



CAT NEWS

The California Automotive Teachers Newsletter

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The President’s Letter
by Drew Carlson



Greetings CAT Members!

As a new president of CAT, I want tell you a bit about myself. I am an Automotive Instructor at Cosumnes River College in Sacramento. I taught part-time since 1997, and full-time since 2000. I worked as a technician for 19 years, first at a major chain retailer, briefly at a dealership, and finishing as a heavy-duty fleet tech at a school district.

I graduated with an A.S. degree in Automotive Technology at Modesto Junior College, and later completed a B.A. I would have considered becoming an automotive instructor sooner in my career had I not been misinformed (by a community college instructor, no less!) that I needed a master’s degree in voc-ed to teach at community college! I am currently enrolled in a graduate program at Sacramento State, learning how to incorporate the Internet in education.

I am thrilled and honored to serve as your president of CAT. Until very recently, I never had education courses in college, and I have depended on my immediate colleagues at CRC (thanks, guys!) for tactical guidance, and on organizations like CAT for professional development, networking, and strate-

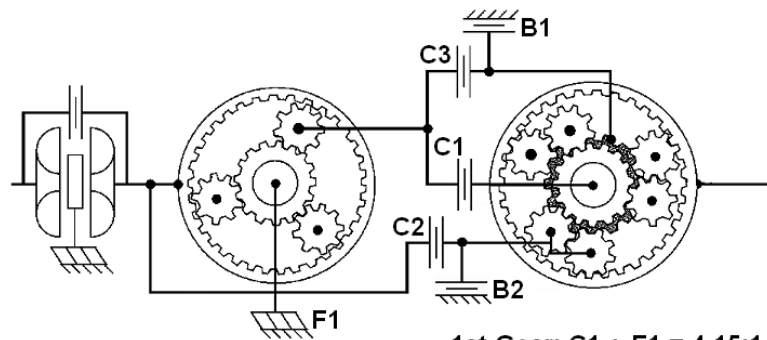
gic development of the automotive teaching profession throughout the state.

I want to add here that CAT also greatly benefits from the support of our industry partners who attend our conferences as speakers and vendors. Without them we could not put on such informative and comprehensive conferences! Make sure that you shop our conference supporters first when considering new resources for your program. Thanks, vendors for supporting CAT!

I consider myself a relative newcomer to teaching and CAT, but some CAT members have told me it is good for the CAT leadership to inject some “new blood” into the organization. I don’t know if that is true or not, but I do respect and admire the work of CAT’s leaders, of the CAT Board, as well as its membership at large.

I don’t come to this position with an agenda for major changes in the direction of CAT. I am, however, greatly concerned with many of the same issues that most of you have expressed over the years, such as the serious decline in the number of automotive programs and instructors teaching in our state. The K-12 system in particular is beset with the problems related to getting test scores needed for showing academic progress and meeting the state’s core subject area requirements. As a result, schools are eliminating “expensive” career and technical education

CAT Fall Conference - October 14 & 15
Mira Mar College
Conference Information - calautoteachers.com



**Type 13 Gear Train
Lepelletier Principle**

1st Gear: $C1 + F1 = 4.15:1$
2nd Gear: $C1 + B1 = 2.37:1$
3rd Gear: $C1 + C3 = 1.56:1$
4th Gear: $C1 + C2 = 1.15:1$
5th Gear: $C2 + C3 = 0.86:1$
6th Gear: $C2 + B1 = 0.69:1$
Reverse: $C3 + B2 = 3.39:1$

TIRE INDUSTRY WARNING

Tires Older than 6 Years Pose Hazard

The following article was sent in by Mike Burkemper of St. Louis, Missouri. It is from the September/October 2003 "Strategic Safety News". This information is especially relevant to those of us in the old car hobby who often "run" on old tires and even with new tires, often see limited use.

Following the Ford/Firestone tire tribulations, Congress passed the TREAD Act that mandated NHTSA upgrade tire standards and examine a tire aging requirement. Because of industry opposition and the lack of substantive information submitted in response to their request for comments, NHTSA in a June 26, 2003 final rule (FMVSS 139), decided to defer action on its proposal that suggested three possible test protocols to artificially simulate aging tires and to subject tires to testing after they were aged. They also announced intentions to perform further research related to deterioration of tire performance caused by aging before adopting a test procedure. Despite industry claims that there is no real-world evidence of the need for an aging requirement and no industry standard for tire aging Strategic Safety presented findings to NHTSA on September 17, 2003, providing evidence to the contrary. Strategic Safety's comments were precipitated by findings that the tire and vehicle makers have set recommendations related to tire aging, most of which were inconspicuous or simply hidden from

the public.

The industry tipped its hand when the UK-based Tyre Industry Council (TIC) issued *unprecedented* warning to consumers about the dangers of old tires in September. The TIC, a non-profit funded by tire manufacturers and tire retailers whose principal objective is to improve tire safety awareness, issued a press release after it noted a number of vehicles inspected during roadside tire checks were fitted with tires that were 10 to 15 years old. The TIC press release warned motorists to check the date codes on their tires and replace them if they are 10 years old or older. They also recommended tires six years old or older that have not been used should not be placed into service and tires older than 10 years be removed from vehicles. The TIC press release pointed out that tire components dry with age and can separate. It also noted that anti-aging chemicals added to tires are "only active when the tyre is in use; therefore tyres fitted to spare wheels, caravans and trailers are particularly at risk of premature aging brought on by ozone degradations and static 'sitting' for lengthy periods of time."

The TIC based its recommendation on a previously secret 2001 British Rubber Manufacturers Association (BRMA) recommended practice. The BRMA

you could germinate, if appropriate. Some are in response to the immediate crises of closing programs and declining course offerings, and, while not optimum, may help to keep an auto program going at your school.

1. Tie your automotive curriculum (learning outcomes) as closely as possible to graduation (A-G) requirements. Show that the work students do in your courses is academic. It could show our administrators and school board members how important our work is to student success. NATEF has a booklet about which of the automotive tasks relate to which discipline. Here is the Internet address: http://www.natef.org/documents/AUTO_APPLIED_ACADEMICS.pdf Granted, I don't teach at the high school level, but I haven't heard from anyone who has specifically done this. There may be members who have done this, or there may be a better way to tie automotive skills to (A-G) requirements. If so, please contact me so I may pass this important work on to our members.
2. Make sure your program is certified/accredited. It lets interested stakeholders (industry partners, administrators, etc.) know that you teach to standards. CAT's ATTS program is designed with California Auto Teachers in mind. It's our program. If you are already NATEF certified, you can get ATTS certified easily, too!
3. Make sure your community business partners who hire your auto students attend your advisory committees, and regularly communicate with your school site council and school board. That may be the only way the administration and board members know about the value of your program.
4. Stay as current as possible with technology. Students need to know how to service vehicles into the next 30 years, not the last 30

years! You may need a few older vehicles and/or components for covering theory or physical concepts, but get the older cars and obsolete labs (i.e., re-curve ignition distributors, DC generator output tests etc.) out of the curriculum, especially for students who expect to work in the field. Consult the NATEF task lists or ask your advisory committee if unsure of what to lose. It is almost always better to have an easier-to-organize shop with a newer vehicles and equipment. It makes students (and parents, administrators, advisory committee members, etc) react more positively to your auto program.

5. Shop space and/or resources a problem? Consider a small engine program. I teach small engines at the community college level, and students love the hands-on, live work nature of the course. It is perfect for those students new to engine operation, or who have never used hand tools. The tools and engines are comparatively cheap, and you have more control (safer) because students aren't spread over such a wide area as they are on cars and trucks.
6. Integrate the Internet as a learning resource for your students. Make sure your administration knows you need Internet resources (or use of the computer lab) for automotive training and research. There are many products offered by vendors at a wide variety of prices, including virtual lab work, if necessary. You can also devise assignments that students can access many terrific websites (some by CAT members!) for free. Show your students you are open to what is new, and you gain even more credibility.

Let me know what you think. I look forward to a terrific conference at Miramar College. See you there!

Drew Carlson

Figure 2 The Hoover Dam, as viewed from the adjacent parking garage, is a major source of hydroelectric power for parts of the southwestern United States. Hydrogen can also be chemically retrieved from the following sources that contain hydrocarbons (HCs) including:

- Petroleum
- Natural gas
- Coal
- Biomass (organic waste)

Hydrogen Refueling After the hydrogen has been generated, it must go through several stages before it can be used as a fuel in a vehicle. These stages include:

Compression. Hydrogen needs to be compressed to be stored and transported. The higher the pressure, the greater the quantity of hydrogen can be stored in a container. Hydrogen compression is usually one of three pressures of 3,600 psi, 5,000 psi, or 10,000 psi.

Purification. Hydrogen must be purified after it is compressed to remove other gases that can affect the operation of the engine or fuel cell where the hydrogen will be used.

Storage. After purification, the compressed hydrogen must be stored until it is needed for use in a vehicle or other uses.

Dispensing. The hydrogen needs to have a connection made between the high-pressure storage unit and the vehicle that will ensure a leak-proof seal.

Hydrogen Safety Concerns Hydrogen presents several safety related issues because of the following characteristics:

Hydrogen is difficult to detect because it is not visible, nor does it have a smell (odor).

The molecule size is small, meaning that it can leak from very small openings or connections.

Hydrogen is flammable over a wide range of air-fuel ratios and therefore presents a serious fire threat.

It requires very little energy to ignite hydrogen, meaning that a small static spark could ignite hydrogen.

Hydrogen is 1/16 lighter than air and this means that it will rise to the top of an enclosure and remained trapped there unless it is vented to the atmosphere.

HYDROGEN-HYBRID Because the hydrogen is

introduced as a gas and not a liquid like in a conventional engine, it is necessary to use different injectors. These hydrogen injectors are driven from the same engine control computer (PCM) but with a new program to optimize the use of hydrogen. Converting an existing internal combustion engine to hydrogen, results in a loss of power compared to gasoline because hydrogen contains lower heat energy than gasoline. To overcome this problem, a supercharger or turbocharger is installed to help the engine produce the same power as it would if gasoline were used. Another concern of using hydrogen as a fuel is the increase in NOx exhaust emissions that are created compared to the same engine operating on gasoline. Besides using exhaust gas recirculation (EGR), some demonstration engines using hydrogen as a fuel, lower the combustion temperatures by injecting water into the cylinders. The relatively low-energy density of hydrogen requires that the gas be stored at very high pressures to help reduce the size of the tanks and to increase the range of the vehicle. Pressures as high as 10,000 psi have been proven to be safe and reliable. Some vehicle manufacturers, such as BMW, have been developing liquid hydrogen fueling systems, posing the problem of dealing with temperatures as low as -423°F (-253°C). Liquid hydrogen tanks require a continuous bleed-off system to keep pressures in balance as the hydrogen becomes warmer and turns into a gas.

METAL HYDRIDE HYDROGEN VEHICLES
There are three ways to store hydrogen including:

- Gas
- Liquid

- Solid One way discovered to store hydrogen in solid form is as a metal hydride similar to how a Nickel-Metal Hydride (NiMH) battery works. A demonstration vehicle features a lightweight fiber-wrapped storage tank under the body that stores 3 kg (about 6.6 pounds) of hydrogen as a metal hydride at low pressure. The vehicle can travel almost 200 miles with this amount of fuel. One kilogram of hydrogen is equal to one gallon of gasoline.

Three gallons of water will generate one kilogram of hydrogen. A metal hydride is formed when gaseous hydrogen molecules disassociate into individual hydrogen atoms and bond with the metal atoms in the storage tank. This process uses powered metallic alloys capable of rapidly absorbing hydrogen to make this occur.

Executive
Directors
Report

by Bob Barkhouse



Thanks to George Hritz and Indian Valley College for a great Spring Conference. There was a great turnout and for the first time there were sections for counselors and administrators. This went over very well and I hope will be considered again at a future conference.

Normally, I would be telling you about what I have been doing. Since our activities with ARC (Automotive Repair Coalition), ASC, CITEA, CTE Coalition and others are going well I want to spend this time clearing the air regarding two issues. What I have to say about them is strictly my opinion. The first deals is about the raffles that were held at Skyline and Indian Valley. These funds were used to send a CAT team to the annual ARC Conference.

ARC has taken on the issue of automotive training in the high school and the community college as a major project over the last 4 years. Their concern is the aging automotive workforce and the fact that 50% of the CTE (Career Technical Education) programs in the high schools have been closed in the last ten years. In order to cause change, it is necessary to push bills through the legislature. ARC has found that this requires a great deal of money to support extensive use of a lobbyists. ARC has one of the finest lobbyist. He is very informed about CTE and especially automotive training. He lives and breaths your cause. CAT is a member of ARC which cost CAT \$2,000 a year in dues. During the year, ARC has fund raisers to pay it's bills and continue their fight for automotive industry needs and CTE needs. One of ARC's major fund raisers is

their annual golf tournament. The fee for the tournament is \$750 dollars which allows 4 people to participate in the tournament. Along with the tournament is the annual meeting with many corporations in attendance. CAT's presence at this meeting is very important. In the past, we have used the money raised in the raffles to cover our \$750 donation we make to this fund raiser. We have fielded a CAT foursome at the last two fund raisers. The first year was Rio Honda College and last year was Cuyamaca College. Next June, ARC will again hold their annual meeting and golf fund raiser. We will again be looking for a CAT foursome and any CAT member who is interested should contact me so that we can form a foursome. The foursome does not have to be from the same school. We will continue to use the raffle to cover this expense in lieu of using membership dues.

My second concern is the recent comments made by a person who attended the last conference at Indian Valley. I feel that his comments have shown a concern by him but he failed to come to the board meeting (held the Friday night before every conference) and express his concerns. Instead he chose to criticize CAT behind our backs. I can only address the second hand information as he has never come to me with his concerns. The following are my responses to the second-hand information that I received:

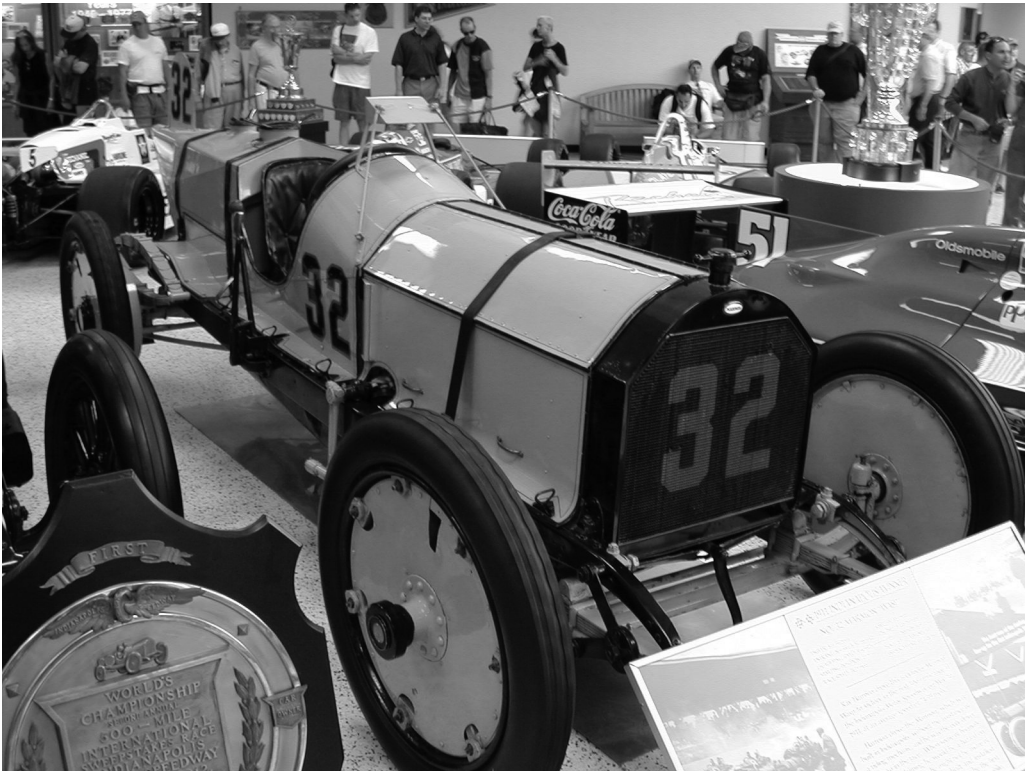
"CAT is a closed clique and only the chosen few can become officers." CAT over the many years has chosen officers from those that attend Board meetings and show a genuine interest in it's activities. CAT is always searching for new officers and anyone that is interested only has to let it be known to the Board. The part that scares some off is the 10 year commitment that comes with becoming an officer. Serving two years in each chair and the 10 year commitment is instrumental in making CAT as strong as it is. This commitment by the officers gives continuity to CAT. If you have been around a while, you will agree, CAT has made very few changes in it's successful format. Secondly, no single officer can make changes without Board

and career-technical education pathways between high schools and community colleges for the benefit of pupils and students in both education systems, as described. The bill would require the board of governors to ensure that elementary and secondary school educators strongly collaborate with college faculty in implementing this provision. The bill would appropriate \$20,193,000, as scheduled, to the board of governors for allocation for local assistance grants to consortia of community colleges and their public elementary and secondary school

partners, and for associated workload, for purposes of the bill.

5. SB 875 - (Runner) - CTE Eligibility for After School Program Resources - This bill would include career and technical education as an authorized activity eligible for funding in the After School Education and Safety Program.

Christopher J. Walker, ARC Legislative Advocate



What Major Inovation Did This Indy Car Introduce?
(answer on page 13)

Had your Torque Wrench Calibrated Lately?

It’s something to think about, beyond saying “I’ll get around to it.” Clicker torque wrenches, depending on how they are stored and used, go out of adjustment.

A service that I used recently was half a country away for me, but it may be just down the street for you. Team Torque, also known as Missouri Valley Calibration, in Bismark, North Dakota. They repair and calibrate 56 brands of torque wrenches, from Aimco to Wright. The cost of simple calibration, for wrenches - up to 250 lb-ft - is \$17.50 plus \$7.00 return shipping and handling. They try for a three working-day turnaround. With just ordinary shipping, the total time for me was a little more than a week on the calendar.

Any repairs are at extra cost, but Team Torque can keep your favorite torque wrench working in many cases.

The hardest part was finding, and, finally, making a long, slender box for shipping. I shipped via the United States Postal Service (USPS) Priority Mail. Yes, I’ve had good luck with them. That’s two-day service, for only a little bit more than regular parcel post.

USPS also has a new service -- Delivery Confirmation Number. It’s what other services call a tracking number. You can check on delivery date and time via the USPS website or an 800-number call. The number is just another 35 cents over the postage charge.

Team Torque called for credit card authorization for the charges. When the wrench came back to me, there was a paid invoice and calibration sheet. My 10-150 lb-ft wrench was checked 3 ways, as received and 12 ways after adjustment. Mine was off: torquing (sic) high. Thirty lb-ft was actually 33.71, 90 was 95.9 and 150 was 159.02. Afterward, 30 was 30.46, 60 was 59.63, 90 was 89.5, 120 was 119.3, and 150 was 150.92. The tolerance on a setting is 4% clockwise and 6% counterclockwise.

Team Torque is located at 2910 East Broadway Avenue, #24, Bismarck, North Dakota, 58501. (888) 332-5283, (701) 223-4552 (phone), (701) 222-3731 (fax), and www.teamtorque.com. If you live in or near a large metro area with manufacturing companies, you’ll likely find a torque wrench calibration and repair service near you.

10 Reasons Why Your Torque Wrench Went Bad:

- 10. Instead of putting it away safely, dry and in its case, I left it in a puddle! (Moisture and adverse temperatures will quickly effect your wrench.)
- 9. I did not follow the manufacturer’s rules for regular maintenance of my tool! (Manufacturers recommend calibration at least once a year for a tool used professionally daily.)
- 8. I turned it down way too far, and the wrench fell apart! (If it quits working, send it for repair. (Don’t take it apart or mess with it.)
- 7. I forgot to turn it back down to its lowest setting after using it! (The internal spring of your click-style wrench should be loosened up to retain accuracy.)
- 6. I thought I could clean it in the parts washer. (My wrench never looked so good, now it doesn’t work ... never use chemicals to clean it.)
- 5. I pulled it past the maximum torque range of my wrench. I thought I could give it a little more to make sure it was tight! (Always stop at the top of the adjustment range. Never exceed the tool’s maximum setting.)
- 4. I didn’t follow the directions for which way it is designated to click! (Not all wrenches can be used in the counterclockwise direction.)
- 3. Hey, John, can I use your torque wrench? Sure! (Tossing it like a football.) Incomplete pass! (Remember that your torque wrench is a precision measuring instrument.)
- 2. It hasn’t worked right since I added the 8-foot pipe to click that nut! (Never use an extension on the handle of your torque wrench.)
- 1. I have used it every day for quite some time. I wonder if it is accurate? (The more often your torque wrench is used, the faster it will wear.)

Source: Service Tech Magazine

Editor’s note: When you get my age (62) you no longer need a click-type torque wrench. You can use a breaker bar and your elbow will click!!!

continued from page 4

cation, then I might consider using studs there.

Back to the heads! I take my heads off a lot! I have a 428 block for a race motor that I’ve had since 1968. I know those heads have been off at least 22 times. That is 22 times that I have had to torque all those head bolts. The threaded head bolt holes still feel good and snug. I always lubricate the threads to the clamping force due to a given torque valve is consistent. My engine is in an altered drag racer so there is no fender/hood interference to give me grief if I had head studs. But I have no reason to use them. Five of the studs on each head might just interfere with the T&D rocker arm stands. I would still have to pry the heads up the length of the stud, surely ruining the gasket (yes, I have reused a gasket at the track when none were otherwise available, and it worked). As a matter of fact, I regularly use Grade 8 bolts with an ultimate tensile strength of 165,000 PSI (capscrews, remember?), easily available at my favorite hardware supply, due to the various lengths needed for different heads.

On the plus side, you must know that the threaded holes in the block I am referring to here are all National Course (N.C.). When studs are used, they are N.C. at the bottom to thread into the holes, but at the top, where the nut is placed, they are National Fine (N.F.). Because the thread angle is shallower on an N.F. fastener, the same torque value on a nut at the top of the stud will produce a greater clamping force in the fastener. This sounds good, but it means that a greater pull out load is being applied to the same threaded holes in the block. If you do use studs, be careful here as I have seen block damage occur due to too much torque (a friend has big arms and damaged his block). Always remember that these high strength fasteners are threaded into relatively weak (from a yield point viewpoint) cast iron.

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Five CTE Bills on Governor’s Desk in 2005

There was good reason to expect significant policy gains in Career and Technical Education (CTE) during 2005. In January, Governor Schwarzenegger listed CTE as a top educational reform priority, legislators from both houses and both sides of the aisle had pledged their support for CTE policy change and a long list of trade associations, business groups and organized labor included CTE measures in the bills they were following and actively supporting.

However, as the 2005 legislative calendar ended there were only a handful of bills that actually succeeded in making the journey to the Governor’s desk. The reasons for this lack of significant progress in 2005 are complex. However, it is abundantly clear that all parties in the education community will need to be working together during the interim if we want substantive K-12 CTE policy change in 2006.

At the top of the priority list for 2006 is an agreement by **ALL** parties on the identification of the appropriate level of resources for K-12 CTE (teachers, facilities, equipment, etc.), the allocation of those resources and the specific funds to be used for those purposes. This “funding” question will be the key issue to be resolved within the education community for real progress to be achieved on CTE.

THE FIVE BILLS

Before the Assembly and Senate adjourned last week (recessed until January 4, 2006) they sent five CTE related measures to Governor Schwarzenegger for consideration. The Governor has until the end of October 9th to act upon the following measures.

1. AB 1609 (Liu) - School Accountabili-

ty Report Card - This measure would require the school accountability report card to include assessment of career-technical education data measures, such as the number of pupils participating in career technical education and the percentage of pupils that complete a career technical education program and earn a high school diploma.

2. AB 917 (Wyland) - CTE Vision Council - The Career Technical Education Vision Council is hereby created to make recommendations to the Legislature regarding career technical education. The Career Technical Education Vision Council shall develop a workforce preparation and strategic plan and submit it to the Legislature on or before December 31, 2007, shall update this plan biennially thereafter, and shall provide related policy guidance to the Legislature and to the Governor on emerging issues of workforce development and the manner in which career technical education can contribute to that effort.

3. AB 693 (Goldberg) - Integration of SCANS into Teacher Training Programs - The Commission on Teacher Credentialing shall conduct a study about how any or all components of skills identified by the Secretary of Labor’s Commission on Achieving Necessary Skills (SCANS) report can be integrated into existing teacher training programs to better prepare pupils for the workforce. The commission shall report the results of this study to the Legislature on or before January 1, 2007.

4. SB 70 (formerly SB 794) (Scott) - Support for CTE in Community Colleges and CTE Linkages for K-14 System - This bill would require the Board of Governors of the California Community Colleges to assist economic and workforce regional development centers and consortia, including middle and junior high schools or high schools and regional occupational centers and programs, to improve linkages

approval, including the President. Major proposed changes by the Board are also brought to the noon meeting for membership approval. Your Board is very dedicated and takes CAT’s welfare very seriously.

“CAT wastes it time concentrating on legislation. CAT has spent many hours trying to get CTE changes through the Department of Education (CDE). It became very apparent about 5 years ago that change would only occur through legislation, especially if CTE is to survive. 5 years ago, legislators did not want to deal with vocational education. Now, both houses have endorsed the need to do something. We also, finally have a governor that is in support of CTE. Currently there are 5 bills sitting on the governor’s desk awaiting his signature (see bill article elsewhere in this bulletin). CAT must remain vigilant on these issues, or, in the future, there will be very little CTE in the high schools.

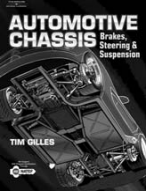
“CAT is out of touch and does little for its members,” The following recounts just a few CAT efforts: CAT spends considerable time trying to provide excellent workshops at each conference to keep you up to date. Up until a couple of years ago, CDE could not afford to mail the summer workshop schedule to each of you. CAT paid for all of those mailings for a number of years. CAT was able to develop a working relationship with BAR through Marty Keller, then Chief of BAR, by establishing the BAR Education Committee headed up by

Ric Escalambre. This committee has brought about many changes that have made the smog program more effective and certainly more manageable in your classroom.

All of these accomplishments, **and more**, are brought about by volunteers who have spent hundreds of hours keeping an eye on things where needed. It is unfortunate that one person chose to criticize CAT by back biting and did not know all the facts. I personally invite this person (and any others) to call me (530-674-3645) and let’s have some open dialogue that could lead to an even stronger organization. The proper channel to effect change is to come to Board meetings and have your voice heard. I am sure CAT would respond in the majority’s best interest.

One additional note. There is a bill in the legislature (AB226) that made it through the Assembly and half way through the Senate. This bill would have moved 10% of the BAR’s annual reserve (in excess of \$30,000,000) and put it into the automotive classrooms with an emphasis on program improvement and retention, especially in the high schools. This money would be a matching amount by your district in effect, doubling your current budget. This bill has been put over to next year into what is called a two year bill.

Remember, keep the shiny side up and the greasy side down. Bob



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HYDROGEN Hydrogen/Hybrid

by James Halderman

Because the hydrogen is introduced as a gas and not a liquid like the original gasoline design, it was necessary to install new injectors. Fortunately, a company in California, has been producing injectors designed specifically for hydrogen. These injectors are driven from the original engine control module, but a new “map” (ignition and injection program) had to be developed to optimize performance with hydrogen.

An internal combustion engine can be converted to hydrogen, but this results in a loss of power (relative to gasoline) due to the lower energy density of the hydrogen gas compared to gasoline. One way to overcome this problem is to install a turbo supercharger (driven from waste exhaust energy) or a supercharger (mechanically driven). Especially when the engine is quite small, a turbocharger is preferred over a supercharger due to the lower parasitic power demands. Another problem that can develop when fueling with hydrogen is the increase in NOX (nitrous oxide). Nearly 75% of our air is composed of

nitrogen gas and the remainder consists of oxygen and some trace elements. When this combination is compressed and heated, it converts to NOX, a contributor to smog formation.

The higher air-to-fuel ratios and higher temperatures generated in a lean burn hydrogen engine also make this a bigger problem than in a gasoline engine. Fortunately there are several methods of controlling NOX, from exhaust gas recirculation, to lowering temperatures by injecting water into the cylinders. The relatively low energy density of hydrogen (compared to gasoline or other fossil fuels) presents not only a problem of reduced horsepower, but requires innovative design of the storage tanks to achieve sufficient range and smaller size. Most of the prototype fuel cell and hydrogen fuel vehicles on the road today use high pressures to gain range and lower the volume of the storage tank. Pressures as high as 10,000 psi have been proved safe and reliable with even greater pressures planned in the future. Some auto manufacturers (such as BMW) have been developing liquid hydrogen fueling systems. Both of these approaches have some limitations. Creating the high

pressures for filling gaseous tanks requires energy that can reduce overall well-to-wheel (point of production to final use) efficiency by as much as 10%, and increase the cost of the tanks. Liquefying the hydrogen not only requires an even greater parasitic energy loss, it also poses the problem of dealing with extremely low temperatures (-423°F, -253°C). Even the best liquid hydrogen tank designs require a continuous bleed-off of gas to keep pressures in balance as the hydrogen warms up and turns to a gas.

Sources of Hydrogen Hydrogen can be obtained by passing an electrical current through water. This process is called electrolysis, which separates the water (H2O) into two molecules of hydrogen (2H) and one molecule of oxygen (O). This process takes energy from one of the following to produce hydrogen by electrolysis:

Solar Power can be used to create electricity directly from sunlight using photo-cells. Wind power can be harnessed using windmills that generate electricity by using large propellers to turn a generator.



Figure 1 An electricity generating wind mill on the plains east of the Rocky Mountains in Alberta, Canada.

Water Power- The force of falling water can be harnessed by having the water turn generators, creating electricity, such as at the Hoover Dam.



Does Your Car Need A Real Stud?

By: Jeff DeRidder, Iron Mountain, Michigan

Please don't read more into this title than is really prudent. I am talking about fasteners! Yes, those nasty little things that hold your heads on and maybe your crankshaft in place. From time to time we see references made in our monthly readers about using studs for certain applications. I cannot recall anyone saying not to bother, unless the subject engine is one subject to a lot of disassembly services. So, without repeating that phrase, I am! Usually, when someone is in support of using studs in an application, they throw in a big strength rating. This number almost always refers to the ultimate tensile strength, such as 195,000 psi or 220,000 psi to indicate the particular grade of steel the stud is made of. Well, I have news for you; bolts can be made out of the same material and are almost always available from the same companies that make studs. In this case, I am using the 220,000 number as an example. This number does not mean that each bolt will hold that as a load. This number represents the stress in the fastener material at the fracture load. This doesn't really mean much as we never get to that point in head bolts or main bearing cap bolts unless something else breaks first, creating a catastrophic load that may break these fasteners.

When parts are designed, the engineer uses a different type of number called the yield point. This number is typically about two-thirds of the ultimate tensile strength. If the load applied to the fastener exceeds the yield point, a failure has occurred. The steel fastener is yielding (stretching, distorting). This means that the head gaskets are no longer clamped tightly or the main bearings are now seeing far more clearance than is consistent with reliable operation. Manufacturers use ultimate tensile strength in advertising as it is a more impressive number. All it is good for is comparison to other large numbers

by other manufacturers to indicate a stronger steel. The consumer must decide if he wants to pay for the stronger steel, even if it is unneeded for the application.

Now, why studs when a bolt of equal strength is simpler to work with? Anyone who has worked on an early flathead Ford V8 knows the effort to remove a head, prying from one side to the other, slowly raising the head to the top of the studs. Our overhead valve heads would require studs three to four times as long, requiring much more time, patience and utterance control. Can you imagine trying to remove heads while the engine is still in the car?

The main bearing caps are a much different story in this regard. The engine is usually upside down on an engine stand, so removal of bearing caps by sliding them up the studs only takes two or three times as long as the few seconds it takes when bolts are removed. (Incidentally, I'll clear this up now: the bolts I'm referring to are really hexagonal head capscrews – technically. I'm a car guy as well as an engineer, so when I say please hand me that bolt, we're using garage language.) Now, when you use a bearing cap stud set, don't forget that you must allow for the additional length of the stud that protrudes beyond the nut, as it may interfere with the oil pan. You know how close the front main cap is to the pan on some engines. The only possible benefit for using main bearing cap studs is that the stud can be run deeper into the threaded hole. This "may" help to distribute the clamping load through the main bearing web in a better manner. But so far, I don't know if that additional eight or quarter inch of depth is helpful in this regard as I have never broken a main bearing web in any of my blocks. Finally, my cranks don't come out all that often, so I really don't believe that saving the wear on the threads that would be caused by using factory style bolts means anything to me. If the threads got sloppy enough that I need to reline the threads with a helicoil appli-

continued on page 8

Lepelletier,

The new kid on the A/T block

Several new 6-speed automatic transmissions and transaxles have been recently introduced that use the Lepelletier design gear train. 6-speed transmissions can give better acceleration along with better fuel mileage by keeping the engine at more-efficient rpms, and compared to other 5- and 6-speed designs, this arrangement is simpler, smaller, and lighter in weight. At this time, transmissions using the Lepelletier design are being produced by Aisin-AW, General Motors, and ZF (Zahnradfabrik Freidrichshafen). Vehicles using a transaxle or transmission with this gearset include the Audi, BMW 7 Series, Cadillac STS-V, Corvette Z-06, Ford Five-Hundred, Mazda 6, Mini-Cooper, Porsche Cayenne, Volkswagen (Golf & Passat), and Volvo XC90.

The Lepelletier design combines a simple planetary gearset with a Ravigneaux gearset. It uses three driving clutches, two reaction clutches, and a single one-way clutch. These parts are connected as shown in the illustration and as follows:

- The input shaft from the torque converter drives the carrier of the front, simple gearset and the intermediate shaft that drives the C2 clutch.
- The sun gear of the front gearset can be held from rotating counterclockwise by the one-way clutch, F1.
- The carrier of the front gearset drives the

C1 and C3 clutches.

- The C1 clutch can drive the rear, small sun gear of the rear, Ravigneaux gearset.
- The C2 clutch can drive the rear planetary carrier.
- The C3 clutch can drive the front, large sun gear of the rear gearset.
- The B1 brake/clutch can hold the large sun gear from rotating.
- The B2 brake/clutch can hold the rear carrier from rotating.
- The ring gear of the rear, Ravigneaux gearset drives the output shaft of RWD transmissions or the differential of FWD transaxles.

Clutch terminology used in this illustration and the gear range chart are from Ford Motor Company and Aisin-AW.

For those that are not familiar with the Ravigneaux gearset, it combines two sun gears (a large and a small). The carrier has a set of long pinion gears that mesh with the large sun gear and a set of short pinion gears that mesh with both the small sun gear and the long pinions. The long pinion gears mesh with the ring gear. Ravigneaux gearsets were used in several early automatic transmissions that include Powerglides and Cruiseomatics and several more modern transmissions that include AOD/4R70W and THM 180/3L30, 4L30.

(See diagram on page 14)

Answer to question on Page 10
The rear-view mirror

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(CTE) programs like auto shop (and wood, metal, carpentry, etc.) and focusing on additional academics needed to keep the schools in compliance.

It is a huge problem. This lack of CTE courses short-changes our 75% of California high school graduates who won't earn a university degree, but leaving them without needed job skills to find a well-paying career. In addition, California law (Ed Code section 51288[b]) mandates that all students be provided an education that leads to employment. The A-G requirement (subjects needed for admission to universities) and the exit exam has reduced or eliminated the offerings of CTE. I think this bias to a 4-year degree sends a deceitful message to our students that if you are not university material, you will be condemned to a life of dead-end jobs. It also permits society to send a very strong message to people with hard-earned career skills: As a society, we don't value technical skills - so don't bother! Of course, we all know of auto techs who have come through our programs and now make comfortable livings, so someone clearly values their skills!

What can we, as members of CAT, do? The CAT leadership works on your behalf in these areas. Our Executive Director, Bob Barkhouse, spends a lot of time working in legislative aspects of promoting and defending automotive education in public schools. Other members of CAT, such as John Chocholak and Tim Gilles, have worked hard on statewide curriculum issues to keep automotive technology standards rigorous and relevant. CAT as a group works on these (as well as many other) larger issues, but each of us, I believe, has a professional responsibility to first promote and defend auto tech locally. As individuals, we have more control of the local environment, our immediate school site and its students who benefit from automotive programs.

I have some specific suggestions, some of which you may have known about, or have even implemented. They are only ideas to plant a seed which

consists of members who manufacture tires, tire-related products or other rubber of polymerbased products in the EU or in the UK, most of whom are the same manufacturers producing and selling tires in the U.S. The BRMA recommended practice on tire aging states

“BRMA members strongly recommend that unused tyres should not be put into service if they are over 6 years old and all tyres should be replaced 10 years from the date of their manufacture.”

The BRMA practice also noted that environmental conditions like exposure to sunlight and coastal climates, as well as poor storage and infrequent use accelerate the aging process and “[I]n ideal conditions, a tyre may have a life expectancy that exceeds 10 years from its date of manufacture. However such conditions are rare.”

Another important point raised in the BRMA recommendation is aging may be identified by small cracks in the tire sidewall. However, “Ageing may not exhibit any external indications and, since there is no non-distinctive test to assess the serviceability of a tyre even an inspection carried out by a tyre expert may not reveal the extent of any deterioration.”

Finally, BRMA warned that spare tires and tires that are not frequently used are particularly vulnerable to aging.

Vehicle manufacturers, primarily those based in Germany, have also issued various “warnings” about the use of tires older than 6 years. For example, in the early 1990s BMW owner's manuals warn spares 6 years old or older should only be used in an emergency. Later BMW manuals indicate that tires 6 years old or older be replaced immediately even if the stated life of the tire is 10 years. Similarly Volkswagen has included a warning in owner's manuals beginning in the 1990s that includes the following language:

“WARNING – Old tires can fail in use, causing loss of control and personal injury. Replace tires after six years regardless of tread wear. Always reduce speed and drive cautiously if you must use an old tire in an emergency. Replace the tire as soon as possible.”

Mercedes-Benz, Audi, GM's German-based Opel division and Toyota similarly warn about tire age.

Evidence suggests that the vehicle and tire industries have in fact developed various internal methods to determine aged tire performance and have used those methods to devise recommendations about the shelf and service life of tires. In some cases that evidence finds its way into the public realm, but in most instances recommendations on tire age remain an industry secret. A recent Bridgestone/Firestone recommendation in Europe suggested that consumers replace tires as soon as four years because of the affects of aging. Korean tiremaker Kumho has acknowledged that after six years its tires are no longer safe.

Other findings confirm tire aging can significantly reduce the internal adhesion levels of tires. The U.S. Department of Defense “shelf life project” and the Israeli army tests conducted by Smithers are two examples. The DOD shelf life project subcommittee for tires recommends that tires have a shelf life of no longer than 5 years. The Israeli army recommended radial tires should be removed from stores and vehicles when they are 11 years or older based on a Smithers report that concluded ties that were 10 to 13 years old experienced the most significant performance loss. Interestingly, NHTSA endurance tests which included four-year old Pirelli tires appear to add anecdotal evidence that older tires fail in service more rapidly.

The technical literature is replete with data and conclusions that aging is a significant factor affecting tires. In addition, tire manufacturers guides for tire professional offer insight that the industry is in fact keenly aware of the changes in physical properties to their products as they age.