Before the
United States Copyright Office,
Library of Congress

In the Matter of	)	
Exemption to Prohibition on Circumvention of Copyright Protection Systems for Access Control Technologies	)	Docket No. 2014-07

PROPOSED CLASS #21 PROPONENTS:

Intellectual Property & Technology Law Clinic,
University of Southern California

Submitter Information:

USC Intellectual Property and
Technology Law Clinic
University of Southern California
Gould School of Law
699 Exposition Boulevard
Los Angeles, CA 90089
Phone: (213) 740-7088
E-mail: ipt@law.usc.edu

Dan D. Nabel, Esq. Interim Director
With assistance from:
Mark Hilkert, *Law Student*
Abtin Amir, *Law Student*
Charlotte Wen, *Law Student*
Alexandria Chu, *Law Student*

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Long Comment Regarding a Proposed Exemption Under 17 U.S.C. 1201

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Item 1. Commenter Information

Submitter: Intellectual Property & Technology Law Clinic, University of Southern California

E-mail Address: ipt@law.usc.edu

Phone Number: (213) 740-7088

Address: USC Gould School of Law
USC Intellectual Property & Technology Law Clinic
University of Southern California
Los Angeles, CA 90087-0074

Item 2. Proposed Class Addressed

Item 2.1 Proposed Class 21: Vehicle software – diagnosis, repair, or modification

This proposed class would allow circumvention of TPMs protecting computer programs that control the functioning of a motorized land vehicle, including personal automobiles, commercial motor vehicles, and agricultural machinery, for purposes of lawful diagnosis and repair, or aftermarket personalization, modification, or other improvement. Under the exemption as proposed, circumvention would be allowed when undertaken by or on behalf of the lawful owner of the vehicle.[1]

This petition focuses primarily on the "agricultural machinery" portion of this proposed class.[2] However, we incorporate by reference and join in the petition filed by the

[1] The Copyright Office asked, in its Notice of Proposed Rulemaking ("NOPR"), "[w]hether a third party – rather than the owner of the vehicle – may lawfully offer or engage in the proposed circumvention activities with respect to that vehicle pursuant to an exemption granted under 17 U.S.C. 1201(a)(1)." The answer is: yes, they may. Third parties providing services for the purpose of repairing a vehicle, which only incidentally involve circumvention of TPMs, are not engaging in behavior covered by 17 USC 1201(a)(2)(A). Such services do not have "only limited commercially significant purpose or use other than to circumvent a technological measure that effectively controls access." Such persons are in the business of repairing vehicles; they are not in the business of circumventing TPMs to facilitate piracy.

[2] On November 3, 2014, we submitted two separate petitions requesting an exemption allowing farmers to circumvent relevant TPMs for the purpose of diagnosing, repairing, and modifying their own farm equipment. Concurrently, EFF submitted a petition requesting a similar exemption covering motorized vehicles, generally. The Copyright Office, in its NOPR, combined these petitions and proposed a single, aggregated class of vehicles/machinery.

Electronic Frontier Foundation ("EFF") addressing the broader proposed class.

Item 3. Overview

> "[God said,] 'I need somebody with arms strong enough to rustle a calf and yet gentle enough to deliver his own grandchild. Somebody to call hogs, tame cantankerous machinery, come home hungry, have to wait lunch until his wife's done feeding visiting ladies and tell the ladies to be sure and come back real soon -- and mean it.' So God made a farmer."
>
> --Paul Harvey

In 1978, when Paul Harvey delivered his famous "So God Made a Farmer" speech,[3] he conceived of a God who created a farmer possessing, among many other virtues, the ability to "tame cantankerous machinery." Back then, the Digital Millennium Copyright Act ("DMCA") and the term "technological protections measures" ("TPMs") did not yet exist. But if they had, Harvey probably would have found the very idea of a farmer facing potential legal liability for taming his own "cantankerous machinery" offensive.

Unfortunately, this has become an actual legal issue. Increasingly, original equipment manufacturers ("OEMs") of agricultural machinery[4] use TPMs to prevent farmers from diagnosing, repairing, and modifying their own agricultural machinery. OEMs often do this by employing TPMs in the form of: (1) proprietary software, (2) passwords, and (3) computer memory modifications; all of which restrict access to embedded software necessary to diagnose, repair, and modify modern farm equipment.

Farmers can circumvent these TPMs using, among other things, custom software and user-installable "modules" that apply directly into their machines. Additional means of circumvention are being developed, simplified, and shared among farmers daily. But the legal obstacles posed by the DMCA remain a major impediment.

Farmers need an exemption making it legal to circumvent these TPMs for purposes of diagnosis, repair, and modification. Each of these uses, as discussed in detail below, does nothing to infringe the legitimate rights of OEMs.

Without an exemption:

(1) Farmers are left at the mercy of their equipment dealer's time schedules (e.g., if a farmer must plant a crop within 2-3 days before rains come and the dealer can't schedule a repair visit for at least 5-6 days, this presents a very real and serious problem for the farmer) *and* fee schedules

[3] This speech was more recently popularized in the Ram pickup truck commercial entitled "Farmer" which aired during Super Bowl XLVII, available at https://www.youtube.com/watch?v=AMpZ0TGjbWE.
[4] E.g., tractors, transplanters, manure spreaders, diesel hauler trucks, etc.

(e.g., a dealer may charge a $200 minimum fee for a technician to travel to a farm, plug in a computer, tell the farmer that a $5 fuse needs replacing, then leave);

(2) Farmers often must pay their dealers to get their machines running even after the farmers fix the problems themselves (this problem arises from the necessity of "clearing fault codes," discussed in detail below);

(3) OEMs are continuing to strengthen their anti-competitive monopolies on repair services;

(4) Farmers are often unable to take adequate preventative measures to prevent damage to their machines;

(5) OEMs are preventing farmers from safely increasing engine power to meet their needs;

(6) OEMs are preventing farmers from increasing environmental efficiency;

(7) OEMs are preventing farmers from improving accessibility for persons with disabilities and implementing additional safety features; and

(8) Prices of agricultural equipment in secondary markets are becoming unnecessarily inflated.

The Copyright Office should grant such an exemption for farmers because the statutory factors articulated in 17 U.S.C. § 1201(a) weigh in favor of doing so. As discussed more fully below, OEMs use TPMs to substantially inhibit farmers' use of the embedded software on their lawfully-owned machines; and farmers have no available alternatives. Additionally, the exemption would not adversely affect the market for embedded software in agricultural machines in any way since such software is always coupled with the sale of farm equipment.

Farmers need this exemption to (1) get the maximum value out of their farm equipment; and (2) efficiently adapt to the ever-changing farming conditions, market needs, and government regulations that they face.

Item 4. Technological Protection Measure(s) and Method(s) of Circumvention

OEMs are increasingly designing their agricultural machines to employ TPMs that restrict access to internal electronic control units ("ECUs"), also known as engine control modules ("ECMs"). OEMs most commonly restrict access to the machines' ECUs by using: (1) proprietary software, (2) passwords, and (3) computer memory modifications.

Item 4.1 Proprietary Software that Restricts Access to the Embedded Software

Description of TPM

OEMs restrict access to ECUs by programming them to only respond to proprietary OEM software. In most cases, OEMs design ECUs to require both a compatible cable[5] *and* a computer loaded with special proprietary software in order to gain access to the embedded software.[6] Specifically, OEMs design their ECUs to require users to have software that can pass a virtual "handshake" before accessing embedded software, even with the proper cable.[7]

Relevant method(s) of circumvention

OEMs generally supply compatible software to dealer technicians,[8] while sometimes supplying limited-functionality versions of their software to third-party service centers and mechanics.[9] OEMs supply only very limited versions of the software, if any at all, to individual farmers who purchase new machines.[10]

Farmers without compatible software can: (1) purchase the OEM software from someone who has it, (2) pay someone who has developed their own software,[11] (3) find people on the internet or locally who will share compatible software; or (4) develop compatible software from scratch.[12] Farmers who wish to develop compatible software from scratch may sometimes find it to be time consuming and expensive,[13] but there are individuals and businesses—domestic and international—willing to share information and/or sell their services to farmers.[14] Some third parties—many of whom are located in outside the United States—have successfully developed compatible hardware and software capable of modifying ECUs and sell those products to end-users to use on their own machines.[15]

Item 4.2 Passwords that Restrict Access to the Embedded Software

Description of TPM

OEMs often use passwords to prevent farmers from accessing an ECU's embedded

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[5] Before using the software, users must first connect their devices to the agricultural machine's proprietary physical data ports—often referred to as Background Debug Mode ("BDM") ports. Exhibit 2, 5:19-22 and 6:1-5. Individuals can easily create compatible cables by purchasing widely available data cables and physically modifying one end to fit the specific BDM port. Exhibit 2, 15:24-26 and 16:1-18.
[6] Exhibit 2, 10:9-12.
[7] Exhibit 2, 13:12-24.
[8] Exhibit 2, 14:7-10.
[9] Exhibit 2, 11:5-20 and 12:1-7; Exhibit 4, timestamp 15:05 to 19:03
[10] Exhibit 4, timestamp 15:05 to 19:03
[11] Exhibit 2, 3:1-6 and 6:1-5
[12] Exhibit 2, 10:13-16.
[13] Exhibit 2, 16:19-21.
[14] *See, e.g., AgTalk* available at http://talk.newagtalk.com/.
[15] Ex. 2, 12:21-26; AP Tuning (Australia & New Zealand) http://www.aptuning.com.au/agricultural/; DTE Systems (England) http://www.chiptuning.com/eng/chiptuning-products/chiptuning-tractor.html; TuningFiles (England) http://www.tuningfiles.com/tractor.

software,[16] including "factory passwords," and "consumer passwords." OEMs often use "factory passwords" to prevent farmers from: (1) accessing locked functionality (such as diagnostic tools and engine performance settings),[17] (2) programming a new ECU (necessary for replacing malfunctioning ECUs),[18] (3) recovering "consumer passwords" necessary to change important parameters; and (4) clearing fault codes (which often prevent machines from functioning properly). By using passwords, OEMs further prevent farmers (and subsequent purchasers) from changing important parameters on their machines due to the difficulty, or impossibility, of obtaining passwords after the point of first sale.

Relevant method(s) of circumvention

Farmers can circumvent OEM passwords in a variety of ways, including: (1) getting working passwords from other farmers or mechanics with similar machines, (2) looking for working passwords that others have shared online, (3) hacking the passwords by manually guessing them, or (4) using "brute force" methods which employ devices or computers that attempt thousands of guess attempts per second until the correct password is discovered.[19] If farmers are unable to proceed with a password, they can alter the OEM software to circumvent the password checking phase entirely, use third-party software, or develop their own.[20]

Item 4.3 Computer Memory Modifications that Restrict Access to the Embedded Software

Description of TPM

OEMs often restrict access to the embedded software on ECUs by modifying computer memory on the ECU itself. OEMs can do this in at least two ways: (1) volatile memory modifications, and (2) non-volatile memory modifications.

First, OEMs can modify the ECU's "volatile" memory to prevent farmers from utilizing an industry standard computer port known as Joint Test Action Group ("JTAG")[21] and Background Debug Mode ("BDM") ports.[22] Specifically, OEMs place a particular "bit" within the ECU's volatile memory which disables the machine's BDM data port every time the machine is powered on,[23] thereby preventing farmers from using the port to access the machine's embedded software.

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[16] As detailed in the *2010 Recommendation of the Register of Copyrights* (at pp 6-7), the House Commerce Committee offered the use of "password codes" to restrict authorized access to computer programs as an example of a TPM. *See* Report of the House Committee on Commerce on the Digital Millennium Copyright Act of 1998, H.R. Rep. No. 105-551, pt. 2 at 37 (1998) ("Commerce Comm. Report").

[17] Exhibit 4, timestamp 17:15 to 19:03

[18] Exhibit 5, timestamp 25:50 to 27:40

[19] Multiple examples of password circumvention could be found at: http://resources.infosecinstitute.com/10-popular-password-cracking-tools/

[20] Exhibit 2, 10:9 to 12:26.

[21] Craig Smith, *The Car Hacker's Handbook* at 56–57, available at: http://opengarages.org/handbook/2014_car_hackers_handbook_compressed.pdf, ("*Car Hacker's Handbook*").

[22] Exhibit 2, 5:19 to 6:5.

[23] *Car Hacker's Handbook* at 57.

Second, OEMs can modify the ECU's "non-volatile" memory to similarly disable BDM ports. However, because non-volatile memory configurations persist after the machine is powered off, farmers are able to disable the bit so that it does not disable the BDM ports upon powering back on.

Relevant method(s) of circumvention

Farmers can circumvent both volatile and non-volatile memory modifications by disrupting the ECU's electrical signals through a process called "fault injection"[24] Once the farmers circumvent these memory modifications, they can simply re-program (or "re-flash") the ECUs memory with a different set of instructions.[25] Fault injection is often used because it is the most practical means of circumvention.

Fault injection can be used to interrupt the ECU before it has a chance to send signals that would otherwise disable the BDM port, thereby allowing the user to connect to the port in its unlocked state in order to access the embedded software.[26] Farmers can use any of three categories of fault injection (non-invasive, semi-invasive, and invasive) [27] to circumvent volatile and non-volatile memory modifications, but non-volatile memory modifications sometimes require more invasive techniques.[28]

Non-invasive fault injections are effective for circumvention, and they also have multiple benefits. Examples of non-invasive fault injection include clock and voltage glitching.[29] Some benefits of non-invasive fault injections include: not physically altering the card;[30] not permanently altering the card's operation;[31] the relatively low cost (generally less than $3,000);[32] no requirement of expensive labs or specialized microscopes;[33] and no requirement of specialized knowledge about a microchip's inner workings.[34]

Semi-invasive fault injections are also effective, but more expensive than non-invasive ones.[35] Examples of semi-invasive methods include optical, thermal, and flash fault

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[24] Jasper G.J. van Woudenberg, Marc F. Witteman, Federico Menarini, *Practical Optical Fault Injection*, pp. 91–92, available at http://ieeexplore.ieee.org/stamp/stamp.jsp?tp=&arnumber=6076471, ("*Practical Optical Fault Injection*").
[25] Exhibit 2, 6:1-5.
[26] O. Kömmerling, Markus G. Kuhn, *Design Principles for Tamper-Resistant Smartcard Processors* at 7–8, available at http://www.cl.cam.ac.uk/~mgk25/sc99-tamper.pdf.
[27] *Practical Optical Fault Injection* at 91–92.
[28] *Car Hacker's Handbook* at 57.
[29] *Practical Optical Fault Injection* at 91–92.
[30] *Practical Optical Fault Injection* at 91.
[31] Exide, *Glitching for n00bs*, slides available at https://recon.cx/2014/slides/REcon2014-exide-Glitching_For_n00bs.pdf, video available at https://www.youtube.com/watch?v=FhesP8HbpHU, ("*Glitching for n00bs"*).
[32] Mohammad Tehranipoor, *Fault Injection Attacks* at slide 8, available at: http://www.engr.uconn.edu/~tehrani/teaching/hst/07%20Fault-Injection%20Attacks.pdf, ("*Fault Injection Attacks*").
[33] *Glitching for n00bs* at slide 6.
[34] *Fault Injection Attacks* at slide 5.
[35] *Practical Optical Fault Injection* at 91–93.

injection.[36] These methods not only require more expertise, but their cost varies dramatically depending on the security of the microcontroller.[37] Non-secure microcontrollers can be influenced by an $8 laser pointer, or a $30 second-hand flashgun.[38] On the other hand, highly secure microcontrollers can require anywhere between $50,000–$150,000 worth of equipment to circumvent.[39]

Invasive fault injections are considered the least practical method out of the three,[40] and are also the most costly and risky due to the high probability of damaging the ECU during the process.[41]

Item 5. Asserted Noninfringing Uses

Farmers and mechanics rightly believe that the software embedded in their agricultural equipment is theirs to access and modify as they see fit.[42] When it comes to agricultural machinery, whether it's a tractor, loader, or anything else, farmers do not distinguish between the software and the physical machine because they are purchased and used as one piece of equipment.[43] The machines rely on the software to operate, just as they rely on tires, oil, and fuel.[44] Farmers are not in the software business.[45] They are just trying to put the software to use to get the most value out of the machines they purchased.[46] Just as OEMs would not be justified in placing locks on the wheels of a tractor or the gas tank to prevent access, they similarly should not be able to prevent farmers from unlocking their ECUs in order to make cost-effective diagnoses, repairs or modifications.

Such activities do not infringe any of the OEMs' legitimate exclusive rights.

Item 5.1 Diagnosis

Accessing diagnostic information on an agricultural machine does not implicate any of the exclusive rights enumerated in Section 106 of the Copyright Act because it only requires the retrieval of information.[47]

For example, if a $5 tractor fuse breaks, but the farmer cannot access the tractor's ECU to diagnose the problem, the farmer must ordinarily either pay to have the tractor transported to the nearest dealer for diagnosis or pay for an authorized dealer's

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[36] *Practical Optical Fault Injection* at 91–93.
[37] *Id.*
[38] Sergei P. Skorobogatov, Ross J. Anderson, *Optical Fault Induction Attacks* at 1, available at https://www.cl.cam.ac.uk/~sps32/ches02-optofault.pdf.
[39] *Practical Optical Fault Injection* at 94.
[40] *Id.*
[41] *Id.* at 91.
[42] Exhibit 3, timestamp 9:26 to 13:02; Exhibit 4, timestamp 2:05 to 2:55; and Exhibit 5, timestamp 11:22 to 12:40
[43] Exhibit 3, timestamp 10:34 to 11:42
[44] *Id.*
[45] *Id.*
[46] Exhibit 3, timestamp 9:26 to 13:02; and Exhibit 4 2:05 to 2:55.
[47] Exhibit 4, timestamp 22:47 to 23:24; and Exhibit 2, 7:14-23

representative to travel to the farm to diagnose the tractor.[48] On the other hand, if the farmer can gain access to the ECU without dealer assistance, the farmer could simply—and immediately—diagnose his or her machine by retrieving the necessary information himself, then replacing the $5 part without the unnecessary added costs and delays. Similarly, if an ECU prevents a machine from functioning properly due to fault-codes produced by an already-fixed problem, the act of wiping the fault codes merely involves utilizing existing options within the software—not copying or rewriting.

In some instances, obtaining the necessary diagnostic information may also require, as a preliminary concern, circumvention of the TPMs described above to create independent diagnostic software compatible with existing ECU embedded software. Such circumvention falls squarely within the reverse engineering exemption provided in 17 USC § 1201(f).

Item 5.2 Repair

Repairing agricultural machinery to restore it to its original specifications, may, in some instances, require copying the vehicle software. However, even where a farmer must copy the embedded software, the Copyright Act expressly provides that such copying does not constitute infringement.[49]

Item 5.3 Modification

OEMs cannot anticipate all of the possible reasons that a farmer would want or need to acquire a particular piece of equipment. Agricultural climates and settings differ across the country, and farmers, particularly on small, family farms, often innovate and find unique "do-it-yourself" fixes for their machinery to save time and money.[50] Farmers must be able to modify their equipment to adapt to the specific needs of their jobs and locations.[51]

Often, farmers putting on different size tires, wider axels, longer-reach arms, etc., may need to modify the embedded software for a particular machine to function properly.[52] Additionally, farmers often must modify their equipment to comply with new legal regulations, such as adding the capability to track certain types of data for regulatory agencies.[53] Such modifications often require retrofitting new devices into older machines, which requires accessing the ECU to install. This, in turn, places farmers at the mercy of dealer installation fees and schedules.[54]

Even modifying settings in embedded software often involves temporarily copying it

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[48] Exhibit 6, timestamp 7:35 to 9:11

[49] 17 U.S.C. § 117(c)–(d); *Storage Tech. Corp. v. Custom Hardware Engineering & Consulting, Inc.*, 421 F.3d 1307, 1314–15 (Fed. Cir. 2005) (a company's circumvention of a manufacturer's password-encrypted system for the purposes of performing maintenance and repairs fell within the section 117 safe harbor and did not violate the DMCA).

[50] Exhibit 3, timestamp 3:49 to 4:48 and 11:42 to 13:02; *E.g.,* Ex. 6 at 11:34 to 14:42

[51] Exhibit 3, timestamp 0:23 to 1:23

[52] Exhibit 3, timestamp 11:42 to 13:02

[53] Exhibit 3, timestamp 13:02 to 14:32

[54] Exhibit 3, timestamp 14:39 to 17:52

first.[55] Although it is sometimes possible to directly modify settings within the software embedded on the ECU's memory chip without copying it first, some consider it too risky to modify the information on the chip directly due to the volatile nature of the chips.[56] In order to avoid corrupting the information on the chip (and causing permanent failure), a user can copy the information and move it to a separate computer where the modifications can be made safely, then transfer the altered information back to the chip.[57] This is because the individual settings that users want to change are part of the same set of information that tells the chip how to communicate with connected devices, and thus, corrupting even a portion of the information may make the chip inaccessible.

Even so, the copying required to modify ECU settings to improve efficiency and/or functionality does not infringe copyright under 17 U.S.C. §§ 117 and 107.

17 U.S.C. § 117

The Copyright Act permits a farmer to modify embedded software for the purpose of improving efficiency and/or functionality as an essential step in utilizing it in conjunction with the farmer's machinery.[58]

17 U.S.C. § 107

Farmers can modify embedded software on ECUs to improve efficiency and/or functionality as a fair use under 17 U.S.C. § 107. For example, farmers may modify their machinery to fit specific, niche agricultural needs; make machinery economically and environmentally efficient; adapt machinery to increase safety and improve access for workers with disabilities; and find new, innovative uses for pre-existing machinery, e.g., by incorporating automobile engines into agricultural machinery in custom-built machines.[59] Fair use law protects each of these activities.

Fair use is "an equitable rule of reason,"[60] and must be decided on a case-by-case basis. Nevertheless, self-reliant, "do-it-yourself" modifications can be analyzed in an overarching fair use framework.

The first statutory factor weighs in favor of fair use because modifying embedded software on an agricultural machine to allow for new and/or more efficient uses transforms the purpose and function of the software.[61] Adapting software so that machinery can be

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[55] Exhibit 2, 7:8 to 8:15.
[56] *Id.*
[57] *Id.*
[58] 17 U.S.C. § 117(a)(1); *Krause v. Titleserv, Inc.*, 402 F.3d 119, 126 (2d Cir. 2005) (finding that a business' "addition of new features" in computer software it lawfully owned a copy of qualified as exempt under 17 USC § 117(a)(1)).
[59] *E.g.,* Pat's Tractor Crossing "handbuilt and customized tractors," website showcasing customized tractors with automobile engines and other modifications: http://www.patstractorcrossing.com/gallery/modified.html (Last visited, November 3, 2014).
[60] *Harper & Row Publishers, Inc. v. Nation Enterprises*, 471 U.S. 539, 560 (1985).
[61] *Cf. Authors Guild, Inc. v. HathiTrust*, 755 F.3d 87, 96 (2d Cir. 2014) ("a transformative work is one that serves a new and different function from the original work and is not a substitute for it.")

used in a new and innovative way does not in any way exploit the original for its intended purpose.[62] Moreover, such uses are noncommercial because they simply involve modifying existing software on an already-purchased vehicle. From a purely equitable perspective, public policy also supports this kind of self-reliance, particularly in light of the growing trend towards codifying a "right to repair" in this country.[63]

The second statutory factor weighs in favor of fair use for at least two reasons. First, the embedded software contains "unprotected aspects that cannot be examined without copying,"[64] Second, this type of embedded software acts much like an internal operating system which lies "at a distance from the core" of copyright protection.[65]

The third statutory factor weighs in favor of fair use even though the entire work is copied because such copying is necessary to achieve the transformative purpose.[66]

The fourth statutory factor weighs in favor of fair use because OEMs have no market or potential market for embedded software designed for new and innovative uses OEMs neither anticipated nor intended. The market for the copyrighted work, i.e., the embedded software, will also not be affected since OEMs always sell the work as part of an integral package, i.e., coupled with the sale of agricultural machinery.

On balance, all four statutory factors favor fair use.

Item 6. Asserted Adverse Effects

Item 6.1 Farmers' Crops and Livelihoods are Put at Risk When they Cannot Effectively Diagnose or Repair Their Own Agricultural Machinery.

Farmers need an exemption so that they can effectively repair their own agricultural machinery quickly when their nearest dealer is either too far, or cannot send a technician in time. Without an exemption, farmers must often send their machines to far-away

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[62] *Cf. Sega Enterprises Ltd. v. Accolade, Inc.*, 977 F.2d 1510, 1523 (9th Cir. 1992), *as amended* (Jan. 6, 1993) (first fair use factor weighed in favor of fair use where one firm copied computer code for "a legitimate, essentially non-exploitative purpose," rather than "to avoid performing its own creative work.")

[63] The legal trend in favor of "right to repair" legislation began with Massachusetts' 2013 Right to Repair Law, which Massachusetts voters passed by an 86 percent margin. Kyle Wiens, *Forget the Cellphone Fight—We Should Be Able to Unlock* Everything *We Own*, WIRED (Mar. 18, 2013 9:30 a.m.), http://www.wired.com/2013/03/you-dont-own-your-cellphones-or-your-cars/. Major automakers in particular, fearing the proliferation of varying right-to-repair requirements across the 50 states, agreed to make the Massachusetts law the new national standard. Christopher Jensen, *Carmakers to Share Repair Data*, N.Y. TIMES, Jan. 31, 2014, *available at*: http://www.nytimes.com/2014/02/02/automobiles/carmakers-to-share-repair-data.html. The agreement requires that automakers standardize diagnostic tools for new car models, beginning in the year 2018. *Id.*

[64] *Sony Computer Entm't, Inc. v. Connectix Corp.,* 203 F.3d 596, 603 (9th Cir. 2000).

[65] *Id.*

[66] *Cf. Authors Guild, Inc. v. HathiTrust*, 755 F.3d 87, 98 (2d Cir. 2014) ("For some purposes, it may be necessary to copy the entire copyrighted work, in which case Factor Three does not weigh against a finding of fair use."); *Perfect 10, Inc. v. Amazon, Inc.*, 508 F.3d 1146, 1165 (9th Cir. 2007) ("even making an exact copy of a work may be transformative so long as the copy serves a different function than the original work").

dealerships,[67] or wait for a technician to travel to their farm to perform diagnostics and repairs – even for minor problems such as a blown fuse.[68] In addition to dealers often being too far away for expedient repairs, when a farmer's large diesel vehicles break down on the side of the road, TPMs prevent farmers and their trusted mechanics from accessing the system to get the vehicle moving again, and thus, require the owner to pay for expensive towing services.[69] Even if a farmer is able to send their tractors over a hundred miles to the nearest dealership for diagnosis and repair, there is no guarantee that the turn-around time will be satisfactory, because dealerships sometimes do not allow farmers to schedule service appointments until the machines actually arrive at the dealerships.[70]

Smaller farms are especially susceptible to longer wait times for service because local dealerships often give preferential treatment to larger, more influential, farms that send the dealers more business.[71] This is especially problematic because smaller farms often cannot afford more than one machine for each task, and downed machines can potentially shut down their entire operation.[72] Self-reliance is a "huge part of the [farmer] culture" which "drives cost out of the production process" by allowing farmers to make repairs and modifications quickly and cheaply.[73] Unfortunately, the added cost and delay in service forces many smaller farms to consolidate into bigger farms in order to be able to keep their machines running.[74]

Even more problematic than the distance or prohibitively expensive fees that dealers charge for prompt repair services, is the problem of expedient scheduling.[75] Problems often arise unexpectedly, and when farmers' machines break down at a critical time in the season, and they lack access to systems required to make the repairs without their dealer technicians, their crops and livelihoods are at risk.[76] For example, when planter machines break down before crops have been planted, and the rain is just days away, it could mean that a significant amount, (if not all), of the farmer's crop will go unplanted for that season, resulting in a total loss.[77] The same is true of crops that need to be harvested before they go bad. Additionally, computer problems often require multiple attempts to resolve, over a period of many days, and this too can lead to problems with time sensitive crops or planting.[78] Disputes between farmers and dealers over the cost of dealer repairs also leads to further downtime, which places farmers in an unsustainable situation which is completely contrary to the culture of self-reliance and ingenuity that farmer have upheld for centuries.[79]

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[67] Exhibit 4, timestamp 6:50 to 8:25
[68] Exhibit 6, timestamp 8:24 to 9:10
[69] Exhibit 4, timestamp 18:52 to 20:12
[70] Exhibit 4, timestamp 6:50 to 8:34
[71] Exhibit 3, timestamp 3:51 to 4:40
[72] Exhibit 6, timestamp 1:07 to 2:04
[73] Exhibit 3, timestamp 4:52 to 6:28
[74] Exhibit 3, timestamp 3:51 to 4:40
[75] Exhibit 3, timestamp 2:14 to 3:10
[76] Exhibit 3, timestamp 3:10 to 3:51
[77] *Id.*
[78] Exhibit 3, timestamp 14:40 to 16:50
[79] Exhibit 3, timestamp 4:52 to 6:28

Item 6.2 OEMs Are Requiring Farmers to Pay Dealers to Get Their Machines Running Even After the Farmers Fix the Machines Themselves.

OEMs employ TPMs not only to prevent farmers from using diagnostic systems to determine the cause of fault codes which prevent the machines from operating normally,[80] but the lack of access to reset the codes also means that farmers must pay dealers to wipe the fault codes even after the farmers fix the problem on their own.[81] OEMs program their ECUs to gather information from various sensors to automatically make adjustments, set off warning lights, or even shut down completely depending on the fault codes created by that feedback.[82] OEMs also program their ECUs to keep the warning lights lit, or even prevent the machine from turning back on, until a dealer wipes the fault codes from the ECU. For example, it is a common problem for sensors to shut down machines if the seatbelt is not fastened,[83] or when crops bump sensors out of alignment. Thus, even if farmers, or their independent mechanics, are able to re-align the sensors or fix the seatbelts, they remain unable to clear the fault codes to get the machines running again.

Item 6.3 OEMs Are Continuing to Strengthen Their Anti-Competitive Monopolies on Repair Services.

Aside from dealer technicians, farmers have historically had many options for maintenance, modifications, and repairs, including: hiring third-party independent mechanics, hiring permanent in-house mechanics, or simply doing the work themselves.[84] Farmers are also willing to hire technology savvy people who could perform the desired modifications and repairs without being subject to the limited number of OEM sanctioned changes offered by expensive dealers.[85] Although modern machines use advanced technology, even non-tech savvy farmers have found websites like YouTube as a valuable resource for instructions for making quick and cost-effective modifications and repairs to their own equipment.[86]

Farmers need an exemption because TPMs often force farmers to pay dealers for service that third-party mechanics or famers themselves could have handled for less.[87] Various OEMs have attempted to monopolize modifications and repair services in the United States since at least 1920.[88] Some OEMs only license the full-featured versions of their software to independent shops in other countries, like Canada, while restricting shops

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[80] Exhibit 6, timestamp 8:24 to 9:10; Exhibit 4, timestamp 19:03 to 20:11 and 26:23 to 27:19; and Exhibit 5, timestamp 4:10 to 5:20

[81] Fault codes on older equipment could be erased by disconnecting the power, but new equipment stores the fault codes until manually erased. *See e.g.* http://www.aa1car.com/library/battery_disconnect_problems.htm.

[82] Fuel/air ratios, timing, etc., remain until fault codes are reset.

[83] Exhibit 3, timestamp 14:43 to 15:56

[84] Exhibit 6, timestamp 9:33 to 10:42; Exhibit 5, timestamp 12:15 to 12:40 and 21:38 to 22:35; Exhibit 3, timestamp 6:27 to 7:50; and Exhibit 4, timestamp 6:50 to 8:56

[85] Exhibit 5, timestamp 13:08 to 15:05 and 30:00 to 31:12

[86] Exhibit 5, timestamp 14:19 to 15:00

[87] Exhibit 4, timestamp 6:50 to 9:37; Exhibit 5, timestamp 10:14 to 10:49.

[88] *See, e.g.*, T.F. Cullen, Real Merchandising Methods Sell 275 Tractors in Year and a Half, CHILTON TRACTOR AND IMPLEMENT JOURNAL, Vol. 4, May 1, 1920 (describing "virtual monopoly" on tractor service in Lake Charles Louisiana).

in the United States to software with very few features and capabilities.[89] Each type of machine has its own special software license required to access its systems,[90] and OEMs charge thousands of dollars for each license, making it so that only dealers would consider the cost feasible, thus, forcing farmers to end long-standing relationships with trusted independent mechanics, simply because those mechanics cannot afford the software required to fix or modify the farmers' machines. Similarly, although some OEMs grant end-users access to basic diagnostic systems, those systems often cannot pinpoint the problem like the dealer-only systems can, nor do they allow users to actually make changes to the settings like the dealers can.[91] In some cases, farmers have to suffer through hours of trial-and-error techniques to diagnose problems that would otherwise takes seconds to complete if they had access to the diagnostic systems protected by TPMs.[92] Worse yet, the physical design of modern machines makes trial-and-error techniques physically impossible, and thus, the dealerships are becoming the only ones able to diagnose and fix problems.[93]

Farmers have historically been able to decide for themselves what machines to invest in, how big a problem is, and what they want to do about it. With modern technology and current TPMs, OEMs are increasingly removing these decisions from the hands of farmers by taking more and more control over diagnosis, repair, and maintenance of machines.[94]

Dealer service can be prohibitively more expensive than in-house or independent third-party mechanics, and TPMs put in place by OEMs force farmers to pay dealers when they would otherwise be able to hire cheaper third-party mechanics, or do the work themselves. Where independent mechanics generally charge by the hour, TPMs allow dealers to charge flat-rate fees of $200, plus parts and additional hourly labor, just to take a look at the machine, even if it turns out the problem is a simple blown fuse that the farmer could have replaced himself for $5.[95]

Item 6.4 Farmers Are Often Unable to Take Adequate Preventative Measures to Prevent Damage to Their Machines.

Farmers need an exemption in order to access to the advanced diagnostic tools built in to their machines in order to take measures to prevent larger preventable problems down the road.[96] For example, machine operators employed by farmers sometimes try to avoid responsibility for catastrophic failures of their assigned machines by being less than honest about the history of warning signs, such as chronic overheating, when something goes wrong.[97] This leads to significantly more damage, cost, and downtime while farmers try to figure out what went wrong. However, if in-house farm mechanics had access to the fault-code logs, (which are protected by TPMs), they could check them regularly in order to catch

[89] Exhibit 4, timestamp 9:38-13:20.
[90] Exhibit 2, 17:8-18
[91] Exhibit 5, timestamp 4:10 to 5:24.
[92] Exhibit 5, timestamp 18:12 to 18:23
[93] Exhibit 5, timestamp 10:25 to 10:48.
[94] Exhibit 5, timestamp 12:15 to 12:40, and 21:38 to 22:35
[95] Exhibit 6, timestamp 7:35 to 9:11
[96] Exhibit 4, timestamp 20:51 to 22:47
[97] Exhibit 4, timestamp 20:51 to 22:47

problems before they become serious, such as chronic overheating that eventually leads to catastrophic failure.[98]

An exemption would also allow farmers to make modifications or install updates to their machines' embedded software to fix or prevent problems. OEMs often develop new versions of embedded software to improve performance and address known problems with their machines, but restrict the ability to "flash" this new software onto machines to dealers.[99] Some OEMs have chosen to license the new software that they develop and sell the software to end-users and independent mechanics who can perform the "flash" process themselves, and users are happy to pay the nominal fee to do so.[100] However, popular manufactures, such as Caterpillar, explicitly refuse to license their software to even small repair shops because Caterpillar considers them to be "competitors."[101] In some cases, Caterpillar creates two versions of the same software; one for dealers (which allows copying and modifying settings), and one for independent shops (with no ability to copy or modify settings).[102] Thus, the incentives behind having machines that farmers can self-repair and modify to suit their needs has grown to the point where farmers make their purchase decisions based on whether or not the OEMs allows users to flash new software themselves.[103]

Item 6.5 OEMs Are Preventing Farmers from Safely Increasing Engine Power to Meet Their Needs.

In addition to increasing engine efficiency, farmers need an exemption so that they can increase the engine power of their agricultural machines.[104] Farmers (particularly small, family farmers) often need to operate their agricultural machinery for non-designed uses due to the machinery's high capital cost.[105] For example, a small, family farmer may need to use a tractor to both pull a manure spreader (a designed use), but also for timber harvest (a non-designed use).[106] Farmers often cannot operate safely and effectively for such non-designed uses without making significant modifications to the embedded software in their machines.[107]

Just as OEMs program the ECUs of agricultural vehicles to shut down if a sensor becomes slightly misaligned, OEMs also tend to program ECUs to completely shut the machine down if they detect aftermarket "modules" which users can attach to modify performance characteristics.[108] Even when the modules are making performance modifications which are not harmful to the machine, the ECU will shut down the entire

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[98] Exhibit 4, timestamp 9:37 to 13:27
[99] Exhibit 5, timestamp 20:51 to 22:47
[100] Exhibit 4, timestamp 9:37 to 13:27
[101] *Id.*
[102] Exhibit 4, timestamp 15:03 to 17:14
[103] Exhibit 5, timestamp 15:03 to 16:34
[104] Exhibit 2, 3:20 to 4:24; Exhibit 4, timestamp 23:17 to 24:44
[105] Exhibit 3, timestamp 11:44 to 13:03
[106] Exhibit 6, timestamp 3:45 to 6:33
[107] Exhibit 4, timestamp 22:47 to 25:20; Exhibit 3, timestamp 11:42 to 13:04
[108] Exhibit 2, 17:1 to end

machine as soon as it detects the alteration in its signals.[109] Circumvention of the ECUs TPMs allows modifications to the ECUs programming which will prevent it from needlessly shutting the machine down due to the presence of the modules while maintaining its safety features for other types of signal chances.[110]

Item 6.6 OEMs Are Preventing Farmers from Increasing Environmental Efficiency.

Farmers need an exemption so that they can increase the environmental efficiency of their machines. Third party developers and even tech savvy farmers who are able to circumvent TPMs on the ECUs in their machines are able to modify them to increase the efficiency of their machines while reducing fuel consumption, and thereby reducing fuel costs and environmental impact.[111] Without the ability to modify default factory engine settings, farmers cannot make these increases in efficiency. Fuel efficiency can also be increased by adjusting other settings as well.[112] For example, users can set the built-in "fan clutch" settings (described above) to only activate at high engine RPMs, thereby using less power and consuming less power and less fuel at most operating speeds.[113]

Although online communities of developers and individual farmers exist to share information and the tools necessary to allow any farmer to implement these changes in their machines, (even for machines that do not have these settings built in),[114] farmers cannot fully (and without fear of legal liability) participate in these communities without the proposed exemption.[115]

Item 6.7 OEMs Are Preventing Farmers From Improving Accessibility for Persons with Disabilities and Implementing Safety Features.

As the Copyright Office observed in 2012, "[g]enerally, public policy favors removing impediments to access for individuals with disabilities."[116]

Farmers need an exemption so that they can easily modify their machinery to improve accessibility for persons with disabilities. Farmers with arthritis, amputations, balance difficulties, impaired sensory perception, etc., may have difficulty operating agricultural machinery effectively without effective modifications.[117] While farmers can fix

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[109] *Id.*
[110] Exhibit 2, 9:6 to 10:3
[111] Exhibit 2, 3:10 to 4:19.
[112] *Id.* and Exhibit 4, timestamp 23:37 to 24:14
[113] Exhibit 4, timestamp 23:37 to 24:14
[114] Exhibit 4, timestamp 24:14 to 25:20
[115] See e.g., ECOMODDER.COM, http://ecomodder.com/; EKOTUNING.COM http://www.ekotuning.com/.
[116] 2012 Rulemaking Recommendation, p. 21, n. 90, available online at: http://www.copyright.gov/1201/2012/Section_1201_Rulemaking_2012_Recommendation.pdf
[117] *See, e.g., Tractor Modifications for Saving Lives*, WEST VIRGINIA AGRABILITY PROJECT, CENTER FOR EXCELLENCE IN DISABILITIES, http://wvats.cedwvu.org/factsheets/tractorfact.pdf (discussing the need to modify tractors for individuals with arthritis, amputations, or balance difficulties; providing modification examples); Timothy Prather, *adaptive Controls for Tractors and Machinery*, AGRABILITY PROJECT, http://fyi.uwex.edu/agrability/files/2010/02/adaptivecontrols.pdf (same).

some accessibility issues through physical modifications (e.g., adding safety steps, handholds, additional mirrors, etc.), other accessibility features and adaptive controls (e.g., achieving vibration reduction, installation of fingertip airbrake systems, etc.) may require modification of embedded software on ECUs. This problem is increasingly acute given that the average age of U.S. farmers has now grown to 58.3 years.[118]

Additionally, farmers need an exemption so that they can activate or implement safety features that are either inaccessible to non-dealers, or are independently created by end-users.[119] Just a few examples include: (1) activating a built-in setting in a large truck's ECU that electronically limits the maximum speed when an inexperienced driver is behind the wheel,[120] (2) re-enabling a machine that shut down due to a faulty seatbelt sensor once the sensor has been fixed,[121] (3) adjusting the wheel-height settings in the ECU so that the speedometer reads accurately when the farmer uses taller or shorter wheels.[122] All of these actions require merely alterations of existing settings on the ECUs, not copying or re-flashing the copyrighted material within it. Similarly, if a farmer's machine tends to overheat more easily than it should, they can alter the "fan clutch" settings built in to ECUs that determines when the fan will activate, depending on the engine speed.[123] In some cases, the settings described above do not exist in the factory settings, and having access allows users to add them using third-party software.[124]

Item 6.8 Prices of Agricultural Equipment in Secondary Markets Are Becoming Unnecessarily Inflated.

Farmers need an exemption so that they do not have to resort to purchasing older machinery (and at higher-than-normal prices). "There's an increasing number of farmers placing greater value on acquiring older and simpler machines that don't require a computer to fix."[125] "[T]his trend is only intensifying."[126] As competition for older agricultural machinery increases, prices rise as a result.[127] Giving farmers a right to repair their newer agricultural machinery mitigates the demand for older, less-sophisticated machinery, which in turn will lead to lower used-machinery prices.

Item 7. Statutory Factors

The statutory factors articulated in 17 U.S.C. § 1201(a) favor granting a DMCA exemption for embedded software on vehicle ECUs. While the second and third statutory factors have little bearing on embedded software in agricultural machinery, the first factor weighs heavily in favor of an exemption for at least two reasons. First, the TPMs

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[118] Danielle Kurtzleben, U.S. News, "The Rapidly Aging U.S. Farmer," February 24, 2014, available online at: http://www.usnews.com/news/blogs/data-mine/2014/02/24/us-farmers-are-old-and-getting-much-older
[119] Exhibit 4, timestamp 24:27 to 25:19
[120] Exhibit 4, timestamp 23:00 to 24:29
[121] Exhibit 3, timestamp 14:40 to 15:51
[122] Exhibit 4, timestamp 23:00 to 24:29
[123] *Id.*
[124] Exhibit 3, timestamp 11:44 to 13:04
[125] Greg Peterson, *Two Answers for Everything*, FARM JOURNAL, September 2014 at 66.
[126] *Id.*
[127] *Id.* at *65–66*.

substantially inhibit the farmers' use of the software, and second, farmers have no available alternatives to protected software. The fourth factor also weighs in favor of a new exemption because the exemption would not adversely affect the market for embedded software in agricultural machines in any way.

Item 7.1 Availability for use of copyrighted works

The Register has stated that the proper inquiry for this factor is "(1) whether the availability of the work in protected format enhances and/or inhibits public use of particular works, (2) whether the work protected is also available in other formats (and whether those formats are protected by access controls), and (3) if alternative formats are available, whether such formats are sufficient to accommodate noninfringing uses."[128]

(1) Whether Availability of the Work in Protected Format Enhances/Inhibits Public Use of Particular Works

In its restricted format, embedded software can inhibit farmers' use of both the software and their own agricultural machinery in at least four distinct ways. First, the protected software can prevent farmers from making even minor adjustments necessary to improve the machines' performance—for example, adjusting the strength of cooling fans to better suit current operating conditions.[129] Second, the protected software prevents farmers from making adjustments to tailor the machines to their own needs—for example, modifications that accommodate for worker disability or unique environmental and agricultural conditions.[130] Third, the protected software can shut down the machinery and render it inoperable in response to the triggering of certain fault codes, which farmers cannot access even after they have fixed the underlying issue.[131] Fourth, the protected software can prevent farmers from diagnosing malfunctioning machinery altogether, leaving them with no recourse but to pay dealerships or contractors exorbitant fees to identify what could have been an expedient and/or inexpensive fix.

(2) Whether the Work is Available in Alternative Formats, Whether those Formats Have Access Controls, and Whether Alternative Formats Are Sufficient to Accommodate Non-Infringing Uses

OEMs specifically tailor the embedded software in ECUs to the agricultural machinery in which they reside. As a result, there are simply no legally available alternatives, which renders the two remaining factors moot. Thus, the substantial burdens that the software protections place on the agricultural public's ability to use the software and accompanying machinery, coupled with the total lack of legal alternatives, weighs in favor of granting a DMCA exemption.

Item 7.2 Availability for use of works for nonprofit archival, preservation, and educational purposes

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[128] *2012 Recommendation* at 152 (citing 2010 Recommendation at 56).
[129] *See supra* Item 6.6.
[130] *See supra* Items 6.5–6.7.
[131] *See supra* Item 6.2.

We have not investigated any potential uses that would fall under this factor.

Item 7.3 Impact of prohibition on criticism, comment, news reporting, teaching, scholarship, or research

We have not investigated any potential uses that would fall under this factor.

Item 7.4 Effect of circumvention of technological measures on the market for or value of copyrighted works

The ability of farmers to circumvent TPMs on embedded software on ECUs will not have adverse effects on either the market for or the value of embedded software on ECUs for at least three reasons.

First, the exemption will not substantially affect either the OEM's sales or production of their own embedded software. OEMs will still be able to package their software into machines and sell them for substantially the same price, as the embedded software and the accompanying machinery will remain inseparable parts of a whole product that farmers must purchase. In this regard, the only effect that an exemption would have occurs after market: farmers will be allowed to replace and modify the manufacturer's software to suit their own needs.

Second, an exemption will encourage original aftermarket software, allowing more farmers to have access to software that suits their specific needs. Currently, farmers and interested third parties have minimal incentive to create new software modules for agricultural machinery because installing such software would require an impermissible DMCA violation, i.e., circumventing a TPM restricting access to the embedded software on an ECU. An exemption would incentivize farmers and programmers to create new aftermarket software modules. Again, this aftermarket software would not affect the original market for embedded software, as that would still come pre-packaged with the machinery.

Third, an exemption will lead to an increase in both the quality and quantity of available software on the market by encouraging competition and stimulating the creation of new software. This, in turn, could indirectly lead to an increase in the value of embedded software because manufacturers would have increased monetary incentive to create high-quality software.

Item 8. Documentary Evidence

Item 8.1 "Exhibit 1" – Recording of Telephone Interview of John Doe

John Doe owns a company in the Southeastern United States that specializes in computer programming for agricultural machines, automobiles, and trucks. He has worked in this field for twenty-one years. His company also develops and sells user-installable modules that modify and increase the power and functionality of agricultural machines, as well as automobiles and trucks. His company sells over three thousand of these modules per year. He spoke to our clinic on the condition that his identity be kept anonymous.

Item 8.2 "Exhibit 2" – Transcript of Telephone Interview of John Doe

A PDF providing a written transcript of the interview of John Doe.

Item 8.3 "Exhibit 3" – Video Interview of Jeff Buckingham

Jeff Buckingham and his family own a cow and calf ranch in Central California. Mr. Buckingham and his family also own a telecommunications business, and he has been involved in telecommunications for the last thirty years.

Item 8.4 "Exhibit 4" – Video Interview of Paul Luiz

Paul is a diesel mechanic with a college certificate in diesel technology, and thirty-three years of hands-on experience. He has been the owner of an independent diesel mechanic shop for fifteen-years in the County of Sal Luis Obispo, California. Mr. Luiz works on all machines powered by diesel engines, including: commercial vehicles, construction vehicles, boats, and generators.

Item 8.5 "Exhibit 5" – Video Interview of Brian Talley and Paul Shamblin

Brian Talley is the owner of Talley Farms, a family owned business that employs four on-site mechanics and grows a variety of fruits and vegetables in Central California.

Paul Shamblin is the head mechanic at Talley Farms, and has been there for twenty-six years. He handles all the repair work and maintenance on the various machines and equipment at the farm.

Item 8.6 "Exhibit 6" – Video Interview of Homero Contreras

Homero Contreras has owned and operated his family owned strawberry farm in Central California for twenty-seven years.