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Dennis Nowak
President - Houston Chapter



For those of you that didn't attend the Annual Dinner in January, let me introduce a few new members of the board **Diane Albrecht** is our new Secretary, replacing Pam Johnson and **Bill Krupowicz** is our new Treasurer, replacing Sarah Nowak. Also, new on the board is **Christopher Soto** as our new Membership Chairperson replacing Jim Moffitt. I want to give a sincere 'thank you' to Pam, Sarah and Jim for their service to the chapter board. Also, a sincere 'welcome' to Diane, Bill and Christopher, I look forward to working with them and all the returning board members this year. All of the board members work very hard and dedicate a lot of their time doing what they do. So give them a big 'thanks' the next time you see them.

Those of you that live out on the West side of Houston are probably already aware of this so I'll inform others that **Momentum BMW West** has changed their name to **BMW of West Houston** and moved into a state of the art building further West on I-10. A few of us visited them during their open house and were impressed by the computerized showroom as well as the super clean shop that you can see through a large picture window. I do wonder if the mechanics feel like they are in a fishbowl now. Go out and visit them when you a chance.

I encourage all of you to come out and join us at the events this year. I want to throw out a challenge to those members who have been members for a while and never attend events. You are really missing out on one of the best aspects of club membership; that being the social side. Come out to the events and I bet you will meet some very friendly folks you might like to hang around with. All of the events are great ways to meet likeminded members, but one of the easiest to attend is the monthly coffee meets. It is a family friendly, casual meet, where you can come and go to talk cars, kids, vacations, food, movies etc. etc. You don't have to talk only cars and you don't have to have a BMW either. You just have to show up with a friendly attitude and I bet you will find it returned. If your desire is to try something a little more sporting, our Autocross committee is planning some AX events for first timers as well as some challenging courses for those more experienced. Questions about the AX events: Contact **Chris Stokes** at the address listed in the board contacts section of the Torque. Questions about Social events, contact **Neil Baer** in the same board member section.

2015 is shaping up to be a great year for our car club. I hope to see you at the events, you can find me . . .

in the driver's seat!

Stay Informed!! - eBlast Signup

Once a month the Chapter emails an eBlast to all members who have indicated that they want to be kept informed about Chapter activities and events, as well as news and information involving the Chapter.

If you wish to receive this information and are not already signed up you may do so on the website at www.houston-bmwcca.com.

The eBlast request is located at the lower left on the front page.

MEMBER SPOTLIGHT



Pam Johnson

Pam has been very active in the club since she joined, attending events, writing articles for the Torque, coordinating Annual Dinners, Rudi Lechner dinners and drives just to name a few. More importantly she has served on the board as Social Events Chairperson and most recently as Secretary, not only carrying out her normal duties, but also stepping up to handle other tasks as they arose. Pam has always added a more colorful and whimsical aspect to whatever it is she is doing at the time and it never seems to stop her from telling it like it is at times. She has taken on several challenging tasks while on the board and has always succeeded in getting the job done. One of the benefits of being in this car club is meeting and then becoming friends with people like Pam, I am glad to call her my friend. As I've said before, it's the cars that bring us together in this club, but it's the people, like Pam, that make us stay. Thank you Pam for all the hard work and fun you have infused into this club.

Nominated by: Dennis Nowak

Mike Williams, Parts Director, at **BMW of Houston North** is offering to BMW CCA members BMW Accessories and Lifestyle products at employee cost plus 10% (excluding regular vehicle replacement parts).

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This offer is good until mid-summer, June 30th. Simply present your membership card at time of purchase.

Also plan to attend the **Wash Wax & Tech Session** Sunday, May 3rd.

For more information contact:

Scott, at BMW of Houston North
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WELCOME! NEW MEMBERS:

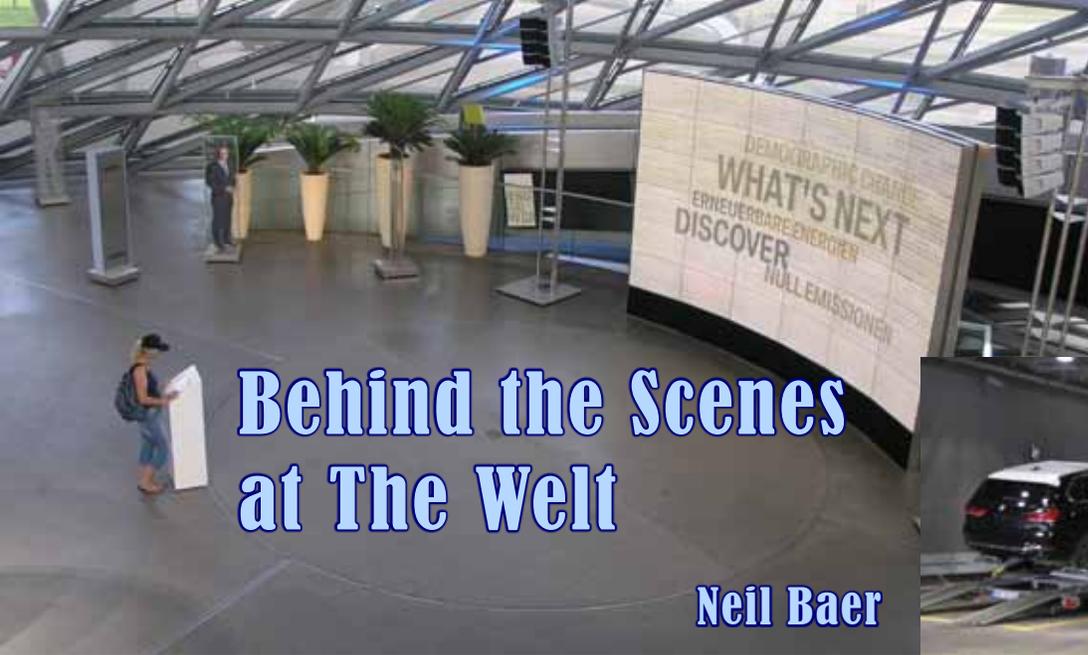
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Brenton Spry
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 Bryce Ward
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 David Wells
 Chris Wolf
 James Yang
 John Yao



Behind the Scenes at The Welt

Neil Baer



designed the BMW Headquarters building across the street! You can't make this stuff up!
As you move through The Welt, you see many people in positions working at several different things. But did you know there are 450 of them? That's because of all things you don't see from that main floor. Like...

Over nine years ago, we picked up our BMW through a program called Euro Delivery. It was our first BMW. First time to Germany for vacation. First time to drive in Europe. It was everything that a trip of "firsts" should be.

Of course, a factory visit was essential to see how those Bavarian beauties were assembled (our First car manufacturing tour). As we walked towards the subway station across the street from the plant, we saw this massive construction zone across the street. Exotic girder designs anchored each end of the massive construction site. We had no idea that we were looking at the new Euro Delivery center – The Welt.

Welt, is German for "World". A pretty heady name for a structure. But it has met those expectations many times.... as since that day, I've been back to visit the Welt many times!

The Welt is the most popular tourist destination in Bavaria. Three times as many people visit as the next most popular attraction, Neuschwanstein. (the famous castle near the Alps) And there's a reason – it's an amazing place and always changing.

So, when our good friend Ida decided to pick up her new 428 in Germany, you know we were on to see the latest version of a great idea. Except this time – an added bonus. A behind the scenes tour, courtesy of BMWNA's, Rainer Wahl. Rainer is married to Keri - Lynne Shaw, another BMWNA person I met years ago after needing some special assistance with that first Euro Delivery. At that time she was managing the Euro Delivery program, and we've stayed in touch ever since. Rainer, who previously worked in Munich, connected us with a special tour that was fascinating.



After signing in, our guide, Julia Bergmeister appeared and the tour was on. Julia is also an architecture student and in her role, she gets to work with BMW at the Welt – inside this unique building, where she can savor the design and construction. As she walked us around, she explained that the walkway from one entrance to another is the longest suspended walkway in Germany. And that 25% of the entire building weight is held up by a relatively small section where the elevator shafts are. And that the designer, Wolf D. Pix, was a student of the person that

- The entry garage – every 30 minutes a truck of new BMW's arrives and is unloaded. Looks just like a regular car carrier in the US. Even if the car is coming from across the street, it rides on the truck. Of course, these cars are from all over – as BMW has four plants in Germany alone. X3,4,5 and 6 owners – get to pick up if the car is destined for Europe – but not if destined for the US. US customers can pick them up in Spartanburg SC, at the Performance Center.
- All the cars are offloaded and the protective plastic is stripped off. Then the cars move through a car wash.
- Once the cars are cleaned, they move to a giant tech center. Even if they are two days old, each car is inspected and checked by a technician in a garage that looks like it was lifted from a BMW mega dealer.
- After getting the green light, the car goes to a special warehouse in the Welt. The atmosphere in the warehouse has only 14% oxygen, to minimize the risk of fire. (fuel tanks are full) And each car is placed – via robot – in one of 264 temporary spaces. The typical lead time is to



get the car two days before the scheduled pickup. There's a window allowing visual access to the warehouse and it was fun to watch the cars being plucked off the rack. Think about it – if the average car is \$65,000 – that's over \$17 million in Bimmers parked in that warehouse.

- But on average, about 100 cars per day are picked up. Interestingly, 90% are by German buyers. We saw many cars with standard German plates (cars going outside Germany have a special plate with a red section indicating the registration expiration date). All of the cars Americans pick up are located on turntables – like at an auto show. When the happy owner comes up to the car, the table starts spinning and the owner is united with their new friend. The folks in Germany can select this type of arrival, or go for a less expensive version where they do not get the same level of service. A max of 30 minutes with an advisor and no turntable. This is not available to the US folks doing pickups.

- There is a tradition that after you have been instructed on your car and are ready to go, you get to take a Victory Lap around the pickup area.



The Welt is ever changing. Since our last visit, they moved the gift shop and took out some of the technical exhibits. Replacing the gift shop area is a section for the new “I” cars. The BMW Individual section was moved and replaced with a new section for Rolls Royce. Per our guide – the only permanent RR exhibition outside of England. We got to see them up close, as part of our tour, though sitting in them was not on the agenda.



And for you motorcycle lovers, a former gift area focusing in books has now been made the motorcycle area. Very popular with the guests.

The BMW Individual area seems more robust than I remember from previous visits.

And – while there are several places to eat - the restaurant has been changed and is now a one star on the Michelin list. Of course we checked it out and the cuisine was quite good.

If you ever get the chance to visit, please do so. Or better, get your next Bimmer through Euro Delivery, enjoy the whole experience – and especially **The Welt**.



Actually, you can take as many laps as you want before driving the car down the ramp leading to the new world you and your car will enter. But – if you have an M car – a little extra treat. There is a hopped up M135 that leads your new M around the Victory Lap. From the sound of it, I'd guess straight pipes! We watched one proud new owner enjoy that extra treat before exiting the Welt.

- Once you exit, they will park your car so you can continue the visit (which we did as the whole day was “BMW Day”)



2014 Autocross Awards

By Jeff Conley

One of the highlights of our chapter's annual dinner is the Autocross Awards presentation. I think it is safe to say that it ranks up there with winning free tires and enjoying wonderfully prepared food. For those who missed the dinner this year, no need to feel left out as we are providing you with a recap of the events in this edition of the Torque of the Town. For those that made it, enjoy a stroll down memory lane.

The autocross awards portion of the banquet began with recognizing the autocross committee members from the 2014 season: Chris Stokes, Jeff Conley, Levi Ball, Karl Hermann, Walter Phillips, Chris Augustine, and Jan Rowe. Chris Stokes thanked them all for their personal time and energy they have put forth to enable us to have such a wonderful Autocross program.

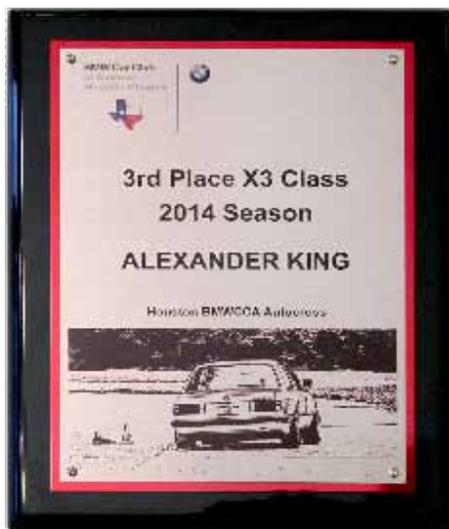
The Autocross program survives by membership participation. Special recognition was given to Chris Augustine, Jeff Thompson and Chris Stokes for being the only three drivers who attended all eleven autocross events, which includes the autocross at the Circuit of the Americas during the Texas Trifecta in March.

The Houston Chapter prides itself on our selection and craftsmanship that goes into our awards. 2014's award was no exception, a gloss black plaque with a stenciled plaque of a lucky member's car on the autocross course. This is very similar to the previous season's except that for 2014 we changed from a Blue border to a Red border and the photo on the plaque was that of Thad Davis's white E30, listing heavily when going around a pointer cone on the course. We will look into a Purple border option for next year.

Now, let's move to the actual results and bragging rights. Read "What Exactly Is an Autocross" in the Summer 2014 edition of the Torque of the Town for a better understanding of Autocross rules, points, and classing. The cliff notes for classing are: As vehicles move up in inherent performance characteristics and owner modifications, they move from Class A up to Class G, for BMW models; for R and X classing, read the details of these classes in the results below.

CLASS A:

Don Guilbault is the champion of A Class, with a maximum 54 points, driving his 1976 2002. It was duly noted that there were no second or third place winners in A Class as Don had no other competition in A Class throughout the season. Don was literally "in a class of his own." For 2015, we're hoping some Isettas, or golf carts, will compete against Don in A Class.



CLASS B:

Chris Ward is the champion of B Class, also with a maximum 54 points, driving his 1970 2002. There were other drivers who competed in the class, but most only raced one or two events, and none with the minimum 6 events to qualify for a trophy. So this got us wondering, what did Chris do? Did he play mind games with the other drivers and scare them off? This is something we'll have to investigate.

CLASS C:

This class was very competitive, with only three points separating first and second places! Third place went to Michael Anastasio who gathered 37 points driving his 2006 M3 Convertible. Second place went to Chris Augustine who got 48 points driving his 1991 E30. C Class Champion went to Lonnie Howell, getting 51 points and five first place finishes in his 1998 528i.



CLASS D:

Third place in D Class was won by Tor Taklo, taking 35 points driving his 1989 E30, and occasionally his brand new M5. Second place went to Walter Phillips who accumulated 40 points driving his 2011 M3. First place went to Gerald Anderson who had 51 points and five first place finishes driving his 1997 M3. Gerald and Tor battled for first place during the first half of the season. Walter however, missing January and February's events, started in fifth place in March, and drove his way up to second place by the end of the season!

CLASS E:

In E Class there was another close battle between first and second places. Three points separated first and second at the end of the season. Third place went to Michael Knieren who got 37 points driving his 1993 M3. Second place went to Antohy Alviar, with 48 points driving his 1999 M3. The Champion of E Class is Thad Davis, who mostly drove his 1987 Franken30, gathering 51 points. Thad held onto first place throughout the entire season, but Anthony and Michael came on strong at the end of the season, taking many first and second place finishes.

CLASS F:

F Class was a very consistent class throughout the season, with the drivers in first, second and third places never changing. Third place went to Aaraj Thyagaraj, who gained 23 points driving his 2002 M3. Second place went to Jeff Otten, with 42 points driving his 1997 M3. And the Champion of F Class, with a perfect 54 points, and a first place finish in all seven events he entered, went to Donovan Brown. Donovan drives a 1997 M3.



Jim Hedderick. Ricardo Barnes had held first place in class up until June when Jim took over and held first through the rest of the season. To lift Ricardo's spirits, we told him we thought if he hadn't been missing-in-action at the May, June and September events, he probably could have kept first place, or at least come in second.

He made the biggest improvement in class position from beginning to end of season. After having missed February, March and the COTA event in late March, by April he was in 6th place in X3 Class. By November he battled up to first place, and sealed the top spot with first place finishes in November and December.



SPECIAL: Cone Killer

The final award of the night, the Cone Killer award, went to the driver who over the season had hit the most cones and amassed the most time penalties. There were dishonorable mentions, who didn't quite measure up to the winner: Jan Rowe with 21 cones downed, Robert Horton with 25, and David Hedderick with an astounding 29 cones. But the driver with the most cones hit (an embarrassing 36 cones) equating to a full 72 seconds of time penalties is Chris Stokes. Chris was apologetic and made some lame excuse about having to hit cones in order to become faster. As you can see, every expense was spared in the making of the trophy, which made the Board happy.

Chris Stokes closed out the presentation by thanking everyone that made 2014 such a successful year. He recognized that a successful AX program goes beyond an enthusiastic autocross committee; having a supportive Club Board, and supportive members that come out to drive, help make the program better. He looks forward to what 2015 brings and hopes to see more of the same faces and cars, along with some new ones.

CLASS R:

R Class was a new, experimental class for the 2014 season that used a handicap system to allow cars from any class to compete with one another. We decided not to continue this class for the 2015 season due to complexities it introduced... and no it wasn't because Chris Stokes came in third place. (Or was it?) As mentioned, Chris Stokes came in third place, with 32 points driving his 1995 M3. Second place went to Brian Colvard, accumulating 45 points while driving his 2012 MINI S Coupe. David Hedderick won first place with a perfect 54 points, and seven first place wins, driving his 2008 Mazda 3s.

CLASS X1:

Next were the non-BMW classes. X1 Class, which includes eight cylinder cars and cars with turbos, was a very competitive and challenging class since we had anything from a Viper to a turbo 4 cylinder Toyota. Some drove on race tires and some were on winter tires. Third place went to David Duxbury, with 24 points, driving his 2000 Toyota MR2. Second place went to Edward Morfe, with 36 points, driving his 2006 Mitsubishi Evo. And gaining a perfect 54 points, and winning first place in all seven events entered, driving his 2004 Miata is Terry Price. It's always fun to watch and see who comes out on top in this class.

CLASS X2:

X2 Class is normally aspirated 6 cylinder cars. This seemed to be our Porsche class with an occasional Ford, Volvo, and Lexus thrown in. Winning third place is Ricardo Barnes, with 28 points, driving his 2010 Cayman S. In another Porsche, Michael Snetzer won second place, with 35 points, in his 2011 Cayman. And yet in another Porsche, winning first place in his 2001 Boxster, with a perfect 54 points and six first place finishes, is

CLASS X3:

The X3 Class, had the largest number of drivers (7) attending 6 or more events. And for that reason, this class had the tightest points spread (9 points) of all classes between first and third places. Taking third place is Alex King, driving his 1990 Miata towards 37 points. Second place went to Chris Chrismon, with 28 points, driving his 2008 Honda S2000. Jonathan Khandaker won first place in X3 Class with 36 points, and two first place finishes, driving his 1999 Miata.



SPECIAL: Driver of the Year

Driver of the year went to Chris Augustine for several reasons. He drove in every event this year, he was a very competitive driver, and he was always willing to lend a helping hand from course setup to breakdown, even though he never really was asked to join the autocross committee. We just adopted him.

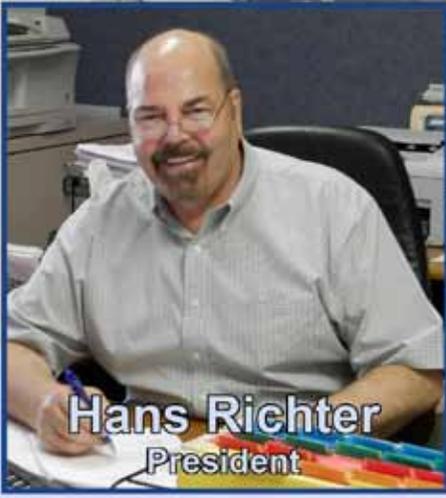
SPECIAL: Most Improved Driver

Jonathan Khandaker was awarded Most Improved Driver for the season.



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From the Webmaster’s Screen Getting Connected

One of the most frequently asked questions I receive has to do with logging in to the web site or the forum. Let’s see if I can clear up the confusion.

To begin with, there are three different web sites we need to concern ourselves with:

- 1) The Houston Chapter web site (www.houston-bmwcca.com) This is the place to go to find out about upcoming events, as well as general information about the chapter.
- 2) The Houston Chapter discussion forum (www.houston-bmwcca.com/forums) The forum is for the discussion of a wide range of topics relating to the activities of the club.
- 3) The BMW CCA national web site (www.bmwcca.org) This is where you need to go to join BMW CCA or renew your membership. You will also find information on club events at the regional or national level, as well as a classified ad section where you may find the next BMW of your dreams.

The Houston Chapter web site

This is the easiest of the three sites to demystify. Even though you will see a place to enter a username and password on the left hand side of the main screen, you don’t actually need to log in. Except for those who need to post content to the web site, logging in is not necessary. Unlike some web sites, all of the chapter web site’s content is available to all visitors. Occasionally, I receive questions from people who used to be able to log into the main site, but find they no longer can. Not to worry; you’re not missing out on anything whatsoever.

The Houston Chapter discussion forum

In order to minimize the likelihood of unwanted postings, forum membership is set up to require administrator approval before you can log in. Logging in is required before you can post to the forum, but not for reading the messages on the forum.

To create an account on the forum, click on the “Register” link, normally found in the upper right hand corner of the main forum page. You will see a screen asking you to verify that you are over or under 13 years of age. This is a feature of the forum software to keep youngsters from accidentally wandering into the forum. Rest assured that we have nothing inappropriate on the forums, and that while the discussions occasionally become ‘spirited’, we do our best to keep the language family-friendly.

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The next screen presents the terms of use for the forum, to which you must agree before proceeding. After agreeing to the usage terms, you will come to a screen where you will need to enter a username, email address and password. Your username can be your real name, but certainly doesn't have to be.

Now comes the tricky bit. You will see a graphical image of a series of letter and numbers. You must enter these characters exactly in the box provided. The purpose of this step is to prevent automated programs from creating accounts on the forum in order to post unwanted content (i.e., "spam"). If the characters in the graphic are difficult to read, click on the "{ VC_REFRESH }" button next to the data entry box to force the graphic to be redrawn in different colors which may be easier to read. After entering the characters from the graphic in the box, click the "Submit" button.

You will next see a screen telling you that your new account must be approved by a forum administrator. This normally occurs within 24 hours, and often much sooner than that. You will also receive a "welcome" email at the address you provided. Another email will be sent out once your account has been approved. After that, you may log in and join the conversation!

The BMW CCA national web site

If you're reading this, it's likely that you have already worked out how to join BMW CCA. Normally, you will log in to the national site with the username and password you created when you joined.

One area of confusion that occasionally comes up is that people don't understand why they can't log into the Houston Chapter web site or forum using the same username and password that they use on the BMW CCA national web site. The reason is that all three web sites are completely separate and do not use the same login information.

Hopefully, this article has answered some of your questions. If not, feel free to contact me at: webmaster@houston-bmwcca.com.

See you in cyberspace!

Jeff Thomson

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The E36

M3 LSD Differential Rebuild with 4-Plates Part 1

The E36 M3 cars use the 188 or medium differential. The M3 differential is very similar to the medium differential that was used in a lot of car models, including E24, E28, E30, E32, E34, E36, E36/7 and probably some others. For many years BMW used three (3) basic differentials (small 168, medium 188, and large 210) as the power went up the size went up. The 188 differential (188 comes from 188mm of ring gear diameter) was used with most 6 cylinder cars. Note that Z3 non-M cars were built with torsen differentials, so this upgrade does not apply to them.

The LSD differential used by BMW in these cars was a plate type differential using two (2) friction plates. The differential was designed by ZF and uses parts that were also used in other cars, specifically Porsche. BMW defines these plate type LSD differentials as being 25% lock-up.

or performance driving the LSD differential drives both rear wheels. For an open differential the power is really only transmitted to one wheel, and unfortunately the one with the least traction. Modern cars use stability and traction control systems to prohibit the wheel spin and work remarkably well for normal driving conditions. If higher performance is required, then driving both wheels enhances cornering potential significantly with increasing driver skill.

Depending on use and maintenance the plates can be worn out in a 100k miles or so. As most of these cars are now well above that, it can be reasonably assumed that the differential can benefit from service.

The medium differential, as built, has a washer at the bottom of the housing that is about 4mm thick. Since a friction plate is nominally 2mm thick, and a fixed plate is 2mm thick, we can remove the spacer and have room for two more plates. Then by machining another 4mm from the end flange on the other side, we have room for another set of friction and fixed plates. By having twice as many plates we can transfer torque over a larger area, enabling more torque to be transferred and distribute wear over a larger area so the differential should last longer as well.

Many differential builders suggest there is benefit to doing a three (3) plate build. Basically two (2) plates on one side, and one on the gear side. This would seem to create imbalance in the lock up depending on the turn direction. Since this car is mostly a dedicated autocross car, we want a balanced left or right turn response,

assuming a typical course has an equal number of left and right turns. Therefore it was decided that an equal (2 friction plates on each side or 4 total) was needed. This is typically considered a 40% lockup conversion.

Another way to change to lockup is to change the ramp angles on the center section. The BMW differentials use equal 45 degree ramps for both acceleration and deceleration. For this rebuild the angles are left alone.

In order to prepare for this rebuild on a 97 E36 M3, another end plate was machined thinner by 4mm. The plan was to swap the end plates to speed up the assembly. This part is not available separately from BMW, so must be found from a used LSD differential.



Figure 1 Final Drive removed from car

To simplify moving the final drive assembly a modified moving dolly was used. The final drive was cleaned next using Simple Green.

Figure 2 LSD "S" marking

Figure 2 shows the typical "S" marking of an LSD differential. The tag also states the gear ratio, 3.23 for the late E36 M3. Other models often have a metal tag under one of the rear cover bolts that will have the S and ratio stamped on it.



For preparation you'll need:

- Friction plates (4)
- Fixed plates (2)
- Output shaft seals (2)
- Output shaft bearings (2)
- Output carrier O-rings (2)
- LSD Flange bolts (8ea 8mm x 1.0mm x 16mm grade 12.9), recommended
- Drain plug gaskets (2)

Consumable supplies needed:

- Blue Loctite (242)
- Red Loctite (272) (for ring gear bolts if needed)
- Gear marking compound
- Gasket Eliminator Permatex (518)
- Differential oil, (2 qts. Redline 75W-90)

With the final drive out of the car the oil was drained. It's a good idea to check the drained oil for excessive particles. With the final drive unit on the workbench a torque test was done on the input flange and the output flanges. This was to confirm the base value of resistance.



Figure 3 Input torque check

Figure 3 shows a 1/4" drive inch-pound torque wrench to test the input. A socket to fit the input shaft nut is also needed. The socket used is a homemade deep 32mm socket that is beveled for a better fit at the front. Since the retainer on the nut prevents the socket seating, a ground taper on the OD helps to get enough contact. Note that torque is low, should only be about 24 in-lbs.

Next test the breakout torque of the existing LSD unit. An adapter made from plate by brazing an old 22mm suspension nut to a piece of 3/16" plate is used to apply torque. Spare cover bolts (8mm x 1.5 x 30mm long) are threaded in to hold the adapter and in the opposite side and reacted with a pry bar against a bench vise. Four bolts are needed and can be taken from an old final drive or bought at Ace Hardware. Expect the torque to break out the LSD should be something less than 60 ft-lbs.

To check the torque the Harbor Freight digital torque meter was used. This device is strain gauge based and reads torque from 25 to 150 ft-lbs. The device also stores the peak torque, ideal for this check.



Figure 4 Torque check before disassembly

The value read was 38 ft-lbs. Less than ideal, but at least indicative of plates not being galled.

Remove the rear cover. Note the condition of the paper gasket. On reassembly a sealant will be used instead of the factory gasket. Note that this differential has aluminum spacers for the rear mounts, but if using factory rubber mounts be sure to check the condition and consider replacing.



Figure 5 Rear cover and crumbled gasket

With the cover off, a problem became apparent, all the LSD flange bolts were broken! The bolt heads were gone and the flange broken.



Figure 6 Broken bolts and flange

To fit two plates on the driver side of the differential, the flange has to be machined thinner. The flange is thick enough to permit this.



Figure 7 Left is replacement modified flange, Right is original height

The flange on the left was taken from a donor M3 differential and machined down from .557 in height to .403" (.154"=3.912mm). 4mm exactly is .157 in, since I was planning to use the existing fixed plates, I assumed they would have a few thousands wear. I asked the machine shop to machine .156" off within .005" of the target. Note the bearing was removed, so the machine can do this work in a lathe, by chucking on the bearing diameter.

Expect to pay about \$75 or so, at an automotive machine shop. We were fortunate and a friend machined this for us. A depth micrometer is used to measure the height of the flange, a caliper isn't accurate enough, because it cannot be held square.

Next, remove the drive flanges from each side. I recommend marking everything with a Sharpy pen for left and right sides. This is particularly important with the shims. This shims are selected to produce the correct bearing preload.



Figure 8 Pry bar to pop out drive flange

The drive flange is held with a snap ring in a groove, a small bump with a pry bar pops them out.

Despite the broken bolts the ring gear showed no damage. Since everything looked good, I checked the gear pattern for reference. This differential ran quiet so I wanted to check the pattern as reference for comparing after new bearings are put in. For this some gear paint is needed. This is Richmond gear marking compound from Summit Racing.



Figure 9 Gear paint tin

Clean the gear teeth with brake cleaner on a shop towel. Apply a small amount of gear paint to about four teeth on the ring gear, and rotate the gear several times around in the forward direction of the car. It will produce a pattern on the gears. If too much is applied the pattern won't be clear, just clean with brake cleaner and try again.



Figure 10 Gear marking paint to check gear pattern

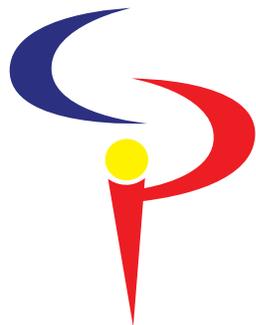


Figure 11 Contact pattern after a few rotation

This gear set looked very good, in excellent condition.

The side flanges are removed next this allows the differential to come out of the housing. Remove the bolts from each side, the pry the flange out from one side part way, then the other side. Support the differential to prevent bending the speedometer sensor wheel. There is one shim on each side, mark these L and R (noting orientation of the housing, best to mark always as the drive unit is in the car).

(Continued on page 16)



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Figure 12 Output flange, O-ring, shim and bearing inner race

Mark each flange and shim L or R. Remove the O-ring with pick or small screwdriver and discard.



Figure 13 LSD differential removed with right side up

To prevent damage to speedometer wheel and to provide more room for the bearing removal, it will be removed. Heat the ring with a propane torch and tap and pry the interface with screwdriver or chisel. There are four windows that allow a tool to pry up. The idea is to heat the ring fairly quickly without warming the main body very much. Fitting the new plates will require several fit and measure cycles so having the speedometer wheel out of the way will allow the work to be easier later..



Figure 14 Flange and ring gear bolts

Next the flange should be removed. If the bolts are in place, there are eight (8) 8mm low head socket screws. They are supposed to be installed with Loctite.

Make sure to have a good fitting 6mm hex drive, well aligned with downward pressure. The torque is supposed to be 25 ft-lbs, which is almost at the limit of the hex capacity. If difficulty is encountered, try heating the head of the screws with a propane torch, then allow to cool, to break the Loctite bond.

This differential had all bolt heads broken, and just pieces of thread in the holes. A little heat on a couple of them, needle nose pliers, and small vice grips and they all came out.



Figure 15 Removing broken flange bolts

Once the flange is removed carefully lift the flange up. There are three (3) parts in the counter bore, a keyed washer, a Bellville washer, and a flat washer. Note the order and place in order for later install.



Figure 16 washer, Bellville spring, and keyed washer

The three (3) washers are typical of both ends of the differential. Keep them separate to reinstall in the same positions. The pock marks in the keyed washer face the shaft face to hold oil.

There are ports at the right side of the differential housing, and the internal assembly can then be lifted out. Figure 17 shows the assembly after cleaning and with 2 additional plate pairs added. The center section contains the spider gears. The outside gear has a spline that the friction discs engage. At the bottom of the differential housing is a large washer 4mm thick, this washer will no longer be used.



Figure 17 Internals of differential with additional plates on each side



Figure 18 Friction plates, used plates at top

BMW calls the friction disc the inner disc. The keyed disc is called the outer disc.

For this build the plan was to reuse the old outer discs by simply turning them over, and install four (4) new inner discs. Due to the bolts being broken on the flange the load on the inner discs, was reduced so the wear was much less than expected. Usually with over 100k miles, it's best to be prepared to put new discs in.

These discs are genuine BMW parts. The same part can be ordered as a Porsche part, and there are a couple of aftermarket discs available, from www.bimmerworld.com and www.bimmerdiffs.com. The BMW part number for the inner disc is 33141210626 for the 188 differential. To find this number in the BMW parts database, search the where used section and a parts breakdown is listed under the E24 635CSi. This is one of the few parts that BMW still sells for the LSD.

Part 2 coming in the Summer issue of TORQUE OF THE TOWN

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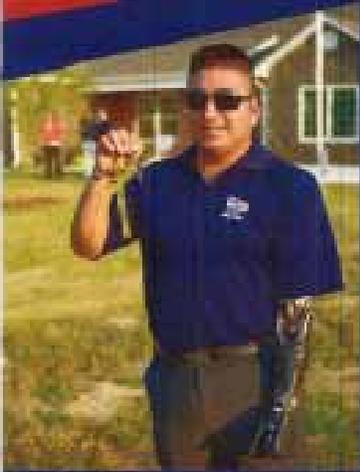
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HOUSTON AUTOSHOW

Editor's Corner Jim Robinson

I made it out to the auto show on Sunday, the last day of the event. I went to see the exotics; the eye candy.

Of course my first stop was the BMW section. The M4 in bright orange was certainly eye-catching. And the i8 was stunning but I'll get back to that in a moment.



BMW's other offerings included the brightest spots in their production line. The 750Li had all



the bells and whistles and people were climbing all over it. From what I could see of it amid the crowd it had the displays on the back of the front headrests and all the comfort features you'd ever want in a land yacht. The run of the mill 3 and 4 series cars as well as the X series cars all had crowds around and inside them; it was fairly hopeless to get decent pictures. The i3 was represented well but after seeing the i3 ad during the Super Bowl I'm cringing now. Seriously, Katie Couric and Bryant Gumbel? I'm sorry, that went over almost like the "cherubs" flying around the X5 commercials several years ago.

I didn't spend a lot of time looking at the normal cars; GM, Ford and all the rice burners. They had some nice offerings but to me most were mundane in their effort to dazzle with bright lights and uncommon designs. I can't really expound on the already overused clichés. But I have to attest that Lincoln's baleen whale grille accurately describes it regardless of

Matthew McConaughey's ads. Buick can't escape the "old person's" car attitude. In their ads, "That's a Buick" still falls flat. And Cadillac, From aristocrats, and gangsters to Elvis, I like Cadillac, but they seem to have lost their way over the last decade. Not seen was the new 640hp CTS-V that was

reported to be the next version of the M5 killer. And it's just as well because, like Lexus and all those other car companies comparing themselves to BMW or Mercedes makes them sound like the cheap imitations they are. I don't know what their marketing departments expected to achieve but such comparisons seem to insult the potential buying public. The new Corvette is stunning but I'm still waiting on the mid-engine design which has been hinted at for 2017. And, one more comment before I move on. Ford didn't have the new GT40 concept on display.

I thought that Houston was a big enough venue to roll it out. But once again, I'm sure the turbo V6 is nice but the true heritage of the car that beat Ferrari is lost.

On the next page I've included pictures of the novelty items and the historic automotive icons; death traps by today's CAFE standards but still they stand out as examples of automotive willful disobedience.

Speaking of Automotive Willful Disobedience

There were fewer supercars than I had expected to see; the high point being the Pagani Hurayra. Staged as it was with glitzy lighting and backdrop images it indeed looked otherworldly. A placard listed the amenities:

- Argentine Blue with Blue Carbon Exterior
- Custom Grecale White leather and Grigia Alacantara interior with blue carbon trim (I guess that's better than regular leather and imitation leather)
- Custom Digitalis yellow luggage (I thought digitalis was a medication for heart attacks) maybe that has something to do with the price which wasn't listed.
- Brembo Carbon Ceramic Brakes
- Pirelli P-Zero Tyres



- 6 Liter V12 Twin-Turbo Engine
- 730bhp (Grrr!)
- 1350 kg Dry Weight (that's 2976lbs soaking wet to you and me)
- Traverse Sequential Seven Speed Gearbox (so they stuck the tranny in there sideways?) The car was presented by Pagani of Dallas. 5333 Lemmon Ave. Really: Lemmon Avenue? But perhaps I'm being too cynical. It is a very amazing looking car and I'm sure you would need some kind of heart medication before or after driving it.

Compared to the Pagani the Lamborghini Huracán seemed merely atypical. But if I could afford to choose I'd pick the Huracán every time. Ferrari was under represented at the show. As were Rolls Royce and Bentley. Audi had their V10 R8 and Jaguar had their concept F-Type Project 7 roadster.





Oh Mein Gott!



The images from the automotive press don't do it justice. BMW's own pictures don't express this profound automotive creation. The pictures I was able to get don't do it justice. The car was locked and with the tinted windows seeing inside was impossible. The grimy fingerprints all over it testified that everyone wanted to touch it just to make sure it wasn't a figment of their imagination. The crowd prevented me from getting more image close ups. This car is what the moniker "Hybrid" was intended to mean. While the Porsche 918 Spyder Plug-In Hybrid is a supercar on steroids the BMW i8 has the elegance of futuristic style and real world performance in a package that even the Pagani Hurayra can't match. Elton Musk's Tesla look bland utilitarian compared to the i8. This car is in a class by itself. I don't think it's just me saying that this was the highlight of the show. Seeing it in person is absolutely stunning.



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