



California Automotive Teachers

Spring 2017

Issue #48

CAT NEWS

www.calautoteachers.com

Newsletter Highlights

- ♦ VW Settlement
- ♦ Apprenticeship Program
- ♦ Tesla's Gigafactory
- ♦ GM/FORD Joint Venture

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\$14.7 Billion Deal in VW Diesel Scandal

A U.S. judge on Tuesday approved one of the biggest corporate settlements on record, Volkswagen AG's \$14.7 billion deal arising from its diesel emissions cheating scandal, and the German automaker said it would begin buying back polluting cars in mid-November.

U.S. District Judge Charles Breyer in San Francisco signed off on VW's settlement with federal and California regulators and the owners of the 475,000 polluting diesel vehicles in a pivotal moment for the world's No. 2 automaker as it tries to move past a scandal that has engulfed it for more than a year.

VW admitted in September 2015 to installing secret software in its diesel cars to cheat exhaust emissions tests and make them appear cleaner in testing than they really were. In reality, the vehicles emitted up to 40 times the legally allowable pollution levels.

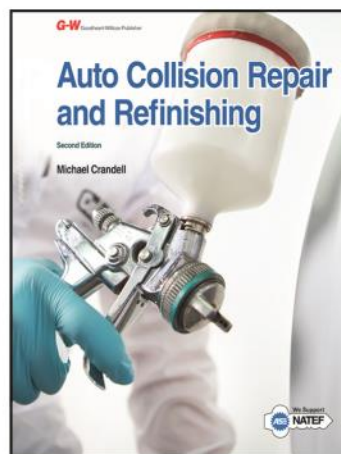
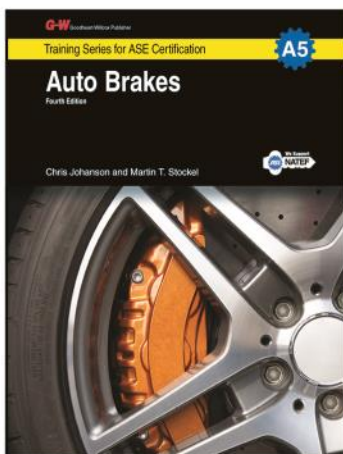
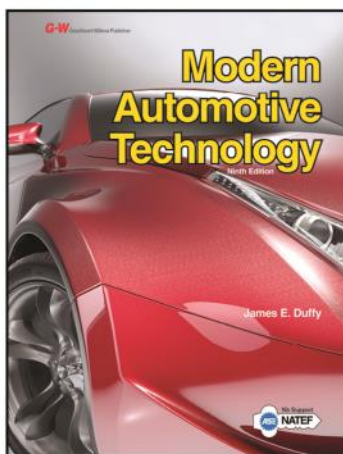
Volkswagen CEO Matthias Mueller told reporters in Berlin that Breyer's approval was "an important milestone for us on the way towards clearing up the problem that we caused some time ago." Hinrich Woebcken, president and CEO of Volkswagen Group of America, pledged to carry out the terms "as seamlessly as possible."

(Continued on page 12)

**The California Automotive Teachers will meet at Pasadena City College
for the Fall 2017 Conference on October 20 & 21.**



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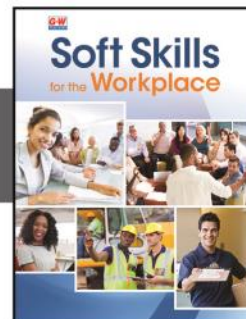
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President's Letter by Don Schumacher

First let me say THANK YOU! Thank you for your continued membership and support of the best Automotive Teacher Association in the United States in my humble opinion. Thank you to all the schools that have hosted a CAT Conference. It takes a lot of work to put one on. Thank you to all the Exhibitors who find value in traveling to our conferences and displaying your wares. Thank you to all the Presenters, each one of you brings meaningful and relevant information that we take back to our schools to enrich our programs and student's experiences. Finally, I want to say Thanks to all of you for the support you gave me as your President. Thank You!



As a recap, the last couple of years we have seen some exciting changes in CTE. Senate Bill 850 Authored by Sen. Marty Block and signed by Gov. Jerry Brown authorized a pilot program which gives 15 California Community Colleges the ability to offer Bachelor Degree's in subjects not offered by the CSU's. Rio Hondo College was awarded the Bachelors in Automotive Technology degree. At our General Lunch Meeting, Steve Tomory will give all of us an update on how the new program is working.

A Strong Workforce plan was developed by the California Community Colleges Chancellors Office and signed by the Governor. This authorized \$200 million dollars in ongoing funds for CTE. Among other things it is designed to help struggling CTE programs and enhance successful ones. It also gives Colleges the ability to start new programs that are needed to support local industry. I have heard from many of you how this money has been a game changer for your programs.

The Strong Work Force Task Force developed 25 recommendations that were adopted by the Board of Governors. Among them, recommendations 13 thru 16 dealt with the difficulty of finding new CTE faculty that can meet your Colleges minimum qualifications. We all know people in industry that are highly qualified and would bring a wealth of experience to our programs but they can't meet "Minimum Quals". Hopefully with the Board accepting these recommendations, you working with your Administration and Academic Senates we can start to increase the pool of highly and uniquely qualified individuals.

Lastly as I look back, CAT had some Mile Stones in 2016. CAT celebrated its 50th Year Anniversary. We had changes in many Board positions. Bob Barkhouse retired as Executive Director. George Hritz graciously volunteered to take over that position for 5 years. Which means not too far down the road we will be looking for his replacement. Steve Vail announced his retirement as you're Treasurer. Julius Vargas stepped up to fill his position.

(Continued on page 5)

Executive Director's Report by George Hritz



Having completed my first full year as executive director I can tell you that I find the position to be rewarding and gratifying.

The conference at Fullerton College organized by; David Diaz, John Farley, Charles Zepeda, David Lopez, Victor Miranda and the student volunteers was a definite success. The organizers provided great tours, stimulating workshops, and a diverse trade show. As always there was valuable interaction with our colleagues to share ideas and solutions to the issues we face in the teaching profession as well as boast of our successes. Thanks to all including Don Schumacher the CAT Conference Coordinator, impressive job!

Please encourage your students to apply for the automotive scholarships available from our industry partners. If you click on the Resource Information tab on the left side of the www.calautoteachers.com home page, you'll find a scholarship page. My contacts in industry always tell me there are never enough applications for their scholarship programs. Try giving your students an option to earn extra credit in your class if they apply for a scholarship. I'm sure the number of students receiving scholarships will increase.

Last year SB 1123 passed unanimously and Governor Brown signed it into law. The Bill authorizes local education agencies to accept a Career Technical Education Course as an optional High School graduation requirement. The law will be in place for five years. If your local school district has not made this option available to your students, please encourage your school board members to make this happen.

The "Pathways to Equity" Conference sponsored by the California Perkins Joint Special Populations Advisory Committee was held from November 30th to December 2nd 2016 in Sacramento. One of the breakout sessions I attended was a presentation by Carolyn Zachary, from the Department of Education and Robin Harrington from the Community College Chancellors Office. The presentation was about what is happening at the State and Federal level and on how to improve your Perkins programs. There was so much important information presented that I asked them to come to the Spring 2017 conference at Yuba College. They have agreed to make two presentations. I'm sure you'll learn a great deal if you can attend.

The Bureau of Automotive Repair has been working on revising the regulations covering Certified Institutions and Instructors to align them with the new licensing structure. They are not going to approve the changes until the new Disciplinary Regulations for repairs not covered under Smog Check are approved. The reason they are waiting is one of the disciplinary actions they hope to impose is a required class on BAR rules and regulations. They are expecting Certified Instructors working with the BAR Education Advisory Committee to develop these courses and eventually teach them. I am passing the information on and will keep you informed on progress being made.

(Continued on page 5)

I was invited to participate in a Workforce Development panel discussion titled Education Pathways to Success: Forging a New Partnership Between Government, Education and Industry hosted by Universal Technical Institute on February 16, 2017 at the State Capital Building. The group was made up of members of the State Assembly Education Committee, their staff, members of the State Student Aid Commission and Governor's office and transportation employers. Mr. G. Douglas Young, Managing Director of Wilcap L.L.C. gave a presentation that focused on the fact that common assumptions about college, careers and pathways to success are outmoded because of the dramatic changes that have occurred in the labor market.

The whitepaper demonstrates the benefits and advantages of helping students pursue an occupation-driven education path beginning as early as middle school. This information should be shared with your school counselors and parents. Here is a link to the whitepaper;

<http://www.uti.edu/docs/default-source/scorecard/whitepaper.pdf?sfvrsn=28>.

February 25, 2017, I participated in the ASCCA team weekend. I serve on the Government Relations Committee which monitors legislation affecting the automotive industry and CTE.

The first meeting of the new Transportation Industry Statewide Advisory Committee will be held on April 20th at the SkillsUSA competition in San Diego. I will report the committee activities at the Spring 2017 CAT conference business meeting and in the next newsletter.

I am looking forward to the Spring Conference at Yuba College April 28th and 29th I know Don and Philip are hard at work and will organize a remarkable conference.

See you at Yuba! ([Link back to TOC](#))

Now as we look forward, I mentioned at the Fullerton Conference we will be holding elections at the Yuba College Spring Conference for Vice President. My Tenure is up and Ruben Parra will become your next president. If you don't know Ruben, he is a member of Skyline Colleges Excellent Automotive program. He has been a CAT member almost as long as Bob Barkhouse and he will make a great president. This means the V.P spot is open. If you are from the South part of the state and have thought about becoming a part of the CAT Board you will have a chance to be nominated and voted upon at the General Lunch meeting.

Well that's it for me!

Hope to see you at Yuba College ([Link back to TOC](#))

American Skilled Labor Association: Compensation for Training in the Automotive Field

By: Judy Wax



American Skilled Labor Association (ASLA) launched their official paid, reimbursable apprenticeship program during ASE Vision 2017. ASLA is a non-profit 501c3 organization that was developed to fill the gap in automotive facilities to assist in finding trainable technicians. They are a paid apprenticeship program in the automotive industry that reimburses shops to help offset the cost of training. The Automotive Technician and Parts Specialty Programs are officially accepting applicants. ASLA is approved by the United States Department of Labor and the Veterans Administration.

It is the mission of ASLA to provide a suitable employee to the American Workforce. We will do this by providing businesses with a clear path for mentors and locating employees who have the aptitude to succeed in a chosen career.

ASLA pre-approves apprentices with illegal drug testing and completed background checks. They accept tuition monthly, quarterly, or yearly. Tuition is \$12000 for the first year and is all inclusive, including all training material. The apprenticeship program is for 2 years and the apprentice will test for their 8 ASE certifications over that time.

Automotive Repair Facilities are located throughout the continental United States and receive recommended curriculum, the ability to apply for federal funds, and a reimbursement of \$10,600 over the course of the year to offset training and reduction of productivity. All qualified shops are requested to join ASLA as members to have an apprentice placed in their shop.

Industry partners are supporting ASLA by not only registering their businesses, but sponsoring apprentices, hosting workshops or conferences, and providing promotional items. Industry sponsorship encourages competently trained technicians and helps in decreasing unskilled labor.

In the near future, ASLA will offer medium/heavy duty repair and parts specialists, collision, and educational facility program accreditation. They are working on development of school programs for grades 5-12 with a full curriculum and accreditation. They hope to provide grants to 150 elementary, middle, and high schools across the country to implement a basic automotive knowledge class to help shape, mold, and ultimately create future technicians.

Register to mentor an apprentice or be an apprentice on their website at :

<http://americanskilledlabor.com> or miked@americanskilledlabor.com

or

judyw@americanskilledlabor.com for more information.

(Continued on page 10)

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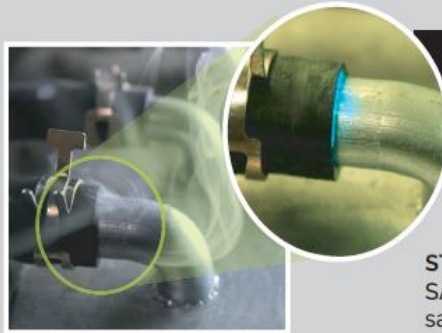
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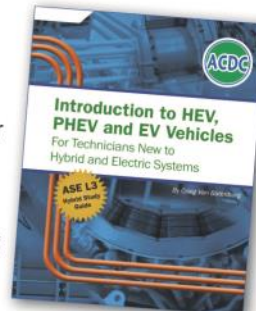
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WEBMASTER Report by Tom Broxholm

CAT has a new timeline for registration information and payment methods. We are now requiring hosting schools to setup presenters earlier. This way our first registration letter on registration day will have a more in-depth list of presenters and workshops. By doing so we want to give our members the information about workshops that they may need to secure authorization and funding earlier.



This is also the first conference that we are requiring registration to be paid for by credit card. Checks and PO's became a nightmare to keep track of. Remember we are volunteers often with fulltime teaching jobs. Everything that can be done to make our CAT work simpler is greatly appreciated. I can tell you from all the work I have to do this has greatly simplified my life with CAT registration. Thank you all for your support and cooperation.

If you have a job opening send me the link. If you have had me post a job for you and it has filled please notify me so I can take your ad down. ([Link back to TOC](#))

Automotive News Stories—Online Articles and Links

Regulators Find Another Cheat Device in Audi Car

<http://www.msn.com/en-us/money/companies/us-regulator-found-another-cheat-device-in-audi-car-report/ar-AAjXcsZ?ocid=se>

Mercedes Expands 500cc Cylinder Engine Family

<http://a.msn.com/08/en-us/AAjxogZ?ocid=se>

California Sets Stricter Emission Targets for 2030

<http://www.motortrend.com/news/california-sets-stricter-emissions-goals-2030/>

Germany Calls for Ban on Combustion Engine by 2030

<http://www.autoblog.com/2016/10/09/germany-ban-internal-combustion-engine-2030/>

2018 Dodge Challenger SRT Demon Arrives with 840 Horsepower for the Track

<http://www.msn.com/en-us/autos/news/2018-dodge-challenger-srt-demon-arrives-with-840-horsepower-for-the-track/ar-BBzJWjX?ocid=spartandhp>.

CONTACT: Judy Wax-Brevell

American Skilled Labor Association

www.americanskilledlabor.com

PHONE: 501-481-2450

Email: judyw@americanskilledlabor.com

FOR IMMEDIATE RELEASE:

**Paid Apprenticeship Program Creates Jobs
by Connecting Employers and Workers**

LITTLE ROCK, ARKANSAS, April 03, 2017—

Finding skilled automotive technicians just became easier. Automotive repair facilities across the nation struggle to find and keep quality technicians. And with the advancing technology in today's vehicles, the gap will only widen in the future.

The American Skilled Labor Association (ASLA) was formed to solve this issue. ASLA was created by Mike Davidson, a 30-year automotive industry veteran and 17-year owner of Parkway Automotive in Little Rock, AR. ASLA exists to match member shops with interested workers to produce a fully-trained automotive technician.

During the 2-year program, each shop provides a Mentor technician to work with and train a pre-qualified Mentee student. And since this training will decrease production of the Mentor, the program reimburses the shop for training time. Students pay a tuition to be part of the program, are tested routinely, and are encouraged to take ASE tests to prove their competence.

ASLA pre-approves apprentices with illegal drug testing and completed background checks. They accept tuition monthly, quarterly, or yearly. Tuition is \$12,000 for the first year and is all inclusive, including all training material. The apprenticeship program is for 2 years and the apprentice will test for their 8 ASE certifications over that time.

The unique aspect of ASLA is that the student becomes a paid employee of the shop during the 2-year program and may be hired upon completion of the program. Or, the student will be able to take their skills to find a joy in the automotive field anywhere in America.

ASLA is the first program of its kind to actively provide a structured approach to training the next generation of automotive repair professionals. ASLA is being welcomed with open arms by industry experts and is approved by the United States Department of Labor and the Veterans Administration. ASLA is a non-profit 501(c)(3) organization. ([Link back to TOC](#))



New!

Automotive "Believe It or Not"

[\(Link back to TOC\)](#)

If you have pictures of unusual automotive experiences, please share them with CAT Members.

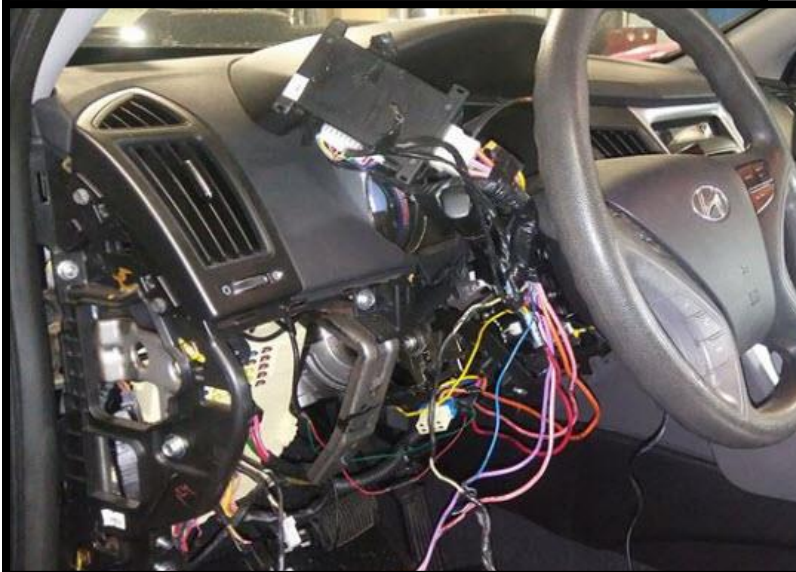
A little humor goes a long ways:

New Way to Lift a Vehicle

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Critters Under-the-Hood

Metal Fuses



Breyer turned away objections from car owners who thought the settlement did not provide enough money, saying it "adequately and fairly compensates" them. Owners will get the pre-scandal "trade in" value of the vehicle and \$5,100 to \$10,000 in additional compensation. "Given the risks of prolonged litigation, the immediate settlement of this matter is far preferable," Breyer wrote.

Volkswagen agreed to spend up to \$10.033 billion on the buybacks and owner compensation and \$4.7 billion on programs to offset excess emissions and boost clean-vehicle projects. The settlement was reached with the U.S. Justice Department, Federal Trade Commission, the state of California and vehicle owners who had filed a class action lawsuit against VW. Volkswagen has admitted to misleading regulators and still faces an ongoing criminal investigation.

It represented the largest civil settlement worldwide ever reached with an automaker accused of misconduct. While huge, the approved deal was still smaller than the \$246 billion settlement reached by cigarette makers with 46 U.S. states in 1998 and the \$53 billion by BP to address costs and penalties arising from the 2010 Gulf of Mexico oil spill.

In total, Volkswagen has agreed to date to spend up to \$16.5 billion in connection with the scandal, including payments to dealers, states and attorneys for owners. The scandal rattled VW's global business, harmed its reputation and prompted the ouster of its CEO.

The settlement covers 2.0-liter polluting diesel Beetle, Golf, Jetta, Passat and Audi A3 cars from the 2009 through 2015 model years. Up to 490,000 people will take part in the settlement because some vehicles had multiple owners.

Volkswagen spokeswoman Jeannine Ginivan said the automaker expects to begin buying back vehicles in mid-November. VW has hired 900 people, including one to be stationed at each dealership, to handle buybacks.

MORE COSTS FOR AUTOMAKER

VW still faces billions more in costs to address 85,000 polluting 3.0-liter vehicles and Justice Department fines for violating clean air laws. It also faces lawsuits from at least 16 U.S. states for additional claims that could hike the company's overall costs.

Last month, a Volkswagen engineer pleaded guilty in Detroit to helping the company evade U.S. emission standards. His lawyer said he would cooperate with federal authorities in their criminal probe. Kathryn Phillips, California director for the Sierra Club environmental group, said Volkswagen broke the law and that

GM S.E.T. Troubleshooting Trainer

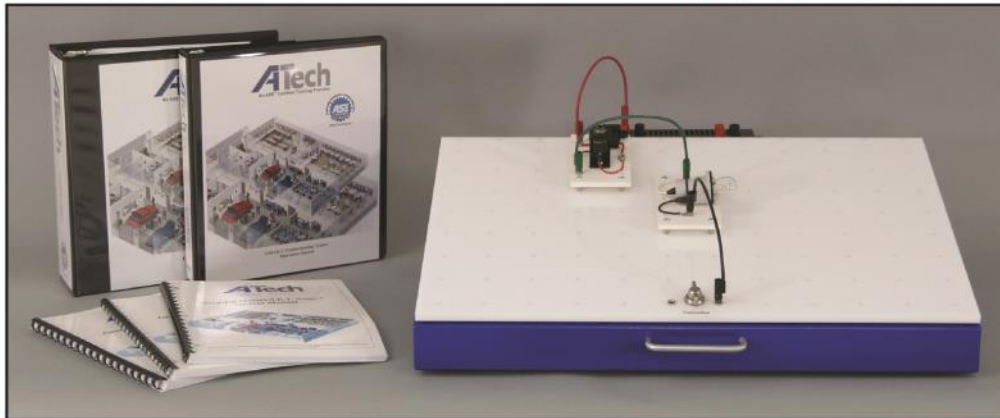


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"Judge Breyer is making them pay the price. Volkswagen chose to poison our families with dangerous pollution just to pad its pocketbook."

"Today is a landmark day, when this innovative settlement can be put into action, investing billions of dollars into public health protections to remedy these serious violations," added Cynthia Giles, U.S. Environmental Protection Agency assistant administrator.

VW will provide \$2 billion over 10 years to fund programs to promote electric vehicle charging infrastructure, development of zero-emission ride-sharing fleets and other efforts to boost sales of cars that do not burn petroleum.

Volkswagen has been in intensive talks over how much compensation it may offer owners of the larger 3.0-liter diesel Porsche, Audi and Volkswagen vehicles that emit up to nine times legally allowable emissions and whether it will offer buybacks for some of the polluting SUVs. No final agreement has been reached. Volkswagen faces a Nov. 3 court hearing to update the court on those vehicles' status.

Volkswagen agreed to make up to \$1.21 billion in payments to 652 U.S. VW brand dealers and \$600 million to 44 U.S. states to address some state claims.

Nearly 340,000 owners have registered to take part in the settlement. About 3,500 owners have opted out. Volkswagen must fix or buy back 85 percent of the 475,000 vehicles under the agreement by June 2019 or face additional costs.

Owners have until September 2018 to submit paperwork to sell back vehicles. VW will have to destroy repurchased vehicles unless it wins approval for fixes. ([Link back to TOC](#))

Editor's Note

On behalf of the CAT Board and its membership, I would like to thank the newsletter advertisers, the conference exhibitors, presenters, and sponsors. Without your commitment to the organization and to education in general much what CAT does could not take place. We appreciate your support and willingness to contribute money or time to improving the educational environment for our members.

[\(Link back to TOC\)](#)

Fall 2016 Conference at Fullerton College, Pictures by Roddy Rampersad



Fall 2016 Conference Highlights

The conference at Fullerton was a great success. There were a total of 176 attendees and with twenty one vendors. Fullerton had the shop clean and setup for members and exhibitors. Signage looked great. There were a few new exhibitors, Easy Run Engine Stands, INNOVA Test Equipment, Red Baron Tools and a company from Utah (Fluid Power) that purchased 4 tables. Everybody who took a tour seemed to be pleased with them. For the most part all of the training sessions were just that.

David Diaz (Fullerton College) did a fantastic job pulling all of this together. Lunch was good, service started on time and we had a great lunch meeting. All of the raffle prizes given away were good quality tools, no hats, t-shirts or books. The tour was outstanding! ([Link back to TOC](#))

A Message from the Newsletter Editor!

We always need technical articles to share with our members.

If you have an article for the newsletter
(it is never too early) please email them to:

rick@calautoteachers.com ([Link back to TOC](#))

CAT NEWS AD Space!

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| 1. | Full page (H 9 3/4" x W 7 1/2") | \$300.00 | \$200.00 |
| 2. | Half page (H 4 7/8" x W 7 1/2") | \$150.00 | \$100.00 |
| 3. | Quarter page (H 4 7/8" x W 3 3/4") | \$ 75.00 | \$ 50.00 |

rick@calautoteachers.com ([Link back to TOC](#))

Peeking Inside the GM/Ford Traverse Nine Speed Automatic

There's been a flurry of recent information released about the new 10-speed automatic that rivals GM and Ford have co-developed for longitudinal engines as it gets readied for production in the Chevy Camaro ZL1, Ford F-150 EcoBoost 3.5, and Ford Raptor, but Chevy's unveiling of the Equinox provided our first real look at that joint venture's transverse nine-speed, which GM will dub the 9T50 (with those last two digits varying to connote different torque ratings in the future).



According to GM transmission expert Scott Kline, the goal was to package nine ratios in roughly the design envelope of the former six-speed automatic while retaining that transmission's on-axis design (which keeps all the planetary gears aligned with the engine crankshaft). This design "stacks" the planetary sets in line, whereas the ZF nine-speed nests several of them in a package that is shorter in length but much wider. To help reduce the overall length of the GM/Ford gear train while adding another full planetary gearset, the system of clutching for first and reverse gear was completely redesigned. The six-speed transmissions utilized two clutches—a fat conventional multiplate clutch and a slimmer "sprag"-type one-way clutch that freewheels in one direction but locks up against any effort to spin it the other way. What the team came up with was an ingenious "selectable one-way clutch" that looks like two slim sprag clutches stacked together, one of which gets a control mechanism to keep the little sprag's feet collapsed when freewheeling in one direction if desired. Releasing these sprag feet allows the clutch to lock like a multiplate clutch resisting motion in both directions.

The latest generation of smart torque converter used in this transmission employs both a spring-loaded mass damper to counteract engine vibrations under certain driving conditions when the converter is locked and "micro slip," tiny bursts of unlocking that permit brief 10–60-rpm speed differentials to eliminate vibrations at engine speeds where the normal mass damper doesn't work. This greatly broadens the operating conditions under which the transmission can smoothly lock the converter (including much of first gear operation), greatly increasing efficiency.

To support auto start/stop there is a large oil-pressure accumulator that is "powered" by a gigantic coil spring when the engine is off, providing sufficient pressure to the first-gear clutches when restarting. The other various clutches controlling the rest of the gear changes are powered by "linear force solenoids" that power their various valves directly, instead of via a boost valve circuit. And to keep the transmission squeaky clean and free of damaging debris, it includes a second filter on the pressure side of the oil pump; most trannies only filter on the suction side where oil is picked up from the pan. The filters are sized to never need replacing.

The 9T50 is expected to make its first appearance next summer paired with the Chevy Equinox's 2.0-liter turbo-four and eventually perpetuate throughout the transverse-engine lineup.

Editor's Note: This article was written by Frank Markus—MOTOR Trend! ([Link back to TOC](#))

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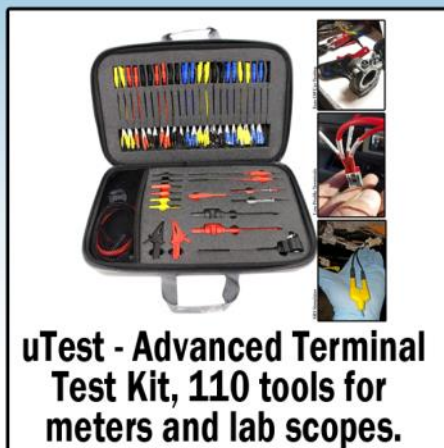


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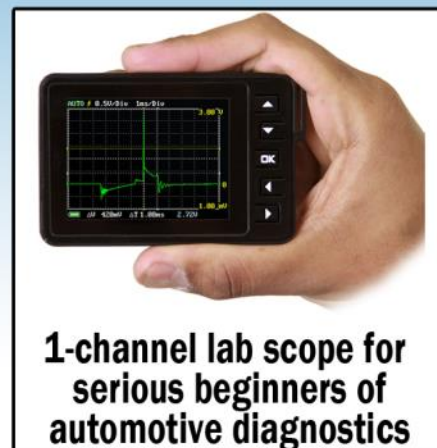
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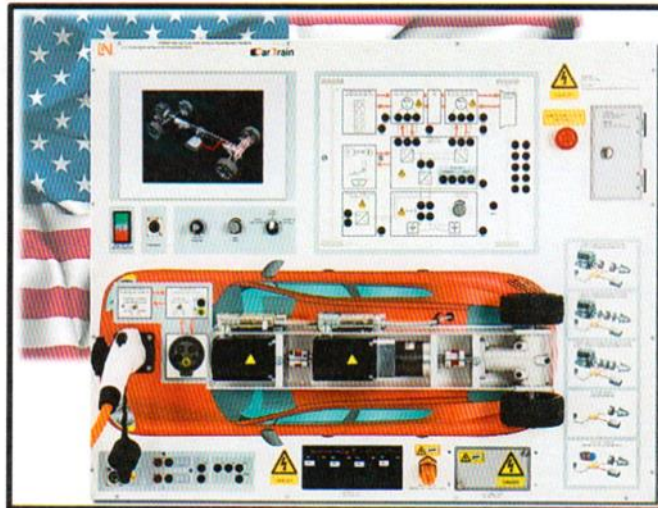
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What Tesla's New Gigafactory Means for Electric Vehicles

Tesla's new Gigafactory opened at the end of July in Nevada, with much excitement from both the media and the general public. Only 14 percent of the massive structure has been built, with the rest of the \$5 billion project to be concluded by 2020. According to Tesla, battery cell production will start in 2017; by 2018, the Gigafactory should be cranking out cars to the tune of 500,000 Model 3s per year. A big part of Tesla's need to build the Gigafactory lies in the reduced expenses for lithium-ion battery production it provides.

The Gigafactory is a marvel of modern production technology, "a machine that builds machines," as Tesla CEO Elon Musk puts it. In addition to being cool, it offers unprecedented economies of scale for lithium-ion battery production, lowering the price from \$190 per kWh in April 2016 to an estimated \$130 per kWh once complete. The huge scale of the production, coupled with reduction of waste and a vastly reduced supply chain, provide significant savings and ultimately a 30 percent reduction in battery production costs.



The Gigafactory is a big statement from Musk, and a clear sign that Tesla believes the world is ready for full electrics. But does the world agree? Are lithium-ion batteries the way to go? The total number of cars sold in 2015 was around 72.37 million. Electric vehicles accounted for around 0.8 percent, or 540,000, of that number, a significant step up from about 376,000 EVs sold in 2014, but still less than 1 percent of cars sold worldwide.

As far as Tesla goes, the company sold 50,580 vehicles in 2015, 0.07 percent of all cars sold globally, less than 10 percent of all electric vehicle sales. So, Tesla is winning the publicity battle, but so far it's the big, traditional car manufacturers such as Renault-Nissan that are winning the zero emissions war. Nissan-Renault, the manufacturer of Nissan LEAF, the most-sold EV in the world, and a slew of other electric vehicles, sold 100,000 EVs between August 2015 and August 2016.

(Continued on page 24)

So for now, Tesla has gone all-in for lithium-ion batteries. What other options are there? Brands such as Ford, BMW, Mercedes-Benz, Audi, Toyota — essentially all the big players on the market — are working mostly on hybrids in addition to their traditional lines of cars.

What's holding back electric vehicles?

To give you an idea of the timescales in which the car industry works, consider this: Toyota started development on its FCEV technology in 1992 and started selling the Toyota Mirai in 2015. That's 23 years. It's very common for car models to reach an age of 7-8 years before getting a facelift, which might just mean minor changes to the design of the car and possibly some upgrades under the hood.

Now let's compare that to Tesla. Founded in 2003, Tesla brought its first car, the Roadster, on the market in 2008. Musk has later admitted that the Roadster "was completely unsafe," it "broke down all the time," and it "didn't really work." Nonetheless, to bring a new car model to the market five years after the company was founded is impressive. Eight years removed from the launch of the Roadster, Tesla has the Model S and the Model X, with Model 3 a few years away.

In the time most car manufacturers make mostly cosmetic changes to existing models that are based on old, proven technology, Tesla brought to market completely new car models with highly complicated, often unproven technology. Without Tesla lighting a fire under the backsides of the more traditional car companies, it's very likely that electric cars would experience a slower introduction to the market. But the Tesla engineers can't solve all the problems of the electric car industry by themselves.

Let's turn our attention to energy storage, an undervalued industry. There is a lot of talk about renewable energy production, but energy storage is sort of an afterthought to many. If you have ever wondered why renewable energy is not more prevalent despite us possessing the technology to power the world with it, the reason is energy storage.

Wind and sunlight are inherently unstable sources of energy, because the sun doesn't shine 24 hours a day, nor does the wind howl away at an endless, steady pace. Energy storage devices are needed to balance the times of highs and lows. The small, incremental improvements in battery technology over the last 267 years — since Benjamin Franklin first coined the term "battery" to describe a set of linked capacitors he was using — have not been enough to keep up with the ever-growing global need for energy storage.

The same logic that applies to our homes, factories and shopping centers applies to our cars. Fossil fuels possess energy density capabilities far beyond what batteries can achieve, which means that despite their well-documented drawbacks concerning the environment, gasoline-powered cars will not disappear until energy storage catches up.

For a typical consumer, the jump from a combustion engine to a full electric, or even a hybrid, is a big leap. Even with constant upgrades and advancements in battery technology, lithium-ion batteries are heavy and suffer from capacity deterioration, leading to EV owners having to change the battery packs in their Teslas, or other electric vehicles, within 5-10 years. By Tesla's own admission, the battery pack capacity starts deteriorating latest at 4-5 years of use, and by the 8th year, the battery pack capacity is expected to have decreased by 30 percent. With range being the top concern for

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most buyers, that's cause for worry, especially with the price of a battery pack replacement hovering currently at a minimum of \$12,000, according to Tesla, although the talk on the Tesla Motors Club forums circles at much higher numbers: from \$25,000-\$45,000.

The prices for EVs will decrease as the technologies involved become mainstream and economies of scale come into play with higher production numbers, so the problem we are left with is range. Extending the range requires one of two things: adding more batteries, which makes the car much heavier, or a rapid acceleration in the energy storage capability of lithium-ion batteries.

Adding more batteries is hardly an ideal solution, but can we expect big increases in lithium-ion battery capacity? Current lithium-ion batteries hold more than twice the amount of energy compared to the first Sony-manufactured lithium-ion batteries introduced to the market in 1991. If a doubled capacity in 25 years of constant research is the best the smartest people on the planet can achieve, it's not realistic to expect huge increases. In fact, the consensus among the research community is that at most a 30 percent increase in energy by weight is possible for lithium-ion batteries. What that means is that lithium-ion batteries will never be the solution electric vehicles need to dethrone the internal combustion engine.

Knowing that, why in the world would Tesla put all its figurative eggs in the lithium-ion basket? Because lithium-ion batteries are currently the most cost-effective solution to furthering Elon Musk's Master Plan, Part Deux, the key word being "currently."

Therefore, Tesla's gung-ho approach to lithium-ion batteries should not be taken as a statement on the future of electric vehicle energy storage. Tesla is an early adopter, and even more often the inventor of new technologies, and will surely adopt any advantage in energy storage they deem viable enough to improve on the current designs, regardless of the investment made into lithium-ion batteries. Musk himself has predicted that ultracapacitors, not batteries, will be the breakthrough for electric vehicles.

What's preventing Tesla from using ultracapacitors? Ultracapacitors, or supercapacitors as they are also known, have several advantages over batteries, the incumbent energy storage technology. Ultracapacitors charge and discharge in seconds, have a lifetime up to 500 times that of lithium-ion batteries and are highly reliable. Sounds perfect, right? Well, not quite. Energy density, the one crack in the ultracapacitor armor, is keeping them off car manufacturers' short list of potential replacements for lithium-ion batteries. They're perfect for powering start-stop and Kinetic Energy Recovery Systems, but alone they're not the answer.

The future of electric vehicles

Sooner or later, the reign of lithium-ion batteries will come to an end, because the inherent limitations of lithium-ion batteries mean that better alternatives must emerge. If we circle back to the four types of electric vehicles discussed earlier, only one does not rely on battery technology: the Fuel-Cell Electric Vehicle.

Hydrogen, the fuel used in FCEVs, is an extremely plentiful element, and when pure hydrogen is derived from renewable energy sources, the entire chain of energy production and consumption is free from carbon emissions. There is

a group of devoted FCEV believers within the automotive industry; Toyota is perhaps the most enthusiastic among them. Toyota and Honda have been feverishly working on their FCEV models, with the Toyota Mirai and the Honda Clarity both already on the market, to get a head start on other manufacturers, but the competition is getting its act together. Lexus and Audi both debuted their hydrogen concept cars, the LF-LC and the h-tron quattro respectively, at the Detroit Auto Show in January.

At the outset, hydrogen looks like a promising alternative to fuel the future of transportation, but what does Elon Musk think? When asked to comment on FCEVs while visiting the Automotive World News Congress in Detroit in 2015, Musk was, true to his nature, quite direct in his appraisal, calling FCEVs “incredibly dumb.” Musk is not alone in his scathing criticism. Robert Zubrin, the author of *Energy Victory*, was quoted in the *Economist* as saying hydrogen is “just about the worst possible vehicle fuel.”

The disdain is easier to understand if we look at the two biggest problems FCEVs face: the production and delivery of large quantities of hydrogen. It's currently very costly to produce hydrogen, especially carbon-free, and transferring it is equally expensive. Not to mention that the electricity needed to produce hydrogen could be directly used to power electric vehicles already on the market. It's looking increasingly likely that FCEVs, despite not relying on batteries, are not the answer.

Where are we headed, then? We can already produce the utopian dream of an electric car enthusiast: a zero-emissions electric vehicle that uses a combination of ultracapacitors and batteries. Batteries provide the range, ultracaps the power and regenerative energy — it's a perfect marriage of slow and fast energy storage. Is it perfect as a car? Not even close. It's pricey, and either extremely heavy with longish range, or just heavier than an average car, but with a very limited range. In some years, lithium-ion batteries will hit a wall, and we'll need an alternative energy storage technology. Whether it's ultracapacitors, hydrogen, methanol, a combination of existing technologies or something completely different, it remains to be seen.

The sad thing is that Tesla is currently the only car manufacturer with the courage ([take note Apple](#)) to push the boundaries and make things happen, while other manufacturers seem to be content at developing hybrids and conducting small-scale tests hoping for a miracle. And what makes that even more baffling is that even though Tesla is the one manufacturer making huge investments on the Gigafactory and lithium-ion battery production, if and when the times comes for another technology to overtake batteries, Elon Musk will be there, ready to pounce. Until then, we're stuck with Tesla. I can live with that — for now.

Editor's Note: This article was written by Jussi Pikkariainen—Crunch Network 11/21/2016! ([Link back to TOC](#))



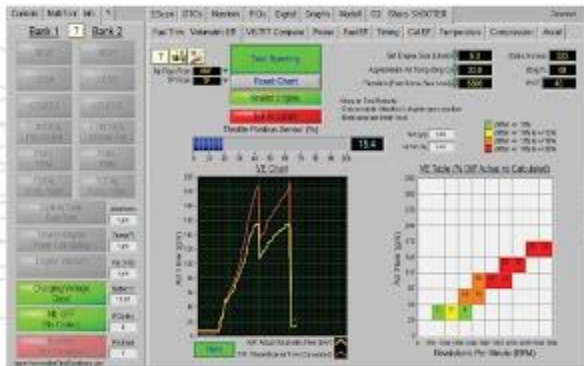
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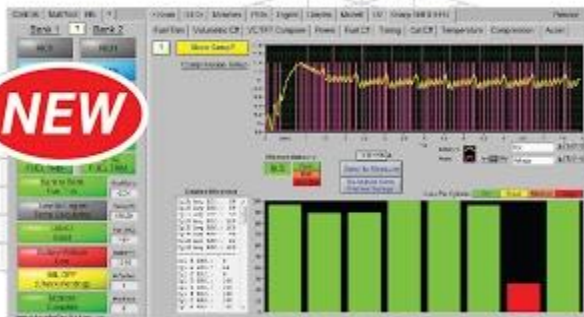
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