And where are those offices located? 11 A On Madison Avenue in New York. 12 Q And is Mr. Schenker in the room with 13 you? 14 A He is. 15 Q Is anyone else in the room with you? 16 A I've got to look past some others. 17 No. 18 Q All right. Dr. van Schalkwijk, are 19 you currently employed? 20 A Self-employed, through my consulting 21 company, Battery Sciences, LLC. 22 Q All right. And have you ever been 23 deposed before? 24 A Yes. 25 Q How many times have you been deposed?	Page 8 1 A Understood. 2 Q -- verbal answers. Got it? 3 A Got it. 4 Q All right. 5 From time to time your counsel may 6 object. Those objections are just placeholders 7 for the record. You still have to answer the 8 question, unless your counsel specifically 9 instructs you not to. 10 Do you understand that? 11 A I understand that. 12 Q And, Dr. van Schalkwijk, do you 13 understand that you're testifying under oath 14 today, under penalty of perjury? 15 A I do understand that. 16 Q We'll take a break probably about 17 every hour, but if you'd like a break more 18 often, you can feel free to ask. 19 A Okay. 20 Q The only thing I ask, if there is a 21 question pending, just answer the question 22 before taking a break. 23 Does that sound good? 24 A That's -- that's acceptable. 25 Q Good.
Page 7 1 A I'm going to say about 15, sometimes 2 multiple on one matter. But somewhere in the 3 vicinity of 15 times I've been deposed. 4 Q Were those all matters relating to 5 patent cases? 6 A Most of them. Almost all. 7 Q Okay. I'm going to go over the ground 8 rules again, at a high level, just so -- so that 9 we're clear. Is that all right? 10 A (Witness nods head.) 11 Q So I'm, obviously, going to ask you 12 some questions today. If you don't understand a 13 question that I ask you, please tell me, and I 14 will try to rephrase it. All right? 15 A Sure. 16 Q And unless you tell me otherwise, I 17 will assume that you did understand my question. 18 Sound good? 19 A Great. Thanks. 20 Q Your answers are being recorded by the 21 court reporter, so please try to speak up and 22 give verbal answers so that the court reporter 23 can hear you clearly. If you nod or shake your 24 head, that won't appear in the record, so we 25 need --	Page 9 1 Dr. van Schalkwijk, did you do 2 anything to prepare for your deposition today? 3 A I have seen the exhibits, and I've 4 gone through my expert testimony document, my -- 5 my expert report. I've gone through the reports 6 written by the expert on the other side, Vani 7 Dantam. I've gone -- I've read a lot of the 8 other materials: The Court ruling, the 9 petition, the patent holders' response. And, 10 once again, you know, because it's been quite a 11 few months, I went through the background 12 materials of everything we cited -- that I cited 13 in the writing. 14 Q Did you speak with anyone in 15 preparation for your deposition today? 16 A I had a session with Josef, where we 17 looked at the material. 18 MR. SCHENKER: I'm going to counsel 19 the witness to answer who you met with, and you 20 can answer how long you met, and so on, but the 21 subject matter, what we discussed, is 22 privileged. 23 A Did you hear that? 24 Q. (BY MR. LaROQUE) I did hear that, yes. 25 A Okay.

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Page 10 1 I met with Josef for pretty much the 2 business hours of yesterday and the day before. 3 Q Did you meet with anyone else? 4 A No. 5 Q And, Dr. van Schalkwijk, just so I'm 6 clear, you said you do have a paper copy of your 7 declaration, Exhibit 1003, with you today? 8 A I do. 9 I'd like to correct my previous 10 answer. 11 In the room with me, I have Josef 12 going through the preparation online. I had 13 Conor McDonough as well. 14 Q Understood. Thank you. 15 Dr. van Schalkwijk, what is your 16 billable rate for the work that you're doing on 17 this matter? 18 A I believe that I'm billing at \$700 an 19 hour, and that's marked up by the agency that 20 had found me and contracted me for this work. 21 Q Understood. 22 And your declaration, Exhibit 1003 in 23 this case, did you draft that declaration 24 yourself? 25 A I did. The contents -- the legal	Page 12 1 A So where am I going to find this now? 2 Q Well, it should be coming up. It 3 should now in the Marked Exhibits folder. 4 Do you see it there? 5 (Previously Marked Deposition Exhibit 6 Number 1003 introduced.) 7 A Yes. I see it. It says, A new marked 8 exhibit has been introduced. So I'm going to 9 View exhibit, and there it is. Adjust the 10 resolution so it's a nice, big font for me. 11 Thank you very much. I have it. 12 Q And -- I'm sorry. Just for the 13 record, the naming here is a little bit 14 confusing, because it says 15 Exhibit 0001-Exhibit 1003, because I'm having 16 some issues with the stamping. But let's 17 just -- for the record, this is already in the 18 record as Exhibit 1003. And I'll refer to it as 19 such. 20 A Okay. 21 Q So if you can turn, 22 Dr. Van Schalkwijk, to page 3 of this exhibit. 23 A Okay. 24 Q Do you see, at the bottom, it says 25 Materials Reviewed?
Page 11 1 format was assisted, obviously, by the 2 attorneys, but the -- the technical matter was 3 all written by me. 4 Q And you've adopted everything in that 5 declaration as your own, correct? 6 A Yes. 7 Q Do you recall about how many hours you 8 spent drafting that declaration? 9 A Oh, boy. This was, like, nine months 10 ago. I'd have to look at the invoices, and then 11 I could tell you. I'm going to say that it was 12 somewhere in the vicinity of 30 hours. 13 Q Understood. 14 And, Dr. van Schalkwijk, if you have 15 Exhibit 1003 with you, could you turn to page 3, 16 please? 17 A Have we done the share yet? 18 Q Well, I've got the link set up, if you 19 want to share it that way. 20 A Sure. Let's see if we can do that. 21 Q Yeah. I'm happy to put it in. 22 A Having it up on my screen means I 23 don't have to shift back and forth with my 24 reading glasses. 25 Q Sure. Understood.	Page 13 1 A Yes. 2 Q And over page 3 and onto page 4, 3 there's a List of Materials there? 4 A Yes. 5 Q And you reviewed all of those 6 materials that are cited in this list, correct? 7 A I have. 8 Q All right. Thank you. 9 If you can go to the next page, sir, 10 page 5, and do you see at paragraph 15 -- 11 A I do. 12 Q -- it says, In my opinion, a POSITA in 13 the field of the '097 patent would have had at 14 least a master's degree in chemical engineering, 15 mechanical engineering, materials 16 science/engineering, or a related field, and 17 three to five years of experience in design and 18 implementation of battery recycling processes. 19 Do you see that? 20 A I do. 21 Q And that is the definition for a 22 person of ordinary skill in the art that you 23 adopted in your declaration, correct? 24 A It is. 25 Q And you're aware that the board

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Page 14 1 disagreed with your definition in its decision 2 to institute this IPR review? 3 A I am aware of that. 4 Q And you're aware that the board 5 adopted the patent owner's position, that a 6 person of ordinary skill would have had at least 7 a bachelor's degree in electrical engineering, 8 materials science, chemical engineering, or an 9 equivalent field, as well as at least two to 10 three years of academic or industry experience 11 in the recycling or processing of lithium-ion 12 batteries? 13 A Yes. I'm aware of the difference 14 between what I put and what the expert from the 15 other side and from what the board has said is 16 more proper. 17 Q All right. But you haven't changed 18 your opinion since you wrote your declaration; 19 is that right? 20 A Actually, in discussion, I offered 21 that the education system in Germany is a lot 22 different than the education system in the 23 United States, which was kind of, like, my 24 focus. And there's -- there's a lot of very 25 good technical education at Fraunhofer	Page 16 1 uses the term drying to mean the removal of at 2 least one solvent in the conducting salts. I 3 have applied this definition of drying in my 4 analysis? 5 A Yes. I see that. 6 Q And that's still your understanding of 7 the definition of the term drying? 8 A That is the patentee can act as their 9 own lexicographer in drying his -- a term -- 10 (Reporter clarification.) 11 A I accepted that definition of drying 12 in my analysis, because it is an active -- it's 13 an active verb, drying. And having removed at 14 least one solvent during the process of removing 15 material and drying the material by removing 16 solvent. So that is drying. And so I accept 17 that as the definition. 18 Q Okay. That is the definition that you 19 used? 20 A Yes. 21 Q Understood. 22 Let's go to the next page, page 8. 23 And if you go down to paragraph 25 at the bottom 24 of the page there, do you see that? 25 A Yes.
Page 15 1 Institutes and various other institutions in 2 Germany, where people get a very solid 3 education -- even without a degree, a very good 4 technical education that prepares them for jobs. 5 And we really don't have that same 6 structure here in the United States. This is 7 why I put down master's degree and the amount of 8 experience; the structure of education in 9 Germany is different. 10 So I'm willing to adopt something that 11 was a little bit different than what I have 12 here. 13 Q Have you set that definition out 14 anywhere? 15 A I have not. Just in discussion. 16 Q Okay. I understand. 17 If you turn ahead to paragraph 20, 18 which is on the next page of your report, 19 page 6. 20 A Yes. 21 Q And, actually, let's look at the next 22 page, which is still paragraph 20, but at the 23 top of page 7. 24 Do you see, in the middle of that 25 first full paragraph, it says, The '097 patent	Page 17 1 Q All right. And you say, I've been 2 informed that a patent claim composed of several 3 limitations is not obvious merely because each 4 limitation was independently known in the prior 5 art. 6 You see that? 7 A Yes. 8 Q And then you say, Hindsight reasoning 9 is not an appropriate basis for combining 10 references to form an obviousness combination. 11 You see that? 12 A I see that. 13 Q And then you say, I have been further 14 informed that it can be important to identify a 15 reason that would have prompted a POSITA to 16 combine multiple prior art references or 17 multiple teachings of the same prior art 18 reference. 19 Do you see that? 20 A Yes. 21 Q And so you understood all of these 22 things as you were preparing your declaration, 23 correct? 24 A Yes. 25 Q Let's go to the next paragraph, 26.

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Page 18 1 You say you've been informed that 2 various secondary considerations may support a 3 determination of nonobviousness, and that such 4 secondary considerations must be considered as 5 part of an obviousness analysis. 6 Do you see that in the first sentence 7 there? 8 A I see that. 9 Q And then down below, you have a 10 listing of these secondary considerations. 11 Correct? 12 A Yes. 13 Q So, A, you wrote, Evidence that 14 others, including the accused infringer, copied 15 the patented invention. 16 Right? 17 A I see that. 18 Q You see, B, Evidence of a persistent 19 problem or need in the art that was resolved by 20 the patented invention? 21 A I see that. 22 Q You see, C, Evidence that others have 23 tried and failed to solve the -- to solve the 24 problem or failed to provide the need resolved 25 by the claimed invention?	Page 20 1 Q Paragraph 67. 2 A Sixty-seven. Okay. I'm there. 3 Q And do you see it says, The risks 4 associated with recycling lithium-ion batteries 5 have also been long-known in the art. For 6 example, it has been known that LiPF₆, a 7 commonly used electrolyte in lithium-ion 8 batteries, can undergo hydrolysis in the 9 presence of water to form hydrogen fluoride, 10 which is toxic. 11 Do you see that? 12 A Yes. 13 Q So you say that it was a well-known 14 problem in the art that LiPF₆, a commonly used 15 electrolyte in lithium-ion batteries, can 16 undergo hydrolysis in the presence of water to 17 form hydrogen fluoride, which is toxic, right? 18 A That's correct. 19 MR. SCHENKER: Form. 20 A Let me also correct, because I wrote 21 this, LiPF₆ is a commonly used salt in the 22 electrolyte. 23 Q. (BY MR. LaROQUE) Okay. Thank you. 24 But, specifically, you said, for 25 example, it has been known, right?
Page 19 1 A I see that. 2 Q And you see, D, The willingness of 3 industry to license the patent at issue? 4 A I see that. 5 Q You see, E, Evidence that those of 6 ordinary skill in the art were skeptical as to 7 the merits of the invention? 8 A I see that. 9 Q And do you see, F, Evidence of praise 10 directed to the invention by others in the 11 field? 12 A I see that. 13 Q And you see, G, Evidence that those of 14 ordinary skill in the art were surprised by the 15 capabilities of the claimed invention? 16 A And I see that. 17 Q And you have no reason to disagree 18 with -- with these instructions that you 19 received, correct? 20 A I have no reason to disagree with 21 that. 22 Q I'd like to turn now to paragraph 67 23 of your declaration, which is at page 21. 24 Let me know when you're there. 25 A Are we on 61?	Page 21 1 A Yes. 2 Q So this is just one example of a risk? 3 A It is. 4 Q And I was wondering, can you tell me, 5 what are other examples of risks that are 6 associated with recycling lithium-ion batteries? 7 A There's the risk -- 8 MR. SCHENKER: Objection. Form. 9 You can answer. 10 A There is the risk of flammability from 11 the solvents that are used in the electrolyte to 12 dissolve the LiPF₆. They are volatile. They're 13 flammable, as they say here. 14 And if the material -- the anode and 15 cathode material, which, in this case, would be 16 graphite and a transition metal oxide, were not 17 deactivated or inactivated -- I think I use 18 those terms equally -- then you could have a 19 situation where an uncontrolled reaction could 20 occur. Some would call it a runaway, a thermal 21 runaway. But in any case, it would be leading 22 to -- could lead to explosion or fire and the 23 release of the other chemicals, like HF, 24 hydrogen fluoride. 25 Q. (BY MR. LaROQUE) Are there any other

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Page 22 1 risks? 2 MR. SCHENKER: Objection. Form. 3 A Well, the aforementioned toxicity. 4 And most of these materials are toxic, to one 5 degree or another, HF being probably the worst. 6 There would also be the formation of 7 POF3 from the decomposition of the salt, which 8 is a neurotoxin. 9 Q (BY MR. LaROQUE) And how would that 10 neurotoxin POF3 be formed in this process? 11 A If moisture -- water were allowed to 12 react with the LiPF6, or if the LiPF6 were 13 heated to a temperature of sufficiently high 14 temperature. 15 Q Are there any other risks that you're 16 aware of in -- in this process of recycling 17 lithium-ion batteries? 18 A At the early stage, before the 19 comminution of the battery, when it's still a 20 whole cell, you would have to make sure it's 21 been not totally deactivated, but reduced in 22 capacity by having the battery at a very low 23 voltage, before crushing it and putting it open. 24 Otherwise, there would be the risk of -- again, 25 the risk of fire and release of chemicals.	Page 24 1 something to happen. It could safely be handled 2 in the low-energy state by discharging it before 3 the comminution procedure. 4 Q All right. I understand. 5 I'm going to introduce another 6 exhibit. And give me just a moment. Let me try 7 stamping it differently this time and see if I 8 can clear up this issue. 9 A Okay. 10 Q All right. I think that worked a 11 little bit better. 12 (Previously Marked Deposition Exhibit 13 Number 1011 introduced.) 14 Q. (BY MR. LaROQUE) Do you see now 15 another exhibit in -- in the shared folder, 16 Exhibit 1011? 17 A Well, from where I was, I hit the Back 18 button, and then it went to a place where it 19 says there's nothing there. 20 Q So it should be in -- in that Marked 21 Exhibits folder. 22 A Yeah. Up in the upper right-hand 23 corner of the Veritext, I see a bell with a red 24 light on, so I clicked on that, and Exhibit 1011 25 looks like it has been introduced.
Page 23 1 Q I see. So you mentioned just now, you 2 would want to reduce the -- 3 A Voltage level of the battery to -- 4 essentially down to 0. 5 Q Down to 0. Prior to comminution, I 6 think you said? 7 A Yes. 8 Q But even if you did that, there would 9 still be these other risks that you mentioned, 10 such as the toxicity associated with hydrogen 11 fluoride, right? 12 A Yes. 13 Q Also the formation of this POF3, this 14 neurotoxin? 15 A Yes. 16 Q And also this risk of flammability or 17 a thermal runaway explosion? 18 A All of those risks would remain, 19 because the battery, even though you have 20 discharged it all the way, could still be 21 recharged, inadvertently, or by just recovery of 22 the voltage, which could occur naturally as 23 well. 24 So the battery is still armed, I guess 25 you would say, with all of the ingredients for	Page 25 1 Q Okay. That's the one. Let me know 2 when you have that up and you're able to view 3 it. 4 MR. SCHENKER: Seems like nothing is 5 loading on the -- 6 A Yeah. The dizzying circle is just 7 going round and round. 8 Q. (BY MR. LaROQUE) Mine was a little 9 slow, but it did eventually come up, so let's 10 give it just a moment. 11 A Well, the dizzying circle has stopped, 12 and it looks like the exhibit is loading. 13 And it's loaded. 14 Q Okay. 15 A Where should we go? 16 Q Well, let's go ahead to the second 17 page, which is the front page of the patent. 18 Do you see that? 19 A I see it on there. 20 Q And do you recognize this document? 21 A Yes, I do. 22 Q And what is this? 23 A This is a patent by somebody named 24 Meador, who lives in Texas. I don't see a 25 company affiliation. It's a patent from 1994,

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Page 26 1 which was, actually, early in the history of 2 lithium-ion batteries. And it is for a battery 3 hydrolysis process. 4 Q And I want to make clear for the 5 record that this document already has a stamp in 6 the footer, and it says, Ascend Elements 7 Exhibit 1011, because this was an exhibit to 8 Ascend's petition. 9 A Yes. 10 Q All right. Dr. Van Schalkwijk, if you 11 would turn, in this patent, this Meador patent, 12 to column 3. 13 A Okay. 14 Q I'd like you to look at -- it's always 15 a little tricky to line up the line numbers. 16 But I'd like you to look, starting at line -- 17 about line 16, it says, The process comprises 18 continually introducing previously crushed 19 batteries into a pyrolysis chamber and conveying 20 them by an auger through the pyrolysis chamber. 21 Do you see where it says that? 22 A I see that. 23 Q So this reference to continually 24 introducing previously crushed batteries into a 25 pyrolysis chamber suggests that this is a	Page 28 1 you -- back at the beginning, you fill another 2 bin, or whatever, with the raw material that 3 you're trying to recycle, and it goes through, 4 and then it is collected at the other end. 5 And you're doing this sort of by bin. 6 You're -- you're, for example, in this case, a 7 pyrolysis chamber, if -- it would probably be 8 something that has got the material moving 9 through it. But if it were a batch process, it 10 might be something shorter, that -- where the 11 material from that batch, the raw material bin, 12 goes into an oven, cooks, then moves to the next 13 step. 14 Q Are you aware of any advantages of 15 continuous processing for lithium-ion -- 16 I'm sorry. Strike that. 17 Are you aware of any advantages of 18 continuous processing in battery recycling as 19 compared with batch processing? 20 MR. SCHENKER: Objection. Form. 21 A Well, there are advantages and 22 disadvantages. 23 So the advantages are, you can have a 24 better expected throughput and, you know -- I 25 don't know if you would call it high speed, but
Page 27 1 continuous process that's being taught, right? 2 A That would be how I would interpret 3 it, yes. 4 Q And what -- what's your understanding 5 of a continuous process in this context? 6 A Feedstock goes in at one end, and the 7 resulting material, whether it be deactivated, 8 comminuted battery material or recovered 9 solvents, or whatever else they're trying to 10 recycle, it comes out at the end continuously, 11 maybe fed into some sort of a container 12 directly. But you are feeding in materials at 13 one end, it goes through the process here, the 14 pyrolysis that they are claiming, and then the 15 resultant material, after that pyrolysis, comes 16 out other end and is collected. 17 Q Are you familiar with the term batch 18 process in the context of recycling batteries? 19 A Yes. 20 Q Is that different from a continuous 21 process? 22 A That is a continuous -- that is a 23 process where you put in a certain amount of 24 material, put it through all of the processes, 25 get the resultant material at the end, and then	Page 29 1 in my experience, everything related to batch 2 preparation of raw materials, from ore to making 3 cobalt for, in this case, spent batteries going 4 in and being -- going through a pyrolysis 5 process, doing it in terms of batches is 6 generally slow. Sometimes there has to be some 7 manual manipulation of things. 8 But in a continuous process, you are 9 going through just from one vat, putting in the 10 feedstock. It starts going through the process, 11 and then the resultant material comes out and is 12 collected. And it's just -- doesn't need a lot 13 of intervention. It doesn't need -- usually it 14 doesn't need separation physically of the steps 15 of the process. 16 By that I mean, you don't have to line 17 up every battery in a certain configuration to 18 then allow it to go through -- you know, have 19 every battery standing on its end so that you 20 can then have something come down and work with 21 it before it moves to the next step. And that 22 would -- that would involve more apparatus or 23 even personal intervention to do this. 24 But the -- you know, the short answer 25 is that, in my opinion, when you have a conveyor

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Page 30 1 from one end to the other of the process, that's 2 going to be a continuous process, and you will 3 get a higher output of a factory that is doing 4 it that way. 5 Q. (BY MR. LaROQUE) You mentioned when 6 you see a conveyor. What do you mean by that? 7 A It could be a conveyor belt. It could 8 be something that grabs something from -- you 9 know, there's a resultant mass that comes out of 10 a hopper into a big bin. The next vat bin just 11 immediately -- maybe it wheels a certain 12 distance to another kind of chamber and then 13 dumps itself, right. But it doesn't need 14 intervention. And when that bin moves away, 15 another one is right behind it, so that, as 16 material is coming continuously, the process is 17 not interrupted by needing to re-bin anything or 18 align anything; it just -- it just continues on 19 its own, automated. 20 Q I'd like to turn you back now to 21 Exhibit 1003, to your declaration. And 22 specifically I'd like to direct you to paragraph 23 146, which is at page 54. 24 A It's trying to load. 25 Q No problem. Just let me know when	Page 32 1 Q So what does that number, 30 inches of 2 mercury, actually indicate? 3 A That indicates the atmospheric 4 pressure that we are in right now; and that is 5 how high, if you put a vacuum tube over a pool 6 of mercury, atmospheric pressure would be able 7 to push upwards the column of mercury in that 8 vacuum tube to push it up 30 inches. If you 9 were under a vacuum with a lower pressure, then 10 the mercury couldn't be so high. 11 It's used -- this is used, obviously, 12 in meteorology, as the column of mercury 13 generally is around 30 inches of mercury, but 14 sometimes it's a little higher, when they talk 15 about a high or if they talk about a low, maybe, 16 you know, 29, 28 and a half. That's really low 17 pressure. But they -- they talk about the 18 inches of mercury. 19 If you look at pascals, the Pa -- and 20 this is hectopascals. If you -- the full 21 atmospheric pressure that would correspond to 22 the 30 inches of mercury is 101 and a fraction 23 kilopascals. 24 Q Okay. So you're saying that full 25 atmospheric pressure is 101 kilopascals?
Page 31 1 it's up. 2 A Not even the Jeopardy music plays. 3 All right. It's coming. 4 Page -- what was that? 5 Q Page 54. 6 A Fifty-four. Thank you. I'm there. 7 Q And do you see, in the middle of 8 paragraph 146, you say, According to Meador, the 9 pyrolysis chamber can be maintained under slight 10 vacuum, such as .5 inches of mercury, which is 11 approximately 16.9 hPa. 12 Do you see that? 13 A I do. 14 Q So you're explaining here in your 15 declaration that Meador operates its battery 16 processing under a vacuum? 17 A Yes. 18 Q You say specifically a slight vacuum, 19 right? 20 A Yes. 21 Q What are inches of mercury? 22 A An atmospheric pressure, in terms of 23 inches of mercury. Full atmospheric pressure 24 that we're experiencing now is about 30 inches 25 of mercury.	Page 33 1 A Yes. 2 Q And that that's equivalent to this 30 3 inches of mercury? 4 A Yes. 5 Q And I just want to make sure I 6 understand your earlier testimony. 7 You mentioned putting a vacuum tube 8 over a pool of mercury? 9 A Yes. Say a -- say it's just a tube, 10 you know, at least -- at least 30 inches high, 11 usually higher, that's been evacuated. The open 12 end of the tube is placed into the pool of 13 mercury, and atmospheric pressure working 14 against the gravity of the vacuum on the one 15 hand, wanting to pull mercury up the tube, and 16 gravity wanting to hold the mercury down, a full 17 one atmosphere -- atmospheric pressure, standard 18 atmospheric pressure, is 30 inches of mercury, 19 plus or min- -- I don't know the exact number, 20 because nobody uses inches of mercury anymore. 21 They're all using kilopascals. 22 Q And why is nobody using inches of 23 mercury anymore? 24 A For the same reason that a lot of the 25 world is using kilometers instead of miles.

Page 34 1 They're just moving away from -- they're moving 2 away from inches and feet. 3 And no one -- Mercury's pretty toxic. 4 If your pool of mercury is -- mercury, while it 5 looks like just a pool, does have a vapor of 6 mercury above it, and it can cause toxic injury 7 to people, so -- 8 Q So the difference, then, between the 9 inches of mercury and the kilopascals that you 10 mentioned, that's just a standard conversion? 11 A That's just a standard conversion 12 of -- and measurement of the pressure, relative 13 to atmospheric pressure. 14 Q And so you said, again, at paragraph 15 146, that .5 inches of mercury is approximately 16 16.9 hPa, right? 17 A Yes. 18 Q hPa is hectopascals? 19 A Yes. 20 Q And how does hectopascals relate to 21 the kilopascals that you mentioned earlier? 22 A I think it's a factor of 10. It would 23 be 169 kilopascals. No. It would be -- I'm 24 just trying to remember the conversion factor in 25 my head.	Page 36 1 last three lines of column 5, starting at line 2 61, do you see it says, The vacuum pump 70 3 maintains a vacuum on pyrolysis chamber 15 of 4 approximately one-half of mercury, and then 5 parentheses, 5 inches of water? 6 A Yes. 7 Q Okay. So Meador, here, is also 8 referring to inches of water, right? 9 A Yes. And I laugh, because I -- yeah, 10 I remember seeing that. 11 Mercury was used because it's very 12 dense, and you can measure it in something 13 that's just like 1 yard long, 30 inches. 14 If you were trying to do this with 15 putting a vacuum tube over a pool of water, 16 water is a lot less dense, it can rise up with a 17 vacuum. And there's a huge difference in the 18 density of mercury and the density of water, and 19 you would need a tube of about 30 feet -- more 20 than 30 feet high to -- to show 1 atmos- -- what 21 1 atmospheric pressure would do to a column of 22 water. 23 So, you know, one-half inch of 24 mercury, 5 inches of water, there you can see 25 the -- in general, the difference in the density
Page 35 1 Q That's all right. 2 A It would be 169 pascals, which is 3 .169 kilopascals. 4 Q Okay. So does it make sense that 5 hectopascals, that's 100 pascals? 6 A Atmospheric pressure is 7 101 kilopascals. 16.9 hPa would be 8 1.69 kilopascals -- 169 pascals, versus full 9 atmospheric pressure being 101,000. 10 Q Okay. 11 A So -- 12 Q I just want -- just want to be -- 13 A -- just getting rid of the kilos and 14 the hectos. 15 Q That's all right. I just wanted to be 16 clear. 17 So 1 hectopascal is 100 pascals; is 18 that right? 19 A Yes. 20 Q Okay. If you turn back now to Meador, 21 Exhibit 1011, and now I'd like you to look at 22 column -- column 5. It's on the last page of 23 the patent. And let me know when you're there. 24 A I am on column 5. 25 Q And if you go to the very bottom, the	Page 37 1 of these materials. It's -- it's tenfold. 2 Q Have you ever seen one of these tubes 3 of water that's 30 feet high? 4 A Museum of Science in Boston, once upon 5 a time. 6 Q Okay. But that's the only place? 7 A That's the only place I've seen it. 8 Q Understood. 9 A It's in textbooks of the -- back in 10 the day. But the only place where I physically 11 saw it is the Museum of Science. 12 Q Okay. But to be clear, both inches of 13 water and inches of mercury, are those -- those 14 are standard measurements for pressure? 15 A They're well-understood measurements 16 of pressure. 17 When it all went metric, they went to 18 pascals. I forget the exact basis for the 19 pascal. 20 Q Okay. But those would both convert -- 21 could both easily be converted to pascals or 22 hectopascals, right? 23 A Correct. 24 Q If you go back in this same exhibit, 25 in Meador, Exhibit 1011, to column 4.

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Page 38 1 A Yes. 2 Q And if you go to about line 49 of 3 column 4 -- 4 A Okay. 5 Q -- there's a sentence that says, A 6 liquid 31, such as water -- 7 Let me start that over. 8 A liquid 31, such as water, is 9 maintained at a level 32 in the hopper 25 and 10 screw conveyor 26 to exclude oxygen or air 11 entering into the crusher 27 and, thence, into 12 the pyrolysis chamber 15. 13 Do you see that? 14 A Yes. 15 Q And if you could turn now to Figure 1 16 of Meador, because I want to match up some of 17 these numbers in the text with the figure. 18 A Okay. I have to twist my head here. 19 Q No problem. 20 A Okay. 21 Q Do you see -- In Figure 1, at the left 22 side there, do you see the number 25? 23 A I do. 24 Q And it's pointing to -- to the 25 structure that apparently is -- is the hopper?	Page 40 1 And they do have to deal with HF, 2 because they're generating it. And vapors will 3 come out of that auger system, but it's all 4 happening because the raw material is reacting 5 with the water as it's going up through the 6 auger. 7 Q. (BY MR. LaROQUE) Going back to column 8 4 in -- in Meador and that sentence that we just 9 looked at, it said, water is maintained at a 10 level 32 in the hopper 25 and screw conveyor 26 11 to exclude oxygen or air entering into the 12 crusher 27 and, thence, into the pyrolysis 13 chamber. 14 Do you remember that? 15 A Yes. 16 Q So is this water in the hopper also 17 acting as a seal to exclude oxygen or air from 18 entering into the crusher and, thence, into the 19 pyrolysis chamber? 20 A It will act in that way. It will have 21 that dual effect of reacting with the LiPF6 and 22 excluding air from following its way into the 23 pyrolysis chamber. 24 Q Okay. And so the water is there -- is 25 part of this dual purpose to protect the vacuum
Page 39 1 A That looks like it is where the hopper 2 is feeding in to the auger, which is -- looks 3 like the auger is 32. 4 Q And -- so the patent said that a 5 liquid, such as water, is maintained at a level 6 32 in the hopper, right? 7 A Yes. 8 MR. SCHENKER: Objection. Form. 9 Q. (BY MR. LaROQUE) Why would the hopper 10 be filled with water? 11 MR. SCHENKER: Objection. Form. 12 You can answer. 13 A In this case, you look at what Meador 14 is doing overall, and Meador is doing this 15 decomposition at 350 and 600 -- between 350 and 16 650 degrees. 17 Before it gets to the pyrolysis 18 chamber, they're neutralizing, in this -- in 19 this hopper, in -- where -- where you see the 20 water level is -- I mean, as the material goes 21 in and is going through the auger, it's reacting 22 with water. And what will happen there is, 23 water will react with the LiPF6 and form HF, and 24 basically it will just destroy the salt in 25 the -- in the battery.	Page 41 1 inside of the system? 2 A Yes. 3 Q Can you explain how that water seal 4 works? 5 MR. SCHENKER: Objection. Vague. 6 Lacks foundation. 7 A I haven't -- just from a chemical 8 engineering standpoint, it's there as a barrier. 9 Air -- in the absence of the water, the air 10 would just follow the raw materials, the -- down 11 through the auger, as they're going up. And air 12 would just follow and have easy access to ending 13 up in the pyrolysis chamber. 14 If you have a barrier -- in this case, 15 water -- you're putting your raw materials, they 16 go -- they're a solid, they're going to go to 17 the bottom, and then they're going to go through 18 the auger process. But you still have a level 19 of water that they pass through, and the water 20 level is set to a height enough that some water 21 might be augered through, but there's enough 22 water, and at least enough play between the 23 auger blades and the lower part of the chamber, 24 that the water will just stay back down and -- 25 and maintain a level.

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Page 42 1 And they probably have something, 2 that's not listed here, that would just trickle 3 in water to make up for -- for lost water as 4 this process goes on, because water would be 5 slightly consumed if it is reacting with the 6 LiPF6 salt in the -- in the battery. 7 Q. (BY MR. LaROQUE) Okay. So fair to say 8 that the presence of the water here keeps the 9 air from passing from -- from the outside, from 10 the atmosphere, say, into the crusher and the 11 pyrolysis chamber? 12 A Yes. That's what its function is. 13 And they -- they have a way to maintain it, and 14 they -- obviously, through some engineering 15 design, they decided what an appropriate level 16 would be. 17 MR. LaROQUE: We have been going about 18 an hour. How about a short break? 19 THE WITNESS: Okay. 20 THE VIDEOGRAPHER: We are going off 21 the record. The time now is 9:15. 22 (Whereupon, a recess was taken.) 23 THE VIDEOGRAPHER: We are back on the 24 record. This is the start to Media Number 2. 25 The time is 9:26.	Page 44 1 Q And then it goes on to say, This 2 arrangement effects a seal of closed bin 37 3 which excludes air or oxygen entering pyrolysis 4 chamber 15 from closed bin 37. 5 Do you see that? 6 A I see that. 7 Q Okay. So there's another seal here, 8 on the other side of Meador's system; is that 9 right? 10 A I'm scrolling to look at the figure 11 again. 12 Q Sure. 13 A Yes. 14 Q And how does -- how does that seal 37 15 work? 16 MR. SCHENKER: Objection. Form. 17 A Well, it -- there is a seal, 18 obviously, that's controlled by 19 pressure-sensitive switches, that not only 20 you -- you discharge a portion of the material 21 onto the screw conveyor, but there is a -- an 22 arrangement where the closed bin 37, which 23 excludes oxygen by entering -- from entering the 24 pyrolysis chamber -- if I'm looking, and what I 25 understood what I was seeing, bin 37 has -- you
Page 43 1 Q. (BY MR. LaROQUE) Dr. van Schalkwijk, 2 before the break we were looking at Figure 1 of 3 Meador and discussing how the water in the 4 hopper keeps air from entering into Meador's 5 system. 6 Do you remember that? 7 A Yes. 8 Q So it acts as a barrier to keep the 9 air out, right? 10 A Yes. 11 MR. SCHENKER: Objection. Vague. 12 Q. (BY MR. LaROQUE) So as long as we're 13 talking about these barriers, I'd like to direct 14 you to another passage in Meador. And if you 15 would go to column 4 in Exhibit 1011. 16 A Okay. 17 Q And if you look at line 57, there's a 18 sentence there. It says, Closed bin 37 is 19 designed with pressure-sensitive switches to 20 discharge a portion of solid material 33 onto a 21 screw conveyor 39 for transporting to the 22 screening collector 80 for separation of the 23 solid battery components. 24 Do you see that? 25 A Yes.	Page 45 1 know, you see the wavy lines of 33, and you can 2 say, well, that looks like liquid, but it's 3 solid material. And -- and air could come in, 4 basically, as a backflow. And that's why they 5 have seals to protect it from having a backflow 6 of air. 7 You see -- you know, 33, that's 8 collected binned material after pyrolysis, and 9 it -- that's why it's, I guess, wavy, because 10 it's an uneven thing. But you could have, in 11 that system, a backflow of air, that would go 12 down through 36 and then back up into the system 13 and cause a problem. 14 Q. (BY MR. LaROQUE) It would compromise 15 the vacuum that you're trying to maintain? 16 A It would -- it would cause -- it would 17 compromise your vacuum -- 18 MR. SCHENKER: Objection to form. 19 Lacks foundation. 20 A -- in -- in my understanding of this 21 diagram. 22 Q (BY MR. LaROQUE) And that's because 23 the -- because, as you testified, I believe, 24 that air would come -- you'd have a backflow of 25 air that would go down 36 and then back up into

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Page 46 1 the system, right? 2 MR. SCHENKER: Objection. 3 Mischaracterizes the testimony. 4 A This doesn't refer to any of my direct 5 testimony, because I didn't go into a 6 description of the details of Meador's device. 7 Q. (BY MR. LaROQUE) No. I understand 8 that. But I was referring to -- to the 9 statement that you just made in answer to one of 10 my previous questions. 11 You said that you could have in that 12 system a backflow of air that would go down 13 through 36 and then back up into the system and 14 cause a problem. Right? 15 A I did say that. 16 MR. SCHENKER: Objection to form. 17 Q. (BY MR. LaROQUE) Okay. And that 18 problem would be that it would compromise the 19 vacuum in -- inside the system? 20 A In this case, that would be 21 compromising the vacuum. 22 Q Okay. So looking at Figure 1 of 23 Meador, there is a barrier at 32, which is the 24 water barrier that we discussed earlier, 25 correct?	Page 48 1 mercury? 2 MR. SCHENKER: Objection. Form. 3 A By my understanding of the way 4 Meador's system operates, yes, that's how 5 they're configured. 6 Q. (BY MR. LaROQUE) Okay. All right. 7 And so just to be clear, the water on the inside 8 of the seal at the location 32 in Figure 1, the 9 pressure at that location in Meador's system 10 would be the 17 hectopascals? 11 MR. SCHENKER: Objection. Form. 12 A That would be my -- my interpretation 13 of this system, yes. 14 Q. (BY MR. LaROQUE) Okay. 15 Dr. van Schalkwijk, I would like to 16 look back at your declaration now, which is 17 Exhibit 1003. And if you could turn to 18 paragraph 69, and that is at page 22. 19 A Yes. 20 Q And do you see here, you say, 21 Similarly, it has long been understood that 22 reducing ambient air pressure lowers the boiling 23 point of fluids (the temperature at which a 24 fluid transitions to a gas). 25 Do you see that?
Page 47 1 A (No audible response.) 2 Q I'm sorry. Was that a yes? 3 A Yes. 4 Q And there's a barrier at -- at 37, 5 which is the -- the -- which is the -- the bin 6 that we were just discussing, correct? 7 A Yes. 8 Q And -- and between those two barriers, 9 you have Meador operating the system under a 10 vacuum, correct? 11 A Yes. 12 Q That's the vacuum that you described 13 at paragraph 146 of your declaration, right? 14 MR. SCHENKER: Object to form. 15 A A few minutes ago, looking at 146 in 16 my mind right now, yes, that would be the 17 vacuum. 18 Q. (BY MR. LaROQUE) And that's that 19 vacuum that's at, you said, .5 inches of 20 mercury, or approximately 16.9 hectopascals? 21 A Right. 22 Q All right. And so the entire volume 23 between those two seals, 37 -- I'm sorry -- 32 24 on the one side and 37 on the other side, would 25 be at this pressure, this vacuum of .5 inches of	Page 49 1 A I do. 2 Q Can you explain further the 3 relationship that you're describing here between 4 ambient air pressure and the boiling point of 5 fluids? 6 A If you -- when you see a listed 7 boiling point of a material, a liquid, generally 8 that's going to be based on room temperature of 9 ambient temperature and ambient pressure. It's 10 going to be measured at atmospheric pressure. 11 If you look at a specification sheet 12 for any liquid -- organic liquid or other 13 liquids, inorganic liquids -- often in their 14 specification sheets it will show some 15 information about the vapor pressure or the 16 boiling point at various pressures. If you are 17 above atmospheric pressure, it takes a higher 18 temperature to boil. If you're at a reduced 19 pressure, material will vaporize at a lower 20 temperature. So, in other words, the boiling 21 point would be reduced. 22 You could say, oh, at this pressure my 23 boiling point is -- at room temperature my 24 boiling point is a hundred degrees. At this 25 reduced pressure here my boiling point is, you

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Page 50 1 know, 70 degrees or 80 degrees, whatever the 2 liquid. They're all different. 3 If I'm at 1.1 atmosphere, a heavy 4 pressure on top of my liquid, it would take more 5 to get that liquid to vaporize, so the boiling 6 point would be higher. 7 So there's a relationship between the 8 applied pressure or ambient pressure and the 9 boiling point of a liquid. 10 Q Understood. 11 I want to -- I want to explore that a 12 little bit more. And to do so, I am going to 13 introduce another exhibit, so give me just a 14 moment here. 15 A And it should just show up in my 16 Marked Exhibits list at some point? 17 Q It should. 18 All right. So I will tell you, it's 19 giving me some errors as I'm trying to -- to 20 stamp it. But I'm just going to go ahead and 21 see if I can introduce it here. 22 All right. It should be there now. 23 It's -- 24 A It's there. 25 Q -- number 2025.	Page 52 1 Do you see that? 2 A (No audible response.) 3 Q Just at the bottom of the plot, 4 underneath the plot. 5 A I see it. I see it. I see it. 6 Q Sorry. I think I missed your answer. 7 mbara, do you know what that means? 8 A Millibars, I believe. I'm not sure 9 what the a at the end -- maybe that means 10 absolute, millibars absolute. 11 Millibars are another unit of 12 pressure. 13 Q I think that's a fourth unit now that 14 we've -- 15 A It seems to be, yeah. 16 And I don't know the conversion 17 factors offhand, but it does say a millibar is 18 equal to a hundred pascals. And if you have a 19 hundred thousand of them, you would get up to -- 20 you would get up to 1 atmosphere. 21 Q Okay. I just want to -- want to -- 22 Actually, let me -- let me make 23 something clear for the record. 24 Do you see, at the top of the page 25 here, it says, Water Boiling Point as Function
Page 51 1 (Deposition Exhibit Number 2025 marked 2 for identification.) 3 A Yes. 4 Q Let me know when you have that up. 5 A I have it up. 6 Q Dr. van Schalkwijk, do you recognize 7 what's shown here? 8 A This shows me the water boiling point 9 as a function of absolute pressure. 10 Q And so this -- this is a graph, 11 correct? 12 A Yes. 13 Q And is this illustrating that 14 relationship that you were just describing, 15 between ambient air pressure and the boiling 16 point of fluids, in this case, water? 17 A Yes. 18 Q And fair to say that -- 19 Well, let me -- let me back up. 20 So on the Y axis we have water for 21 boiling temperature, correct, in degrees 22 centigrade? 23 A I see that. 24 Q Okay. And on the X axis we have the 25 units. It says, mbara, in the brackets there.	Page 53 1 of Absolute Pressure? 2 A I do. 3 Q All right. And do you see, at the 4 bottom, there's a URL listed? 5 A I do. 6 Q And it says, 7 https://www.engineeringtoolbox.com/waterevacuat 8 onpressuretemperatured_1686.html. 9 Do you see that? 10 A I see that. 11 Q All right. And just to be clear, in 12 case I missed it, because it's -- the stamp's 13 not shown on here, I've introduced this as 14 Exhibit 2025 for the record. 15 A Yes. 16 Q And that is the next exhibit in line 17 for the patent owner's set of exhibits here, so 18 that's why it has that number 2025. 19 A Okay. 20 Q All right. So going back to -- to the 21 X axis, the 100 -- you see it says, mbara, 22 those -- that millibars, we think, absolute 23 equals 100 Pa? 24 A Yes. 25 Q And we talked earlier how 100 Pa,

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Page 54 1 that's -- that's 1 hectopascal, correct? 2 MR. SCHENKER: Objection. Lacks 3 foundation. Mischaracterizes testimony. 4 A I'm getting my hectos or my -- I would 5 just rather stick with pascals. 6 Q. (BY MR. LaROQUE) Okay. Okay. So 7 if -- if we're talking about pascals, then 8 this -- do you agree that this -- that this 9 exhibit is showing the relationship between the 10 boiling -- the temperature at which water boils 11 on the Y axis and absolute pressure on the 12 X axis? 13 A Yes. 14 MR. SCHENKER: Objection. Lacks 15 foundation. 16 Q. (BY MR. LaROQUE) And, sir, do you have 17 any reason to doubt that what's represented here 18 is -- is not accurate? 19 A No. This is the kind of -- this is -- 20 I mean, an engineering toolbox like this -- and 21 there are various websites of this nature -- you 22 would expect a design engineer or a person of 23 ordinary skill would solve this kind of 24 information. 25 So I have no reason to doubt this	Page 56 1 boiling temperature of water at atmospheric 2 pressure? 3 A 100 degrees. 4 Q And does -- does that help you 5 calibrate what's shown on the X axis? 6 MR. SCHENKER: Object to form. 7 A It does, to a degree. No pun intended 8 with degrees. 9 A hundred degrees C is a boiling point 10 of water at 1 atmosphere. And since we're 11 already showing that axis, it looks like, where 12 the green line is exiting the top of the chart 13 at about 1,000, obviously, then, that makes this 14 millibars, because that's -- a thousand 15 millibars is one bar, 1 atmosphere. It seems to 16 be crossing 100 degrees, as you would expect. 17 Q. (BY MR. LaROQUE) Okay. So with 18 that -- with that clarification, let me go back 19 and reask my question, which -- which was, what 20 is the boiling point of water at 300 millibars 21 absolute, according to this graph? 22 MR. SCHENKER: Objection to form. 23 A According to this graph? It looks 24 like 70 degrees C. 25 Q. (BY MR. LaROQUE) Let's keep going.
Page 55 1 information. 2 Q Okay. That -- I think that -- that 3 answers my question. Thank you. 4 So I wonder if you can help me out 5 here by looking at some numbers. 6 And so my first question would be, 7 what is the boiling point of water at 8 300 millibars absolute? Can you tell that from 9 this graph? 10 MR. SCHENKER: Objection. Form. 11 A The title of the X axis is a little 12 confusing. Is -- is it telling me that each of 13 these numbers is millibars or that -- or is it 14 just telling me that a millibar is a hundred 15 pascals? 16 So I don't know if this axis is 17 referring to pascals or millibars. 18 I'm going to -- I'm not going to make 19 any assumptions without understanding the X axis 20 a little more. 21 But if you want to finish your 22 question, I'll see if I can answer it. 23 Q. (BY MR. LaROQUE) Well, let me ask you 24 another question. 25 Do you know the boiling point -- the	Page 57 1 What is the boiling point of water at 2 100 millibars absolute, according to this graph? 3 A It looks like it's between 40 and 50. 4 Q And I'm going to keep going. And it 5 may be helpful now to move to the -- the blowup 6 that we see here, that's -- that has the X axis 7 units in log scale. 8 Do you see that? 9 A I do. 10 MR. SCHENKER: Objection. 11 Q. (BY MR. LaROQUE) And I'm wondering if 12 you can tell me, what is the boiling point of 13 water at 17 millibars absolute? 14 MR. SCHENKER: Objection. Lacks 15 foundation. Vague. 16 A So I would estimate here, somewhere 17 near 20 degrees. 18 Q. (BY MR. LaROQUE) Okay. So you say 19 it's about -- about 20 degrees. 20 Let's -- let me take a look here. 21 All right. So let me -- let me ask 22 you a question. 23 Do you have a means available to you 24 right now for calculating the boiling 25 temperature of water at an absolute pressure of

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Page 58 1 17 millibars absolute? 2 MR. SCHENKER: Objection. Vague. 3 A I do not have that means. My 4 calculator is packed in my luggage at the hotel. 5 Q (BY MR. LaROQUE) I understand. 6 So if I represent to you that the 7 boiling point of water at -- at 17 millibars 8 absolute is approximately 15 degrees centigrade, 9 do you have any reason to disagree with that? 10 MR. SCHENKER: Objection. Form. 11 A I'm interpolating the chart that I'm 12 seeing, including the blowup, is not an 13 unreasonable number. 14 Q. (BY MR. LaROQUE) Okay. So let me take 15 that just a bit further. 16 We're talking about 17 millibars 17 absolute, right? 18 A Yes. 19 MR. SCHENKER: Objection. Form. 20 Q. (BY MR. LaROQUE) And do you see there, 21 in the X axis, it says, millibars absolute is 22 equal to 100 pascals? 23 A Yes. 24 Q So fair to say that 17 millibars 25 absolute would be 1700 pascals?	Page 60 1 We discussed earlier that the pressure 2 at -- at the inside of the seal, at that 3 location 32, would be .5 inches of mercury, 4 correct? 5 MR. SCHENKER: Objection. Form. 6 A I'd want to go back to look at Meador, 7 with this -- with this chart already in my mind. 8 And I think I know where it's going, but I -- 9 let me go back to Meador, if I can. 10 Q. (BY MR. LaROQUE) Sure. Go right 11 ahead. 12 A Meador, Meador, Meador, pressure, 13 pressure, pressure. 14 Okay. Go into your next question, 15 because I was just checking for some ambiguity 16 here. No. Not finding it. 17 Q Okay. So I -- I was just confirming 18 we discussed earlier that the pressure at the 19 inside of that water seal, at that location 32 20 in Figure 1 -- 21 A Yes. 22 Q -- would be .5 inches of mercury, 23 right? 24 A Yes. 25 Q And we had discussed how .5 inches of
Page 59 1 MR. SCHENKER: Objection. Form. 2 A Say that again, please? 3 Q. (BY MR. LaROQUE) Do you agree, then, 4 that 17 millibars absolute -- if 1 millibar 5 absolute is equal to 100 pascals, that 6 17 millibars absolute would be 1700 pascals? 7 A That would be correct. 8 Q And do you recall earlier we discussed 9 the difference between hectopascals and 10 kilopascals? 11 A Yes. 12 Q And do you remember we concluded that 13 100 -- I'm sorry -- that 1 hectopascal is 14 100 pascals? 15 A Yes. 16 Q So that 1700 pascals -- bear with me 17 here -- would be 17 hectopascals, correct? 18 A I think so, yes. 19 Q Okay. Do you remember also we 20 discussed earlier that the water -- going back 21 to Meador's Figure 1, the water on the inside of 22 the seal at that location 32 would be at 23 .5 inches of mercury? That was your 24 testimony -- 25 Or I'm sorry. Strike that.	Page 61 1 mercury is equal to 17 hectopascals, right? 2 A Yes. 3 Q And we just discussed that the boiling 4 point of water at -- at 17 hectopascals, you 5 agreed with me that the boiling point is 6 15 degrees centigrade, right? 7 A Yes. 8 Q So do you agree, then, that the water 9 at the inside of that seal, at that location 32, 10 would boil at a temperature of 15 degrees 11 centigrade? 12 MR. SCHENKER: Objection to form. 13 A We agreed to a number that would be 14 around there, yeah, 15, 17 degrees, somewhere -- 15 somewhere in that. I think my first number I 16 threw out was about 20. 17 But, yes, a low temperature, compared 18 to the boiling point of water at standard 19 pressure. 20 Q. (BY MR. LaROQUE) All right. And if 21 that water boils at -- inside at that location 22 32, that's -- that's going to actually remove 23 the water from the seal, correct? 24 A That would be taking water away from 25 the seal.

16 (Pages 58 - 61)

Page 62 1 Q And if you take water away from the 2 seal, if you continue to do that, you'll lose 3 the seal, right? 4 A Yes. But I don't see -- You know, 5 they show the seal. I don't know if they 6 mention the operation of maintenance of that 7 seal. Maybe there's a continuous feed of water 8 going into it. 9 Q Okay. But that's not something 10 that -- that you -- 11 A That's not clear, that it shows up on 12 the diagram, but that -- 13 Q Yeah. So just to be clear, that -- 14 that's not shown, correct? 15 A I'm just -- I'm just scrolling through 16 it. I am not seeing it. So, no, I don't see 17 that that's taking place. 18 What I do see -- 19 Q Just to be clear, when you say you 20 don't see that that's taking place, what do you 21 mean by that? 22 MR. SCHENKER: The witness had not 23 completed his answer. 24 (Cross-talk.) 25 (Reporter clarification.)	Page 64 1 to maintain the integrity of the pyrolysis 2 chamber, which is going to have a lot of gas, 3 anyway, from the decomposition of the comminuted 4 materials, which contain electrode material, but 5 also the binder, the separator, and 6 electrolyte -- the electrolyte solvents. Those 7 are going to decompose, and they need to be able 8 to -- to vent those off. 9 Q. (BY MR. LaROQUE) Okay. But those 10 things that you just explained about the 11 water -- the pressure valves releasing that 12 vaporized water, none of that is actually 13 described in Meador, correct? 14 MR. SCHENKER: Objection. 15 A The use of the pressure valves is not 16 provided. The -- the -- the refeed, maintaining 17 the levels of the water, that's not described. 18 But it would be, I believe, a necessary element. 19 The valves 22 and 23 are there for 20 safety reasons, in case pressure does get too 21 high. 22 And all of these -- all of the 23 off-gases from the furnace, which would include 24 any water that's gotten into the furnace area, 25 exits up through the flue, which is, I think,
Page 63 1 MR. LaROQUE: I thought he was 2 finished. 3 MR. SCHENKER: No. He started to say, 4 What I do see... 5 A What I do see is that there -- even if 6 the water is vaporizing and getting up through 7 the auger -- vaporized water is getting up 8 through the auger and down into the -- past 27 9 and into the chamber, there are valves, pressure 10 valves, at 23 and 22 that would relieve 11 pressure. So if there's extra pressure due to 12 some steam that's generated from vaporized 13 water, at least it's vented and not going into 14 the pyrolysis chamber. It's caught by a 15 pressure relief valve at 23. 16 That may not be the exact position of 17 23. Those are kind of -- this is just a 18 schematic, as opposed to the actual -- absolute 19 engineering drawings. 20 But you could prevent the water -- and 21 then there would probably be, again, in the -- 22 the actual device, a method by which the water 23 level is maintained, even though it is 24 evaporating rapidly at that low pressure. 25 23 is venting off the steam, really,	Page 65 1 21. And so your gases are really taken out. 2 They -- In a modern facility, you 3 would have to have a lot of air-handling 4 equipment. This is 1994. You would have to 5 have a lot of equipment for not allowing certain 6 gases to escape the building. And if you go by 7 most factories of any kind, you'd see a lot of 8 plumbing on the roof. And that would have had 9 to have been occurring here. 10 But really what you're doing is, 11 you're decomposing anything organic in that 12 pyrolysis chamber, and you're getting down to 13 really just the -- the active materials in the 14 battery. But you're also cooking the active 15 materials so that they can't be active anymore. 16 Q. (BY MR. LaROQUE) And I just wanted to 17 confirm something that you said earlier. 18 You said, the refeed maintaining the 19 levels of the water. 20 That's not described in Meador, right? 21 A Not described. 22 Q Okay. I want to ask another question. 23 And I'd like to turn you -- your attention to 24 another disclosure in Meador, and that is at 25 column 3, and starting around line 30.

17 (Pages 62 - 65)

Page 66 1 And I think we looked at this earlier, 2 but it says -- again, it says, the feed auger or 3 screw conveyor is sealed with water or other 4 liquid to exclude air or oxygen from the 5 pyrolysis chamber. 6 You see that? 7 A Line 30. Water or other liquid. Yes. 8 Q All right. And we talked earlier 9 about how -- how that water acts as a barrier to 10 keep air from -- from passing through from the 11 atmosphere outside, right? 12 A Yes. 13 Q So you have the atmosphere outside. 14 And then inside, on the other side of that 15 barrier, you have this vacuum, correct? 16 A Yes. 17 MR. SCHENKER: Objection. 18 Q. (BY MR. LaROQUE) So there's a pressure 19 difference, then, between the -- the environment 20 on the outside and the vacuum on the inside? 21 MR. SCHENKER: Objection. Form. 22 A That would be the way I would 23 interpret this, yes. 24 Q. (BY MR. LaROQUE) So we can calculate 25 what that pressure difference would be, right,	Page 68 1 Q Okay. And you actually said in your 2 declaration what the pressure inside the 3 pyrolysis chamber can be, right, at that 4 paragraph 146 of your declaration? 5 You said, According to Meador, the 6 pyrolysis chamber can be maintained under slight 7 vacuum, such as .5 inches of mercury, which is 8 approximately 16.9 hectopascals. 9 You remember we looked at that 10 earlier? 11 A Yes. 12 Q So the pressure in the pyrolysis 13 chamber is -- is the 16.9 hectopascals. Is that 14 correct? 15 A So you can look at that line, column 16 5, at 60 -- 61, maintains a vacuum of one-half 17 inch of mercury. 18 What it doesn't say is that it 19 maintains -- it doesn't say what the absolute 20 pressure is. It says, maintains a vacuum of 21 approximately one-half inch of mercury. 22 Now, the interpretation can go either 23 way here. Is that the absolute pressure that's 24 left, and that's -- that's the mercury -- that's 25 the half inch of mercury, that's the pressure
Page 67 1 if we know -- as long as we know what the 2 pressure is outside? 3 MR. SCHENKER: Objection. Form. 4 Q. (BY MR. LaROQUE) Let me strike that 5 and ask it again different -- differently. 6 We can calculate what that pressure 7 difference would be as long as we know the 8 pressure outside and the pressure inside the 9 system, correct? 10 A Not necessarily. We know the 11 temperature on the inside of the system, but we 12 know -- we don't know what is going to fill up 13 that space, that volume of the chamber. We just 14 know the temperature that the gases would reach 15 during the decomposition, during the pyrolysis, 16 but we don't know what that -- And, in any case, 17 the system is maintaining a vacuum and -- and 18 sucking out these fumes through the flue. And, 19 essentially, since the gases -- the pyrolysis 20 gases are escaping through the flue, the 21 pressure inside the pyrolysis chamber should be 22 quite low, because -- 23 Q And -- 24 A -- because the gas is just -- hot gas 25 is just escaping out the flue.	Page 69 1 relative to atmospheric? It's a very, very, you 2 know, intense vacuum. Or is that a slight 3 vacuum of, really, instead of 30 inches of 4 mercury, which is atmospheric pressure, only 29 5 and a half? So it's -- if it's a slight 6 vacuum -- and that's still going to being a 7 vacuum, and it's still going to be drawing air 8 away from atmospheric pressure. 9 But, in any case, either way, one is a 10 very intense vacuum, one is a slight vacuum. 11 Q So you're just -- 12 A And -- 13 Q Go ahead. 14 A (No audible response.) 15 Q Well, let me ask this question: So 16 you said, at paragraph 146, that the pyrolysis 17 chamber can be maintained under slight vacuum, 18 such as .5 inches of mercury, right? 19 A Yes. 20 Q So -- Okay. So that statement 21 indicates that, between those two 22 interpretations that you just mentioned, the 23 slight vacuum interpretation is -- is the one -- 24 is the correct one? 25 A In my reading of this, yes. Half-inch

18 (Pages 66 - 69)

Page 70 1 of mercury is sucking, but it's not -- you know, 2 it's sucking intensely down to a really big 3 vacuum. If you sucked all the way to a really 4 big vacuum, that's pretty energy intensive. 5 A half-inch of mercury difference in 6 pressure, that small, slight vacuum, as I termed 7 it, is still enough to move a lot of air, push 8 it out of the system, without intense use of the 9 vacuum pump. It would be just really having to 10 lower the pressure a little bit, and then keep 11 airflow all the way through the system so that 12 everything that's generated is moved on out of 13 the -- out of the chamber after the pyrolysis 14 has occurred. 15 Q That can happen at that slight vacuum, 16 which is .5 inches of mercury less than 17 atmospheric pressure? 18 A Yes. That -- that is still enough to 19 make a considerable breeze. 20 Q So if .5 -- I'm sorry. Strike that. 21 You said earlier that atmospheric 22 pressure is approximately 30 inches of mercury, 23 right? 24 A Approximately 30 inches of mercury for 25 1 atmospheric pressure at room temperature.	Page 72 1 absolute, it would take a lot more energy to 2 maintain that level of pressure inside the 3 pyrolysis furnace than if it was -- than if it 4 was the 29.5 inches of mercury that we just 5 talked about, correct? 6 MR. SCHENKER: Objection. Vague. 7 Lacks foundation. Mischaracterizes testimony. 8 A It's -- it's vague, but it -- the 9 reason it makes sense to me, to interpret it the 10 way I did, is that that means within the 11 pressure being very slightly below atmospheric, 12 the issue of water boiling at a low temperature 13 isn't a problem, because we would be very close 14 to the top of that pressure boiling point curve, 15 and water suddenly evaporating at 15 degrees -- 16 boiling at 15 degrees is an issue. 17 And that's why it made sense to me to 18 interpret this as a slight vacuum, just coming 19 down from 30 to 29.5 inches. 20 Q. (BY MR. LaROQUE) Okay. Understood. 21 (Reporter clarification.) 22 Q Okay. And so when you say that's why 23 it made sense to you to interpret this as a 24 slight vacuum just coming down from 30 to 25 29.5 inches, you mean it makes sense to you to
Page 71 1 Q Okay. And so if the pressure inside 2 Meador's pyrolysis furnace is one-half inch of 3 mercury less than atmospheric pressure, then 4 that pressure would be approximately 29.5 inches 5 of mercury, correct? 6 A Yes. 7 Q Okay. All right. So just to be 8 clear, your interpretation where -- of Meador's 9 teaching is that the pressure inside the 10 vacuum -- I'm sorry -- inside the pyrolysis 11 chamber is about 29 point half [sic] inches of 12 mercury absolute pressure? 13 A Yes. Because they don't say here 14 relative for absolute. But either 15 interpretation would serve the purposes of being 16 a vacuum, because they would be reduced from 17 atmospheric pressure, and thus constitute a 18 vacuum in terms of moving material away from the 19 source of the -- of the gas. It would be 20 sucking gas all the way through the system. 21 Q Okay. 22 A And I won't elaborate again on 23 something else here, so -- 24 Q All right. So fair to say that -- 25 that, if the pressure were 17 millibars	Page 73 1 interpret this as a relative pressure, not an 2 absolute pressure? 3 A A relative pressure, because that 4 makes sense because of the water. 5 Q Okay. Understood. 6 I'm going to ask you -- change gears 7 here and ask you about another aspect of Meador 8 here. 9 Can you take a look at paragraph 70 of 10 your declaration, which is Exhibit 1003? 11 A Hold on. 12 Yes. 13 Q And do you see it says in -- about in 14 the middle of the paragraph there, Early work on 15 water-activated batteries demonstrated that 16 batteries with aqueous electrolyte solvents 17 could be rendered inactive by evaporating the 18 water from the electrolyte using heat and 19 vacuum? 20 A Yes. 21 Q What is an aqueous electrolyte 22 solvent? 23 A Where water is the solvent, instead of 24 something organic, which would be nonaqueous. 25 Anything where the word aqueous appears, it's

19 (Pages 70 - 73)

Page 74 1 implied water -- or it's specified water. Water 2 is aqueous. 3 Q So what kinds of batteries would have 4 aqueous electrolyte solvents? Would lithium-ion 5 batteries have aqueous electrolyte solvents? 6 MR. SCHENKER: Lacks foundation. 7 A No. 8 Water reacts with lithium and lithium 9 materials, including lithium anodes, which is 10 really graphite with a bunch of lithium ions in 11 it. And they're at a voltage where they will 12 react with water to basically produce hydrogen 13 and oxygen and a lot of heat. 14 Batteries that have water are 15 lead-acid, nickel-cadmium, nickel-metal hydride, 16 flow batteries, like vanadium, nickel-iron, and 17 other batteries that don't utilize a anode that 18 is of the voltage encountered in lithium or 19 lithium-ion batteries, any kind of 20 lithium-containing battery. 21 Q Okay. So you mentioned -- I think you 22 just mentioned nickel-iron? That's an example 23 of a battery with an aqueous electrolyte 24 solution? 25 A Yes.	Page 76 1 layers of the graphite, the graphene sheets that 2 make up graphite -- graphite particle. 3 More recently, they've made lithium 4 alloys with, for example, silicon. But that is 5 not considered in any of these, and it's going 6 to present new challenges to recyclers. 7 But all of those materials with 8 lithium incorporated -- lithium ions 9 incorporated into those materials are 10 lithium-based anode materials, and they operate 11 at a voltage that would be very reactive with 12 water. 13 Q I see. And so you say, very reactive 14 with water. That means that -- that exposing 15 these batteries to water could be dangerous? 16 A Yes. 17 Q Is -- is that true regardless of 18 whether the battery has been -- has been 19 discharged? 20 A In -- 21 MR. SCHENKER: Objection. Lacks 22 foundation. Vague. 23 A If you had a discharged lithium-ion 24 battery, even if it's down around 0 volts, the 25 anode material is still going to contain some
Page 75 1 Q What about nickel-cadmium? Would that 2 have an aqueous electrolyte solution? 3 MR. SCHENKER: Objection. 4 A Yes. It has -- it has an aqueous 5 electrolyte solution. 6 Q (BY MR. LaROQUE) What about alkaline 7 batteries? Would that -- 8 A Alkaline batteries are also used in 9 the same electrolyte. They're not rechargeable 10 to alkaline, but they have the same electrolyte 11 as nickel-cadmium and nickel-metal hydride. 12 Q I want to ask you a question. 13 You -- you mentioned a moment ago that 14 water reacts with lithium and lithium materials. 15 A Yes. 16 Q And you said that it produces hydrogen 17 and oxygen and a lot of heat, correct? 18 A Yes. 19 Q So that would -- that would have -- 20 and those -- the lithium anodes would be in 21 lithium-ion batteries, right? 22 A The lithium -- the anode in a 23 lithium-ion battery, for the longest time, has 24 been graphite, where you insert lithium -- 25 during charge, you insert lithium ions into the	Page 77 1 lithium ion, so you can never really get it all 2 out of there. 3 So if you open up a lithium-ion 4 battery, where you'd say, well, it's 0 volts, 5 it's fine, then you expose it to water, you're 6 still going to have reactivity. 7 Q. (BY MR. LaROQUE) So there's still 8 potential danger there? 9 MR. SCHENKER: Objection. Vague. 10 Foundation. 11 A It depends on your definition of the 12 word danger. But it -- it -- it's not an 13 advisable thing to do. 14 Q. (BY MR. LaROQUE) Understood. 15 MR. LaROQUE: We've been going about 16 another hour. How about another short break? 17 THE WITNESS: Sure. 18 THE VIDEOGRAPHER: We are going off 19 the record. The time now is 10:22. 20 (Whereupon, a recess was taken.) 21 THE VIDEOGRAPHER: We are back on the 22 record. This is the start to Media Number 3. 23 The time is 10:36 a.m. 24 Q. (BY MR. LaROQUE) Welcome back, 25 Dr. van Schalkwijk.

20 (Pages 74 - 77)

Page 78 1 I'd like to introduce another exhibit. 2 And this also is one that was an exhibit to 3 Ascend's IPR petition. So let me go to the 4 Exhibit Share and get that up for you. 5 A Sounds good. 6 (Previously Marked Deposition Exhibit 7 Number 1010 introduced.) 8 Q And this is Exhibit 1010, 1-0-1-0. 9 Do you see that yet, 10 Dr. van Schalkwijk, in the Marked Exhibits 11 folder? 12 A I do. And it's open, and I'm making 13 the font big. 14 Q Okay. All right. So -- All right. 15 So having just introduced that exhibit, I'm 16 actually going to direct you back to your 17 declaration -- sorry about that -- and 18 specifically paragraph 148 of your declaration, 19 Exhibit 1003, which is at page 55. 20 And then I promise we'll get back to 21 the latest exhibit momentarily. 22 A Sure. 23 Q Do you -- Let me know when you're 24 there, at paragraph 148 of your declaration. 25 A That's the bottom of 55. Yes. I'm	Page 80 1 line 20. 2 Do you see that? 3 A Yes. 4 Q Okay. So now let's go back to -- 5 A Shin. 6 Q Let's go back to Shin, Exhibit 1010. 7 And I'll direct you specifically to 8 column 3 of Shin. Starting at line 4, do you 9 see it says, A vacuum forming step of 10 vacuumizing the inside of the reaction reservoir 11 by using the vacuum forming means. 12 And it also describes a heat treatment 13 step of inputting and heat-treating waste 14 batteries to be treated by opening a gas 15 blocking door of the inlet. 16 Do you see that? 17 A Yes. 18 Q Okay. So is -- is that what you were 19 referring to in your declaration, when you said 20 the batteries are heated under a vacuum to 21 evaporate electrolyte, and the resulting gas is 22 released in the process? 23 MR. SCHENKER: Objection. Form. 24 A Yes. That's what I was referring to. 25 Q. (BY MR. LaROQUE) So I'd like to direct
Page 79 1 there. 2 Q And do you see you say, Similarly, 3 Shin provides examples in which waste batteries, 4 including lithium-ion batteries, are heated 5 under a vacuum to evaporate electrolyte, and the 6 resulting gas is released in the process. 7 Do you see that? 8 A Yes. 9 Q And do you recognize Exhibit 1010, 10 which we just introduced, as the Shin patent 11 that you're referring to here? 12 A Yes. 13 Q So now, in the Shin patent, in 14 Exhibit 1010, if -- I'm sorry? 15 A Shall I go back to Shin? 16 Q Wait. Just -- just a moment. 17 A Okay. 18 Q Let's go to your declaration. I just 19 want to clean that up. 20 So you said that Shin provides 21 examples in which waste batteries, including 22 lithium-ion batteries, are heated under a vacuum 23 to evaporate electrolyte, and the resulting gas 24 is released in the process. And you cite 25 Exhibit 1010 at column 2, line 65, to column 3,	Page 81 1 you, in Shin, Exhibit 1010, now, farther down in 2 column 3. If you go down to line 21, there's a 3 new paragraph there. 4 A Yes. 5 Q And it says, The method further 6 includes a step of injecting inert gas into a 7 treatment space through a gas inlet in order to 8 prevent the inside of the reaction reservoir 9 from exploding subsequently to the vacuum 10 forming step. 11 Do you see that? 12 A Yes. 13 Q So that is column 3, lines 21 to 24. 14 Do you -- do you agree with my 15 numbering there? 16 A Yes. 17 Q But you didn't cite those lines in 18 your declaration at paragraph 148, correct? 19 A I'm going to go back to my declaration 20 and see which lines I did. 21 Q Go right ahead. Sure. 22 A I'm going to start around page 55, so 23 265 to 320. 24 Q Yeah. The part of your declaration 25 that we were looking at was -- was in paragraph

21 (Pages 78 - 81)

Page 82 1 148. 2 A Dr. Shin. Yes. I didn't -- I didn't 3 include this by reference in my declaration. 4 Do you have a question about that, 5 then? 6 Q I do. 7 Do you agree that -- that injecting 8 inert gas into the treatment space, as described 9 at these lines, column 3, lines 21 to 24, 10 would -- would reduce the vacuum in the 11 treatment space? 12 MR. SCHENKER: Objection. Vague. 13 Lacks foundation. 14 A It wouldn't necessarily reduce the 15 vacuum, because the vacuum is being created by 16 the vacuum forming device, which is a pump. And 17 if it's reducing the vacuum, or it's reducing 18 the air pressure inside, creating resulting 19 certain amount of vacuum, instead of that gas 20 that's remaining behind being, you know, a lot 21 of oxygen and nitrogen and other things, 22 especially oxygen, that could be -- contribute 23 to something exploding, you can -- it could 24 introduce argon, which is an inert gas, to just 25 lower the oxygen content and thus reduce the	Page 84 1 maintained by the vacuum pump at the same vacuum 2 level. But it is going to now have a mixture of 3 inert gas; for example, argon, just to keep the 4 percentage of oxygen as lower. 5 So it doesn't -- the -- the regulation 6 of the vacuum hasn't changed, and that means the 7 amount of gas overall in the reaction space, the 8 treatment space, is maintained at a fairly 9 constant vacuum. 10 Q There's no express disclosure of that 11 in Shin, is there, maintaining the treatment 12 space at a particular vacuum level after the 13 vacuum forming step? 14 MR. SCHENKER: Objection. Form. 15 A They don't -- they don't say that, but 16 a person of ordinary skill knows that, by 17 introducing -- you know, if it's a closed 18 chamber, then adding argon would change the -- 19 the level of vacuum. 20 But since this is -- you know, has a 21 vacuum being drawn on the -- on the treatment 22 space, adding argon becomes -- unless you are 23 replacing the argon with a complete trickle of 24 argon coming in, or a trickle -- or a fairly 25 decent flow -- and it doesn't have to be
Page 83 1 chance of an explosion. 2 Q. (BY MR. LaROQUE) But if you introduce 3 argon into that chamber, you're -- you're 4 reducing the vacuum, aren't you? 5 A Not necessarily. You're introducing 6 argon -- the amount of vacuum would be 7 determined by the work done by that vacuum pump 8 and maintaining a certain level of suction. 9 You're now replacing oxygen and other gases that 10 are already there and then are being evacuated 11 by the pump. You're just adding argon to the 12 mix, and everything -- and that's probably not 13 just a one-time addition of the argon. You're 14 probably putting it in there -- you would have 15 to continually put it in there because there's a 16 vacuum, which means that the gas that's there 17 now is not going to be there two seconds from 18 now, or instantly, as it's being sucked out. 19 You've got to replace it. And you want to make 20 sure that the mixture of gases that are in the 21 reaction reservoir are not having enough oxygen 22 to create an explosion. So you're replacing it 23 with argon. 24 So the mix of gas -- and the 25 pressure -- the pressure is going to be	Page 85 1 argon -- unless you're replacing that 2 continuously, then whatever you put in would 3 then be sucked out. 4 So right now what you're putting in is 5 sucked out, but you are just making it so that 6 the mixture of gases in the chamber is now going 7 to be resistant to causing an explosion because 8 you reduce the concentration of oxygen by 9 increasing the concentration of other gases. 10 And you reach a steady state, once you 11 get a flow of argon going through there, of the 12 inert gas going through there, but understanding 13 that, whatever gases are there are continuously 14 being sucked all the way through, because the 15 system is working under a vacuum. 16 If you are doing this in terms of a 17 batch, where you come into a reaction chamber 18 and then you stop to go through your 19 pyrolysis -- or your heat process, then, once 20 you put in extra pressure with the argon, you 21 could continue to use the pump until it is down 22 to the vacuum that you had before, knowing now 23 you have at least brought the concentration of 24 oxygen down by adding the inert gas. 25 So I do not agree that it would be

22 (Pages 82 - 85)

Page 86 1 reducing the pressure -- or reducing the vacuum. 2 Q. (BY MR. LaROQUE) Let me ask you a 3 different question. 4 If you go up to column 3, at line 4, 5 do you see it refers to a vacuum forming step? 6 A Yes. 7 Q And if you go down column 3 to line -- 8 well, we can just look at that passage again 9 that we were justing earlier, where it says, The 10 method further includes a step of injecting 11 inert gas into a treatment space through a gas 12 inlet in order to prevent the inside of the 13 reaction reservoir from exploding subsequently 14 to the vacuum forming step. 15 Do you see that? 16 A Yes. 17 Q And you understand vacuum forming step 18 there to be referring back to the vacuum forming 19 step described at line 4? 20 A Yes. The use of the vacuum device, 21 vacuum forming device -- vacuum forming means, 22 yes. 23 Q And -- but there's no -- there's no 24 subsequent vacuum forming step that's described 25 at lines 21 to 24, correct?	Page 88 1 putting -- you keep putting inert gas injected 2 in there. And, you know, it's hard to read 3 whether they're doing this on a continuous basis 4 or a little bit of batch. But, either way, each 5 time they take -- they take care to make sure 6 that they're not going to have an explosive 7 mixture of gas in the reaction reservoir. 8 Q. (BY MR. LaROQUE) I want to follow -- 9 A And -- 10 Q Go ahead. 11 A And they do that subsequently to the 12 vacuum forming step. So, in other words, 13 they're pulling a vacuum to make sure that the 14 gas that's in there is no longer -- has enough 15 oxygen to really contribute to a bad reaction. 16 Q If you've already pulled the oxygen 17 and then you put in the inert gas, is there any 18 advantage to continuing to pull that -- that 19 same vacuum that you started with? 20 A Well, when you -- 21 MR. SCHENKER: Objection. 22 A When you -- we don't have the basis 23 for this question, but -- if you do the -- they 24 don't call it the pyrolysis step. They call it 25 the reaction reservoir, the reaction.
Page 87 1 MR. SCHENKER: Objection. Form. 2 Lacks foundation. 3 A Further down in column 3, at line 35, 4 you -- you injected inert gas at line 21. You 5 are using another injection of inert gas into 6 the treatment space, again to prevent the 7 reaction reservoir from exploding subsequent -- 8 in the subsequent vacuum forming step. 9 So, again, you're going to be -- it 10 doesn't say, continuous injection of inert gas, 11 but it does repeat, and it seems to be a 12 repetitive process, where you're putting in the 13 inert gas. And this -- this repetition -- if 14 done as the process is going on, this repetition 15 is going to be going on often, and you're going 16 to do it every time you feel the need to keep 17 the explosive gas tendency -- or ability for 18 explosive reaction to take place to be minimized 19 by -- it doesn't say what I've said here. But 20 the answer is, you put in that inert gas to 21 dilute the oxygen, so that there's not enough 22 oxygen to really auto-ignite at this high 23 temperature during this step, the treatment 24 step. 25 So I can read it as, yeah, you keep	Page 89 1 But if they -- if they do that and 2 then separate the material to another reservoir, 3 then they -- and there's an outside door that 4 opens up and collects this material, then you 5 have more material coming into the reaction 6 reservoir, and thus a need for more inert gas to 7 come in. 8 So they seem to be doing this almost 9 like on a -- they say that they're using 10 continuous heat treatment here. But it seems 11 that little door is opening and closing as the 12 material is heated, cooked, off-gassed, and then 13 moved to a collection bin. 14 And at each step, it looks like they 15 are putting in some inert gas to keep the 16 reaction space low, because when you are doing 17 the cooking, you are producing some material 18 that's -- results from decomposition of the 19 electrolyte, the binder, and the separator. And 20 those are all going to contribute to having a 21 mix of things that could be explosive. 22 Q. (BY MR. LaROQUE) So you mentioned 23 these doors opening and closing and the new 24 material being put in. 25 Does that make this more like batch

Page 90 1 processing than continuous processing? 2 A Well, see, they characterize it as -- 3 as continuous heat treatment. 4 But -- addressing -- starting with the 5 next paragraph down, at line 42, In the waste 6 battery treatment apparatus using continuous 7 heat treatment and the method of recovery 8 valuable metals from lithium batteries, and same 9 according to the present invention, the 10 following effects can be expected. 11 And this -- this looks to me like this 12 is a -- a batch treatment, but it seems to be 13 performed in fairly -- like in different, you 14 know, aliquots. I wouldn't call it batches. 15 It's not like a batch of batteries. It would be 16 a whole bunch of batteries, and they're augered 17 materials -- basically, they're comminuted 18 materials -- are coming in at a certain amount 19 into the chamber, moving on to the next step, 20 almost like next, next, next, with the reaction 21 doors opening and closing, and then the gas 22 being added in as well each time for the -- it 23 is a continuous heat process. But then 24 they're -- when the amount that's over the 25 heating elements is cooked and done, it moves	Page 92 1 Hayashi patent, which was Exhibit 1006 to 2 Ascend's IPR petition. 3 A Yes. 4 Q And you've seen this before? 5 A Yes. 6 Q I would like to direct your attention 7 to Figure 1 of the Hayashi patent, which is at 8 page 3. 9 A Yes. 10 Q Do you see the rectangle there, that's 11 labeled number 10? 12 A Yes. 13 Q Do you know what that is? 14 MR. SCHENKER: Objection. Form. 15 Lacks foundation. 16 A Number -- 17 Q. (BY MR. LaROQUE) Strike that. 18 A Okay. 19 Q Go ahead. You can answer. 20 A Number 10 seems to be a battery. 21 Q And let me direct you to column 6, 22 which is at page 8. 23 A Yes. 24 Q And starting at line 2, do you see it 25 says, One example of a wet processing step
Page 91 1 off quickly to being collected. 2 So it's -- I would call it -- call it 3 a continuous process, other than it was -- 4 doesn't need a lot of human intervention. 5 You're putting -- As long as you're feeding raw 6 materials in at one end, you're going to be 7 getting out your inactivated material at the 8 other. 9 Q Okay. Understood. 10 So fair to say it's a batch process 11 that doesn't require a lot of human 12 intervention? 13 MR. SCHENKER: Objection. Form. 14 A That would be my interpretation. 15 Q. (BY MR. LaROQUE) Okay. All right. 16 I'm going to introduce another exhibit, so give 17 me just a moment. 18 (Previously Marked Deposition Exhibit 19 Number 1006 introduced.) 20 All right. I've just added 21 Exhibit 1006 to the Marked Exhibits folder, 22 Dr. van Schalkwijk. 23 Do you see that? 24 A I do. 25 Q And, for the record, this is the	Page 93 1 (water cooling capture) is illustrated in 2 Figure 1. As illustrated, a battery 10 is 3 contained in heating equipment 15, the pipe 4 passage 12 extending from the opening 11 of the 5 battery 10 is connected to a vacuum pump 13 6 through a cooler 16 and a water cooling trap 14? 7 Do you see that? 8 A Yes. 9 Q Which is a long way of getting around 10 to, does that confirm your understanding that 11 number 10 in Figure 1 is a battery? 12 A Yes. 13 Q And in Figure 1 -- there's just one 14 battery shown in -- in Figure 1. Is that -- 15 that fair? 16 A Yes. For simplicity, I might add. 17 Q If you go to -- back to column 6 and 18 you go down to line 44. 19 A Yes. 20 Q Do you see, between lines 44 and 49, 21 there is again a reference to a battery 10? 22 Do you see that? 23 A Yes. 24 Q And if you go to Figure 2 -- 25 Well, before you go there, do you see

Page 94 1 that, at column 6, line 44, the passage we were 2 just describing, it says, Another example of the 3 wet processing step is illustrated in Figure 2? 4 A Yes. 5 Q And if you look at Figure 2, do you 6 see that number 10? 7 A Hold on. 8 Q I'm sorry. I missed that. 9 A I said, Hold on. 10 Yeah, I'm there. Now, yes, I see 11 number 10. 12 Q And, again, just one battery is shown, 13 right? 14 A Yes. 15 Q If you go to column 9, and I'm looking 16 starting at line 37. 17 A Okay. 18 Q Do you see it says, The large-sized 19 battery cell for an automobile (the lithium ion 20 battery 1.66 kilograms) was discharged, the 21 packaging sheet was peeled off, the safety valve 22 was opened, and 18 grams of water was added? 23 Do you see that? 24 A Yes. 25 Q And so that's just describing one cell	Page 96 1 probably part of, maybe, a module of, say, 10 of 2 these connected together in a series/parallel 3 combination and then connected with other 4 modules. 5 So that is the cell. The cell is just 6 a bunch of -- it's basically one anode and one 7 cathode, often wound in a cylindrical cell. It 8 would look like a jellyroll, if you looked at 9 the cross-section; anode separator, cathode, 10 then rolled up. It doesn't look as appetizing 11 as a jellyroll cake. 12 To do it in a large-sized battery for 13 an automobile, it's a flat jellyroll. They wind 14 the electrodes and separator around a flat 15 mandrel, and then they remove the mandrel, 16 compress the material, put it in the packaging. 17 So you have this large, rectangular cell, maybe 18 as much as 1 1/2 centimeters thick. And that's 19 the kind of cell I believe they're describing 20 here. 21 So it is a large cell. And that's -- 22 that's what a cell is in -- relative to the 23 construction of an automobile battery. 24 Q And this example 1 that we're looking 25 at here in column 9, that's just describing the
Page 95 1 here, correct? 2 A Yes. That's a big -- that's a big 3 cell, mind you, 1.66 kilograms. But, yes, 4 that's why it says, large-sized battery cell. 5 Q Can you explain to me what the cell 6 is, in relation to the rest of the battery? 7 A The battery -- if -- if you have a 8 laptop battery, you might have two or three 9 cells in there. They -- they're connected in 10 series, or parallel, to give you the voltage 11 capacity you need. Your phone has one. A car 12 may have hundreds. The original Tesla has 7,000 13 cells in it, almost. 14 And they're connected in groups of 15 about 10 to 12 cells, which would be called a 16 module. And they -- each of those modules would 17 have their own thermal management and voltage 18 management systems and battery management system 19 attached to them. 20 The cells are getting bigger, so that 21 they can -- you get more energy and have less 22 numbers of cells. And that means less numbers 23 of welds on the inside of the electric vehicle, 24 increasing the reliability, because welds can 25 fail. So these are the large cells. This is	Page 97 1 discharging and -- and peeling off the packaging 2 sheath, opening the safety valve, and adding 3 water to this one large-sized cell, right? 4 A Correct. 5 Q So based on the -- the disclosures 6 that we've just discussed and the figures that 7 we looked at, those are describing the 8 processing of one battery or one cell at a time? 9 MR. SCHENKER: Objection. Form. 10 A They're describing the process in its 11 simplest form, which would be, This is what 12 happens to one cell. Or you could change it to, 13 This is what happens to each cell. 14 If you're wanting to do this in a 15 laboratory, yeah, you would do this process, and 16 you'd do it to one cell. 17 If you want to do this in a recycling 18 facility, you would have a whole bunch of 19 batteries come in at once, maybe the -- the cell 20 has already been discharged. There may be an 21 automated way of taking the packing sheet off, 22 the safety valve opened, and the water ejected. 23 And it could probably do that to many, many 24 cells at once. 25 So to that end, it becomes a much

25 (Pages 94 - 97)

Page 98 1 larger process. But you don't need to describe 2 the many. You could describe the one and say, 3 yeah, this is how it -- this is how it operates. 4 Q. (BY MR. LaROQUE) Let's go back to 5 something that -- that we were discussing 6 earlier, when we were talking about the Meador 7 patent. 8 And you -- you said your understanding 9 was that Meador was teaching a continuous 10 battery recycling process, correct, as opposed 11 to a batch process? 12 A Yes. 13 MR. SCHENKER: Objection. Form. 14 Q. (BY MR. LaROQUE) And you remember we 15 spent some time talking about the seals that 16 Meador uses to maintain the vacuum in its 17 system? 18 We looked at water seal and also the 19 pressure switch. Do you remember that? 20 A Yes. 21 Q And I'm wondering, what -- in your 22 experience, what devices would a person of 23 ordinary skill in the art have known to use to 24 maintain a vacuum in these continuous processing 25 systems?	Page 100 1 to be able to, you know, completely evaporate 2 that and then cook it away. 3 But you don't want your sealing 4 material, your polymeric seals, to be damaged, 5 or you would have to replace them every time. 6 You'd want them to last a certain amount of time 7 before they go through maintenance checks or -- 8 and whatever process they have for maintaining 9 their equipment. 10 But you would use a -- probably a 11 fluoropolymer, because they're much more 12 resistant, chemically resistant. So it would be 13 a fluorene-based polymer gasket with a high 14 temperature stability. 15 Q. (BY MR. LaROQUE) Any other seals that 16 a person of ordinary skill in the art might use 17 in a continuous -- continuous recycling process 18 such as the one taught in Meador? 19 A You can use, you know, something that 20 is -- it's going to be a clamped-down, 21 metal-to-metal seal. 22 But, you know, these are going to be 23 very corrosive gases. There is going to be 24 hydrogen fluoride that is made. You try to then 25 sequester it and get rid of it.
Page 99 1 A It would be -- 2 MR. SCHENKER: Objection. Form. 3 A You could have it be entirely metal 4 seals. But metal seals would be subjected to a 5 lot of corrosion here. You could have, more 6 likely than not -- and, in fact, almost 7 certainly -- a polymeric seal, a little bit of 8 give to it. In other words, it's -- it could be 9 compressed a little bit with pressure, in order 10 to help make a tight seal. 11 It would be something that is 12 temperature resistant, wouldn't decompose at the 13 temperatures of the operation. 14 And -- so it would also -- you know, 15 you're -- during some of these heat treatment 16 processes, the high-temperature heat treating, 17 you're cooking off the polyvinylidene fluoride, 18 the binder, that are holding anode and cathode 19 particles together and also holding the anode 20 and cathode to their respective substrates, 21 aluminum and copper. You want to cook those 22 off, so you'd need a temperature that can cook 23 those polymers. 24 And also the 25 polypropylene-polyethylene separator, you want	Page 101 1 But if you have metal-to-metal seals, 2 they would eventually corrode a little bit and 3 no longer be a seal. 4 If I'm designing a system with a seal, 5 I'm going to use a polymer. 6 Q Understood. 7 Do you have experience working with -- 8 with these polymer seals? 9 A I do. Some of the polymer seals have 10 gotten better over the years, and -- but I 11 designed -- I've been doing lithium-ion 12 batteries since before they were commercialized. 13 And when -- even when they were commercialized, 14 we would take cells, and we want -- the first 15 lithium-ion cells would get 300 cycles, and 16 everybody was all ecstatic. Now, in order to 17 put them in an electric vehicle, they need to be 18 able to do thousands of cycles. 19 And in order to understand the 20 chemistry, we essentially recycled the 21 materials. We took cells, opened them up with 22 a -- we discharged them to zero; we then opened 23 them up with a pipe cutter, because they were 24 all cylindrical cells in those days; and then we 25 popped off the electrical connections between

26 (Pages 98 - 101)

Page 102 1 anode and cathode; and we put on a little 2 polymeric seal, a round seal, a gasket, around 3 the top of the cell connected to a hose; and 4 then we would vacuum out the electrolyte. 5 We would -- we would heat the cell to 6 about -- in the vicinity of 80 degrees. We 7 didn't want to go above 80 degrees, because, 8 that way, we would be making a little bit too 9 much decomposition of the salt and making 10 hydrogen fluoride and POF₃, which is a 11 neurotoxin. I have experience with getting that 12 on me once. That wasn't fun. 13 But we would repetitively open up 14 cells. We would collect the gas and then 15 condense the gas. And by condensing the gas in 16 a cooling trap, which is similarly described 17 here, you can collect your solvents from the 18 electrolyte. And we could analyze those 19 solvents for, you know, how do those decompose. 20 Oh, if that liquid is now present, then 21 decomposition was taking place at the anode, 22 where that one is evidence of reaction of the 23 cathode. 24 And it helped us with improving 25 electrolytes for the batteries, improving other	Page 104 1 of recycling. 2 So, yes, I've developed this kind of 3 thing before. And when I've been reading some 4 of these methods that people are trying to 5 devise, it comes back to me. Because we didn't 6 do these just one at a time; we had a fixture so 7 we could do 10 or 20 cells at a time. So it can 8 be not just a simple cell going. It could be a 9 whole lot of cells. And we can examine all of 10 this based on the guts that we were looking at 11 from each cell. 12 We knew the charging history, the 13 voltage, the current, the temperature that that 14 cell was exposed, so we could really make a lot 15 of observations with regard to what's happening 16 in the chemistry under all of these different 17 conditions. 18 So we necessarily had to develop 19 recycling schemes to do this. 20 Q So you mentioned just a moment ago 21 that you could to 10 or 20 cells at a time? 22 A Yes. 23 Q Did you consider this a continuous 24 process or a batch process? 25 A It was certainly a batch process. I
Page 103 1 materials. We would then pull out the jellyroll 2 and unwind it, rinse it off with solvents, and 3 then examine it, x-ray-wise and with other 4 techniques. We would look at it 5 electrochemically. We would look at it 6 spectroscopically. And it allowed us to make 7 improvements to the electrodes materials. 8 And then just -- so this was the 9 extent of which we did recycling. We -- there 10 were no commercial batteries out there to be 11 collected and recycled. So we were -- we were 12 doing recycling in this manner, similar to this, 13 for part of our research to improve the lithium 14 batteries. 15 And I guess we were successful, 16 because that same-sized lithium-ion can -- 17 referred to as 18650, when they first were 18 commercialized, they had about one ampere-hour 19 of energy in there. And by just optimizing 20 everything in the -- in the battery chemistry 21 and in the construction of the cell, within -- 22 within less than a decade, we got three times as 23 much energy than the same-sized can, without 24 really making any huge, huge changes to the 25 chemistry. And this is because we did this kind	Page 105 1 mean, we didn't -- we didn't -- we -- this is 2 pre-commercialization, some of this work. And 3 we were -- we didn't want to put out a bad 4 product, so we were learning as much as we can 5 about the product. And one way to do that is to 6 recycle the materials, understand their -- their 7 shortcomings and their failure modes, and then 8 put them back, maybe with a different batch of 9 electrolyte, and see if we could improve it and 10 that battery would last longer. 11 So it was -- we had a tray, I would 12 say, 20 cells. We had something come down with 13 all of the different seals going onto the top of 14 those cells. And it kinda looked like an 15 inverted cow milker, with all the suction 16 devices on there. And we could then pull out 17 all of the material we wanted from the 18 batteries. 19 I only had, you know, so many 20 scientists working on this at once, that -- 21 doing 20 of these, two and three times a week, 22 kept them pretty busy with doing a lot of 23 chemical analysis and physical analysis. 24 Q Do you have any experience working 25 with these polymeric seals in a continuous

27 (Pages 102 - 105)

Page 106 1 processing environment for battery recycling? 2 A I have been at companies that are 3 doing the recycling in -- in Asia and seen what 4 they have for material. 5 Sometimes they were complaining about 6 the lifetime of some of the materials. And, you 7 know, I made suggestions to different polymers 8 they might try, based on my experience. And 9 it -- they stopped complaining, so they must 10 have found that they had some success. 11 But I didn't design their system. I 12 was in there consulting on how to improve their 13 systems. 14 Q And those were continuous processing 15 systems? 16 A Those were continuous processing 17 systems, or they were gearing it up to be such. 18 Again, even today, having enough material to 19 work with on a continuous basis is sometimes a 20 problem. 21 Q Do you happen to remember what kinds 22 of -- whether they were doing that processing 23 under vacuum? 24 A Oh, yes. Absolutely. 25 Q Do you happen to remember, like,	Page 108 1 Q That is at page 65. 2 A 172? 3 Q Paragraph 172. Correct. 4 A Okay. I'm there. 5 Q Okay. And do you see, in the middle 6 of that paragraph, it says -- you say, Further, 7 I am unaware of any secondary considerations 8 that tend to show nonobviousness of the 9 challenged claims? 10 A Yes. 11 Q Now, you didn't actually go out and do 12 an investigation of secondary considerations, 13 did you? 14 MR. SCHENKER: Objection. Form. 15 A For example, looking at literature, 16 looking at websites, looking at awards of people 17 glowingly discussing the '097? 18 Q. (BY MR. LaROQUE) Those would be 19 examples, yeah. 20 A No. I haven't. 21 Q All right. So you just said that 22 you're not aware of any? 23 A I am not aware of any, and, yet, I've 24 been searching -- even aside from this matter, 25 I've been looking at recycling literature for
Page 107 1 what -- what vacuum levels they were using? 2 A They were using different vacuums, 3 ranging from slight vacuum to something that 4 would blow your hair, if you had hair. 5 But, you know, you didn't want the 6 vacuum to be intense, because it was -- one, it 7 takes a lot of energy to maintain an intense 8 vacuum, a lot of carrier gas; and it takes, 9 also -- you know, you might -- when you're 10 getting down -- especially on the higher 11 temperature portion of the battery recycling, 12 when you're up doing decomposition, you're 13 getting down to particulates. And if you have a 14 vacuum that is really intense, it's sucking air 15 and moving air, and you can get some of the 16 particulate matter from the deactivated anode 17 and cathode coming out. It's -- it's abrasion 18 that will damage your equipment. So you want to 19 have a vacuum that moves air but not particles. 20 Q Understood. 21 All right. I'd like to switch gears 22 here and go back to your declaration, which is 23 Exhibit 1003. And if I could direct you to 24 paragraph 172. 25 A Page number for me?	Page 109 1 other reasons. 2 Q I'm sorry. I don't think I -- I don't 3 think I quite followed that. 4 So -- so what -- can you -- you said 5 that you've been looking at recycling literature 6 for other reasons? Was that an investigation 7 into secondary considerations? 8 A No. That -- that would appear -- you 9 know, if people were talking about some 10 company's stuff -- method being above all 11 others, or things like that, or award-winning, 12 or praised, I wasn't finding that with regard to 13 the plaintiff's patent, '097 patent. 14 And my search in that regard was 15 looking for any and all things about lithium-ion 16 rechargeable battery recycling. 17 Q Was that specifically in the context 18 of this matter? 19 A No. It actually predates this matter. 20 I'm writing a book on -- that's being 21 published by Wiley sometime this spring, on 22 sustainability of the lithium-ion battery 23 industry, and a couple chapters were on 24 recycling. 25 Q Okay. But in your declaration, you

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Page 110 1 just say that you're unaware of any secondary 2 considerations, right? 3 A In all the matter that I dug up for 4 writing those chapters, I didn't see anything -- 5 any -- any secondary considerations. 6 Q Okay. You don't describe those -- 7 those chapters -- the research that you did into 8 those chapters in your declaration, though, 9 right? 10 A I did not. 11 Q Okay. I'd like to direct you to 12 paragraph -- actually, a range of paragraphs in 13 your declaration, starting at paragraph 33 and 14 going all the way through paragraph 63. That's 15 between pages 11 and 20. 16 A Okay. I am at 33. 17 Q Okay. And I just -- I just wanted to 18 ask you, did you write this section of your 19 declaration? 20 A Yes. 21 Q And I notice that there's not -- that 22 there are no references cited in this range of 23 paragraphs, 33 to 63. You're welcome to 24 confirm. 25 But is that -- is that what you see as	Page 112 1 MR. LaROQUE: So, Josef, I'm -- I 2 think I'm just about done, but I do want to go 3 back through my notes. 4 I know you mentioned a lunch break. 5 If -- you know, if -- I'm happy to take two 6 minutes now, see if there's anything else, and 7 then wrap up, or we could do it after lunch. 8 MR. SCHENKER: Why don't we take a few 9 minutes, see if you're done. And then I want a 10 five-, ten-minute break, just to confirm that I 11 don't have anything. 12 MR. LaROQUE: Okay. Sounds good. 13 THE VIDEOGRAPHER: We are going off 14 the record. The time now is 11:31. 15 (Whereupon, a recess was taken.) 16 THE VIDEOGRAPHER: We are back on the 17 record. This is the start to media number 4. 18 The time is 11:43. 19 MR. LaROQUE: Dr. van Schalkwijk, I 20 confirmed that I have no further questions for 21 you, so I will pass the witness. 22 MR. SCHENKER: Thank you. 23 EXAMINATION 24 BY MR. SCHENKER: 25 Q Dr. van Schalkwijk, can you turn back
Page 111 1 well? 2 A That's what I see as well. 3 I -- I've been doing lithium-ion 4 batteries longer than probably most of the 5 people that are alive and still working on them. 6 And a lot of this is -- to me, this is general 7 knowledge that I've accumulated. I've published 8 two other books already on lithium-ion 9 batteries, so a lot of this stuff is just 10 dancing around in my head, ready to come out of 11 my fingers on the type -- keyboard. 12 Q So you -- 13 A So I didn't have to refer to 14 references to write these. A lot of these were, 15 like, well-known. 16 Q Okay. Did you, by any chance, use an 17 AI tool, artificial intelligence tool, to write 18 any of this text? 19 A No. No. In fact, I -- I wrote 20 this -- I don't know -- last spring, and that 21 was before I really became GPT-conscious, which 22 was, like, toward the end of last year that I 23 started even thinking about GPT. So this is all 24 my writing. 25 Q Understood.	Page 113 1 to Exhibit 1011, Meador? 2 A Okay. 3 Q And I believe, during the original 4 examination, there were some questions as to the 5 level of vacuum in Meador and whether that 6 was -- that half-inch of mercury was an absolute 7 vacuum or a relative vacuum. Is that right? 8 A Yes. 9 Q If you look at -- Can you turn to 10 claim 3 of Meador? 11 A Yes. 12 Q And you see claim 3 says, The process 13 of claim 1 wherein the vacuum maintained in the 14 pyrolysis chamber is about one-half to 1 inch of 15 mercury? 16 A Yes. 17 Q That doesn't specify that that's a 18 relative vacuum, does it? 19 A It does not. 20 MR. LaROQUE: Object to form. 21 Q (BY MR. SCHENKER) Does that specify 22 it's the vacuum maintained in the chamber? 23 MR. LaROQUE: Object to form. 24 A It does say that that is the vacuum 25 maintained in the pyrolysis chamber. Yes.

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Page 114 1 Q (BY MR. SCHENKER) So could you 2 understand that as referring to the absolute 3 pressure in the pyrolysis chamber? 4 MR. LaROQUE: Objection. Leading. 5 A When I was trying to decide whether 6 that was an absolute pressure or a relative 7 pressure, I looked at the structure of the 8 system and saw the water, and said, I can't have 9 water evaporating and going into the system this 10 much. So this has to be a -- a gentle vacuum, 11 which is why I called it a slight vacuum in my 12 declaration. And a slight vacuum is good enough 13 to make a good, constant airflow. 14 Q. (BY MR. SCHENKER) Thank you. 15 MR. SCHENKER: No further questions. 16 THE VIDEOGRAPHER: Anything else? 17 MR. LaROQUE: Give me just a moment. 18 Nothing further from me. 19 THE VIDEOGRAPHER: This concludes 20 today's deposition. The time now is 11:46 a.m. 21 (Proceeding concluded at 11:46 a.m.) 22 * * * 23 24 25	Page 116 1 Veritext Legal Solutions 2 1100 Superior Ave 3 Suite 1820 4 Cleveland, Ohio 44114 5 Phone: 216-523-1313 6 7 February 10, 2025 8 9 To: Josef Schenker, Esq. 10 11 Case Name: Duesenfeld GmbH v. Ascend Elements, Inc. 12 13 Veritext Reference Number: 7139923 14 15 Witness: Walter van Schalkwijk , PhD Deposition Date: 16 2/6/2025 17 18 Dear Sir/Madam: 19 20 Enclosed please find a deposition transcript. Please have the witness 21 review the transcript and note any changes or corrections on the 22 included errata sheet, indicating the page, line number, change, and 23 the reason for the change. Have the witness' signature notarized and 24 forward the completed page(s) back to us at the Production address 25 shown above, or email to production-midwest@veritext.com. If the errata is not returned within thirty days of your receipt of this letter, the reading and signing will be deemed waived. Sincerely, Production Department NO NOTARY REQUIRED IN CA
Page 115 1 STATE OF MINNESOTA:) 2) ss. CERTIFICATE 3 COUNTY OF ANOKA:) 4 Be it known that I took the deposition 5 of WALTER VAN SCHALKWIJK, PhD the 6th day of 6 February, 2025; 7 That I was then and there a Notary 8 Public in and for the County of Anoka, State of 9 Minnesota, and that by virtue thereof, I was 10 duly authorized to administer an oath; 11 12 That the witness, before testifying, 13 was by me first duly sworn to testify the whole 14 truth and nothing but the truth relative to said 15 cause; 16 That the testimony of said witness was 17 recorded in shorthand by me and was reduced to 18 typewriting under my direction; 19 That the cost of the original 20 transcript has been charged to the party 21 noticing the deposition, unless otherwise agreed 22 upon by Counsel, and that copies have been made 23 available to all parties at the same cost, 24 unless otherwise agreed upon by Counsel; 25 That I am not related to any of the parties hereto nor interested in the outcome of the action; That the reading and signing of the deposition by the witness and the Notice of Filing were reserved. WITNESS MY HAND AND SEAL this 10th day of February, 2025.  Christine K. Herman, RPR, CRR	Page 117 1 DEPOSITION REVIEW 2 CERTIFICATION OF WITNESS 3 4 ASSIGNMENT REFERENCE NO: 7139923 5 CASE NAME: Duesenfeld GmbH v. Ascend Elements, Inc. 6 DATE OF DEPOSITION: 2/6/2025 7 WITNESS' NAME: Walter van Schalkwijk , PhD 8 In accordance with the Rules of Civil 9 Procedure, I have read the entire transcript of 10 my testimony or it has been read to me. 11 I have made no changes to the testimony 12 as transcribed by the court reporter. 13 14 Date _____ Walter van Schalkwijk , PhD 15 Sworn to and subscribed before me, a 16 Notary Public in and for the State and County, 17 the referenced witness did personally appear 18 and acknowledge that: 19 20 They have read the transcript; 21 They signed the foregoing Sworn 22 Statement; and 23 Their execution of this Statement is of 24 their free act and deed. 25 I have affixed my name and official seal this _____ day of _____, 20____. _____ Notary Public _____ Commission Expiration Date

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Duesenfeld Ex. 2004-030

1 DEPOSITION REVIEW 2 CERTIFICATION OF WITNESS 3 ASSIGNMENT REFERENCE NO: 7139923 4 CASE NAME: Duesenfeld GmbH v. Ascend Elements, Inc. 5 DATE OF DEPOSITION: 2/6/2025 6 WITNESS' NAME: Walter van Schalkwijk , PhD 7 In accordance with the Rules of Civil 8 Procedure, I have read the entire transcript of 9 my testimony or it has been read to me. 10 I have listed my changes on the attached 11 Errata Sheet, listing page and line numbers as 12 well as the reason(s) for the change(s). 13 I request that these changes be entered 14 as part of the record of my testimony. 15 I have executed the Errata Sheet, as well 16 as this Certificate, and request and authorize 17 that both be appended to the transcript of my 18 testimony and be incorporated therein. 19 _____ 20 Date Walter van Schalkwijk , PhD 21 Sworn to and subscribed before me, a 22 Notary Public in and for the State and County, 23 the referenced witness did personally appear 24 and acknowledge that: 25 They have read the transcript; They have listed all of their corrections in the appended Errata Sheet; They signed the foregoing Sworn Statement; and Their execution of this Statement is of their free act and deed. I have affixed my name and official seal this _____ day of _____, 20____. _____ Notary Public _____ Commission Expiration Date	Page 118
1 ERRATA SHEET 2 VERITEXT LEGAL SOLUTIONS MIDWEST 3 ASSIGNMENT NO: 7139923 4 PAGE/LINE(S) / CHANGE /REASON 5 _____ 6 _____ 7 _____ 8 _____ 9 _____ 10 _____ 11 _____ 12 _____ 13 _____ 14 _____ 15 _____ 16 _____ 17 _____ 18 _____ 19 _____ 20 _____ 21 Date Walter van Schalkwijk , PhD 22 SUBSCRIBED AND SWORN TO BEFORE ME THIS _____ 23 DAY OF _____, 20____ . 24 _____ 25 Notary Public _____ Commission Expiration Date	Page 119

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Federal Rules of Civil Procedure

Rule 30

(e) Review By the Witness; Changes.

(1) Review; Statement of Changes. On request by the deponent or a party before the deposition is completed, the deponent must be allowed 30 days after being notified by the officer that the transcript or recording is available in which:

(A) to review the transcript or recording; and

(B) if there are changes in form or substance, to sign a statement listing the changes and the reasons for making them.

(2) Changes Indicated in the Officer's Certificate. The officer must note in the certificate prescribed by Rule 30(f)(1) whether a review was requested and, if so, must attach any changes the deponent makes during the 30-day period.

DISCLAIMER: THE FOREGOING FEDERAL PROCEDURE RULES ARE PROVIDED FOR INFORMATIONAL PURPOSES ONLY.

THE ABOVE RULES ARE CURRENT AS OF APRIL 1, 2019. PLEASE REFER TO THE APPLICABLE FEDERAL RULES OF CIVIL PROCEDURE FOR UP-TO-DATE INFORMATION.

VERITEXT LEGAL SOLUTIONS

COMPANY CERTIFICATE AND DISCLOSURE STATEMENT

Veritext Legal Solutions represents that the foregoing transcript is a true, correct and complete transcript of the colloquies, questions and answers as submitted by the court reporter. Veritext Legal Solutions further represents that the attached exhibits, if any, are true, correct and complete documents as submitted by the court reporter and/or attorneys in relation to this deposition and that the documents were processed in accordance with our litigation support and production standards.

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