Impala SS

Handbook

Original by Karl Frost "QaloSS"
Updated version by Ash Carlton "whteglve"
with help from many others.
In conjunction with,
www.impalassforum.com

Introduction

The original "QaloSS' Impala SS Handbook" was written by Karl Frost (aka: QaloSS on several forums). He created the original handbook after purchasing his 1995 Impala SS, "Butch", on November 1, 1999 with 139,000 miles on it. His thoughts were "When you purchase a high mileage car, you will need to do some repairs in the coming months." After he bought his car, he knew that it car was special, as we all do, and knew there had to be more people who loved these cars just as much as he did, which we do. Well after several run-ins with disaster, "Butch" departed for the highway in the sky in June 2003 when a pine tree fell on it, totaling it.

R.I.P. "Butch"
1995-2003

Karl also wanted to create a reference guide for beginners and just a helpful little tool for anyone who owns a B-body. He never had enough information to go by or enough knowledge to back up his findings. Just like we all have at one point or another. He learned a lot more and had plenty of hands on experience with many procedures and mods. He hoped that this guide would help at least one-person work their way through a repair or modification. I am sure that it has helped a few of us, me being one that it has.

Now it's my turn. My name is Ash Carlton "whteglve". Since I first saw the 1991 Caprice I liked the styling of it, but it wasn't until December 2000 that I really fell in love. A co-worker came in the office one Monday morning and said, "I found your new car". That Friday, December 3, 2000 a friend and I drove two hours away to where I met and test-drove "Elaine", a black 1996 Impala SS. I purchased her on December 6, 2000. He later told me that he knew I was going to buy the car when he saw the look on my face when starting it for the first time. I began taking auto body classes at the local community college so I could learn to do all the things I wanted to do to her. She developed the wonderful P0300 code and in the course of trying to figure it out and getting married, she was parked. Heck, my ownership of "Elaine" has out lasted my marriage. I still have the car to this day and I'm slowly bringing her back from the dead, hence her new name, "ZombeaSSt".

I'm not claiming in any way that I'm the author of any of the material in this version of the handbook. All I did was slight corrections, modifications, simplifications and gathering more information together into an updated version of the great original "QaloSS' Impala SS Handbook".

I hope that I speak not only for myself but for Karl Frost and the many others associated with this newer version of the handbook when I say I hope that it helps you enjoy your car even more than you already have.

Maintenance

Brakes

Stealth Brake Bolt and Metering Bolt Mod

We lost a lot of great info on the Brake Bolt Upgrades in the crash of '09. Here is a brief overview of the problem and solutions with information collected over the years. Much credit due to the people who pioneered these solutions. The Stealth Brake Bolt and "Bolt II" Metering Bolt are two of the easiest, cheapest, and most beneficial mods that you can perform on your B-body. Read on to find out why!

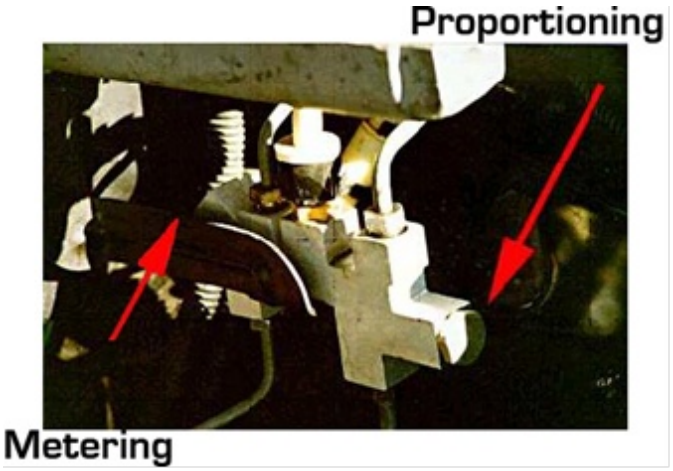
Background

The combination valve in the Impala SS / Caprice performs the following functions:

1. Front/rear brake bias (also called proportioning)
2. Metering (delay) of front brakes.
3. Shuttle switch for hydraulic failure of front or rear brakes.

Because the Impala was made in such small numbers, GM didn't bother to design a specific combination-valve for the SS. The bean counters at GM installed the exact same brake proportioning valve in the 1991-93 Caprice (drum rear brakes) as the 1994-96 Impala SS/Caprice 9C1 (4 wheel disc brakes). This causes two problems:

1. Proportioning: Disc brakes have much greater braking power than drum brakes, so cars with rear drum brakes use a mechanism to reduce the pressure to the rear drums - this way, the front brakes do most of the work. Factory brake proportioning is 95% front and 5% rear, which is ideal for cars with drum rear brakes. In a 4-wheel disc car, however, you want the rear brakes to do more than 5% of the work (because the brakes are much more capable). The result of the 95% front / 5% rear proportioning in a 4-wheel disc car is accelerated front pad wear and excessive brake dive under heavy braking. The rear pads are just along for the ride and last practically forever. The brake proportioning is controlled by a 19mm hex bolt on the front of the combination-valve.



Bolt locations.

2. Metering: Drum brakes take time to "energize." Cars with rear drum brakes use a mechanism to delay the onset of the front brakes so that all 4 brakes engage simultaneously. This "metering function" allows the return springs in the rear drums to be stretched to the point of drum/brake-lining contact before engaging the front brakes. In a 4-wheel disc car - like the Impala SS and Caprice 9C1 - this delay is unnecessary and hurts the reaction speed of your brakes, ultimately resulting in longer stopping distances. In a hard stop, the front brakes will not engage at the same time as the rear brakes. The brake metering is controlled by a 19mm hex bolt on the rear of the combination-valve.

Solutions:

Fortunately, for all of us Impala SS / Caprice 9C1 owners, there are solutions for these two problems. The Proportioning problem (problem #1 above) is solved by replacing the stock 19mm hex bolt on the front of the combination-valve with a nifty little piece called the Stealth Brake Bolt. The stock bolt is vented and holds a spring and red aluminum plunger in place (see below). The Stealth Brake Bolt replaces the stock vented bolt

and the spring and red aluminum plunger are discarded. It's that simple - after that is done, your brakes are now proportioned at approximately 65% front and 35% rear!

The Metering problem (problem #2 above) is solved by replacing the 19mm hex bolt on the rear of the combination-valve with a different bolt, commonly referred to as the "Bolt II" Metering Bolt. The stock metering bolt is aluminum and is comprised of an integral hex nut, rubber o-ring, and a male threaded section. It is a solid bolt and is machined to have two stepped, concentric metal solid cylinders. The innermost metal cylinder is the longest part and it serves as a mechanical stop for the brake safety shuttle switch (should it engage due to a hydraulic failure), as well as serving to reduce the brake fluid volume in the front-brake section of the combination valve. The outermost cylinder also serves to reduce the brake fluid volume in the front-brake section of the combination valve, but its main purpose is an inexpensive metering valve. When the bolt is screwed into the combination-valve assembly, the outermost cylinder covers 50% of the orifice used to feed the front brake line with brake fluid pressure.

Stealth Bolt (left) and Metering Bolt (right)

This can be a bit of a confusing description - the main point is that part of the stock metering bolt covers a hole, causing a brake fluid flow restriction and causing the delay in engagement of the front brakes.

Stealth Brake Bolt Instructions

Tools:

- *19mm hex socket*
- *Adjustable wrench*
- *Ratchet*
- *Needle nose pliers*
- *Paper towels*

Procedure:

1. Place some paper towel or a shop rag underneath the combination-valve.
2. Remove the rubber vented cap and paper tag from the stock bolt (located on the front of the combination-valve).
3. Use the adjustable wrench to hold the combination-valve body. Loosen the stock bolt (located at the front of the combination-valve) with the ratchet. Be careful not to bend the brake lines.
4. Remove the bolt by hand and use the needle nose pliers to extract the spring and red aluminum valve. Be sure that the red aluminum valve has a black plastic "doughnut" at one end. If not, you will have to remove it from the combination-valve with a paper clip or other suitable tool. Discard the spring and red valve.
5. Hold the combination-valve body with the adjustable wrench and install the new Stealth Brake Bolt.
6. Reinstall the rubber vent cap and paper tag (to retain stock appearance).
7. BLEED THE BRAKES (procedure not covered here) and check for leaks, especially around the Stealth Brake Bolt.

"Bolt II" Metering Bolt Instructions

Tools:

- *Ratchet*
- *Shallow 19mm socket*
- *Adjustable wrench*
- *Brake fluid*
- *Plastic bags*
- *Paper towels*
- *Shop rag*
- *Turkey baster*

Stealth Bolt (left) and Metering Bolt (right)

Procedure:

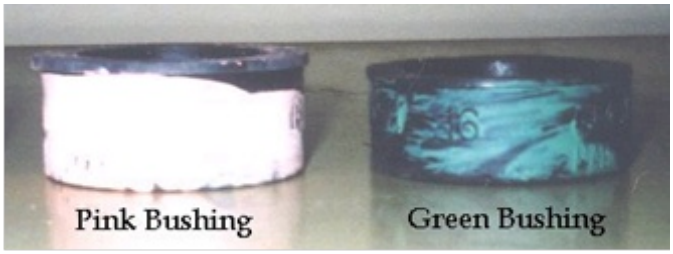
1. Place paper towels inside plastic bags. Place plastic bags underneath back of combination-valve to catch brake fluid.
2. Use the adjustable wrench to hold the combination-valve body. Loosen the stock bolt (located at the rear of the combination-valve) with the ratchet. Be careful not to bend the brake lines.
3. Remove the bolt by hand and discard. Replace it with the new "Bolt II" Metering Bolt.
4. Remove the cover of the master cylinder reservoir and remove the old brake fluid using the turkey baster, down to almost to the bottom of the front and rear reservoir. Wipe the remaining "sludge" from the bottom of the reservoirs.
5. Refill each reservoir halfway, and bleed the brakes (procedure not covered here).
6. Check for leaks, paying close attention to the new bolt that you just installed.
7. Replace the master cylinder reservoir cover.
8. Start the car and press the brake pedal. The pedal should be hard and feel tight.
9. Re-check for leaks.

Chassis / Suspension

Body Bushings, Lower

Scott Mueller's website is referenced at http://www.theherd.com/articles/bushings.html for most of this information. Read his site for more information on the reason why this mod is needed. We've all heard about this modification many times. The one thing you'll found out is that you should've done it earlier! This procedure is easy even for someone is isn't mechanically inclined. To begin you need the proper parts.

New vs. Old Size comparison



Pink and Green Bushings

The pink bushings you will need are slightly thicker than the stock ones to allow a better cushion to the frame with the exception of the Green ones, which fit better at Point 7.

There are 16 total points on the frame but Point 5 requires no lower bushings and the 2 under the radiator do not make much of a difference and I have been told to not mess with those due to the location of the radiator, so you will only need 12 total bushings; 10 pink, 2 green. People have mentioned the need for different bolts for position three. The stock ones are fine and you will not need new ones unless your old ones have deteriorated or rusted or you are replacing the upper bushings as well from the 9C1 package.

Part Number	Description	Approx. Price
377801	Stock 5/8" thick soft rubber (Black)	$7.16
457917	New 3/4" thick firm rubber (Dark Green)	$4.24
457915	New 7/8" thick firm rubber (Pink)	$5.41

› You will need 10 of the Pink ones and 2 of the Green ones.

Notes:

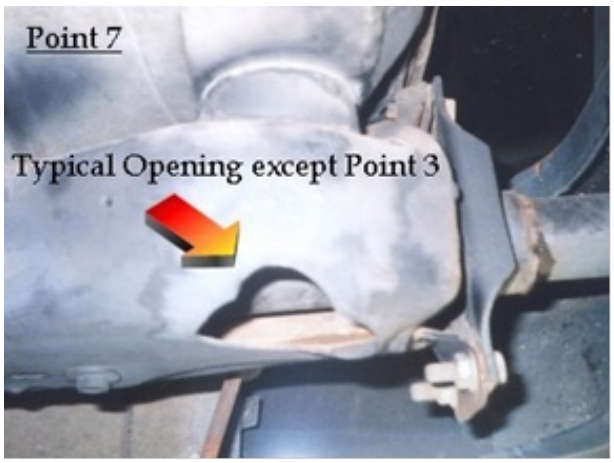
› Points 1-3 do not have any lower bushings, only a washer and bolt. You will not need to use this washer with the new bushings.

› When installing the bushings from Points 1-4 be sure not to catch any wires or cables.

› Points 4-7 (minus Point 5) will have the old bushing and bolt with no washer, simply discard the old bushing and re-install a new one.

› Points 1,2,3,4, & 6 use the pink bushings, and Point 7 uses the green ones.

› All Points have a large opening in the frame with the exception of Point 3 that has a small hole to insert your socket wrench.(See in Procedure)



Point 7 Typical Opening

Point 7 Typical Opening

Point 3 Opening

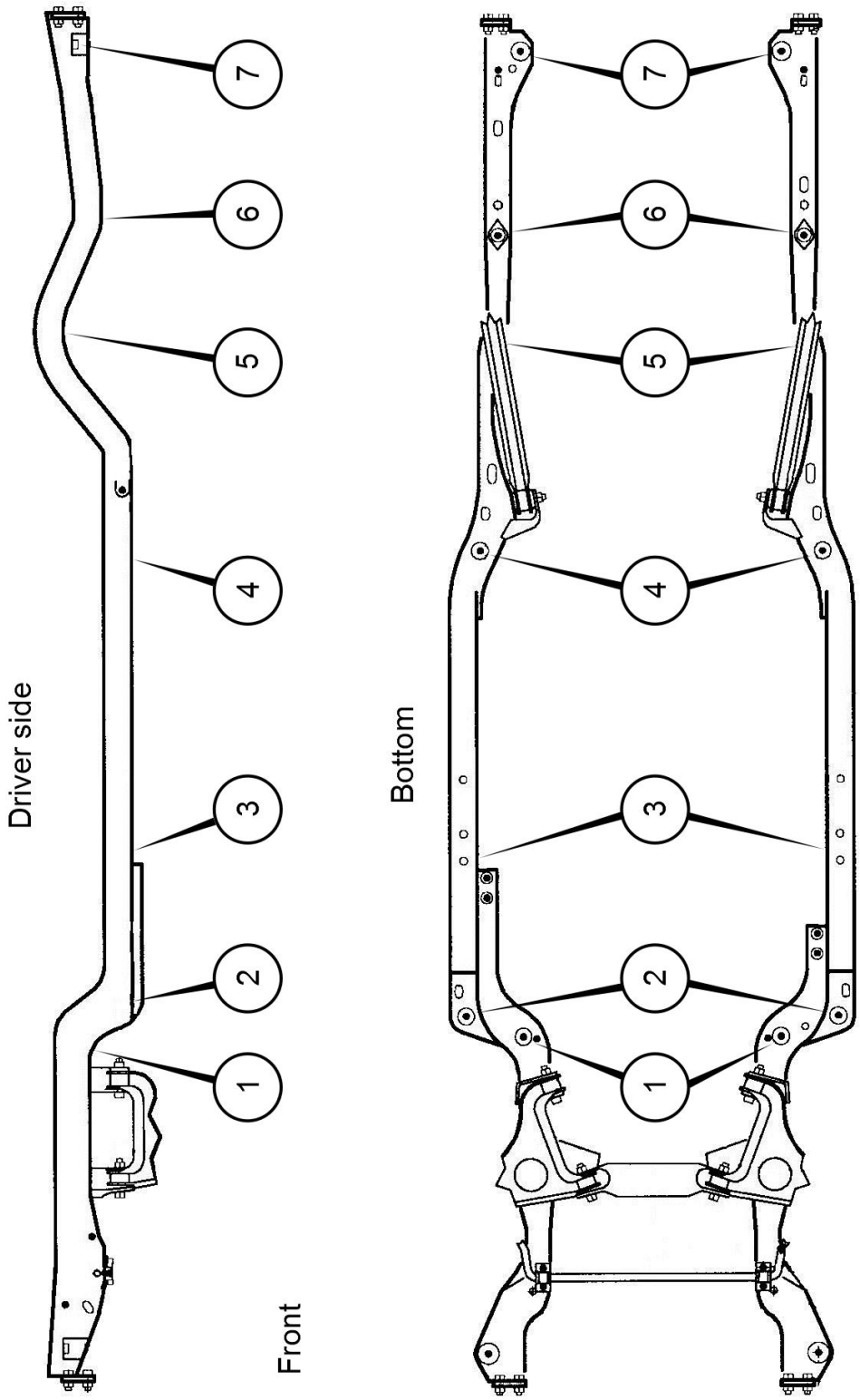
- When installing the bushings, the cupped end goes against the frame. Each bushing has a washer inside it on the flat end. The bolt head should go against it.
- Torque the bolts to 30 ft/lbs as Scott suggests rather than the factory 50 ft/lbs.
- When removing the bolts, Use a breaker bar or pipe to slip over your wrench.
- When installing the new bushings, the bushing will not sit snug against the frame. The upper bushing fits into the lower bushing with metal tube with rubber around it so there will be a small gap between the lip and the frame so don't get mad or keep tightening the bolt thinking they will or you'll strip the hole. Some have fixed this problem by doubling up on the bushings or using shorter bolts all around.

Tools:

- *15 mm socket wrench w/ 6-inch extension.*
- *Torque wrench (optional)*
- *Breaker bar or pipe to slip over you wrench to help break the bolts loose (if needed)*
- *Car jack and jack stands (optional).*
- *And of course, your bushings*

Procedure:

1. You will need to raise one side of the car on jack stands to allow better access to the bolts and make for an easier install. Which end you start at depends on you, but it's a good idea to go from Point 1 to Point 7.
2. Point 1 is directly behind the front tire at the end of the curve towards the engine. It's hard to see the bolt but it's there. Remove the bolt and washer, install the bolt and new pink bushing with no washer, and tighten to specs.
3. Point 2 is a foot down from Point 1 right at the elbow of the frame. Remove the washer, bolt, install the bolt and new pink bushing with no washer, and tighten to specs.
4. Point 3 is a little harder to spot because the hole isn't as large as the others are. It is in the middle between the doors. You can actually look around the edge of the frame to see the bolt. Remove the bolt and washer, replace with a new pink bushing and no washer, and tighten to specs.
5. Point 4 is right in front of the rear tire. Remove the bolt and old bushing, reinstall with a new pink bushing, and tighten to specs.
6. Point 5 is above the rear tire in the bend but requires no lower bushing. You may not be able to see it.
7. Point 6 is behind the rear tire. Remove the bolt and old bushing, replace with a new pink bushing, and tighten to specs.
8. Point 7 is at the end of the frame. Remove the bolt and old bushing, replace with a new green bushing, and tighten to specs.
9. After finishing one side, move the jack stands to the other side and repeat.



Body bushing locations.

Body Bushings, Upper

The Upper bushings are a different story. You will need to lift the body from the frame for those. Here is an example of a busted upper bushing.

New vs. Old Upper Bushings

Busted Upper Bushing

Buick Brace

This brace comes on a Buick Roadmasters but people have put it on their B-bodies to stiffen the rear portion of the frame.


Buick Brace

Coil Spring Replacement, Front

The front coils are harder to replace than the rear, which are very easy. You may want to go ahead and have someone install these for you, but if you are hard headed then go for it. Do these one at a time and keep your day open, it will take a while.

Tools:

- *Spring Compressor*
- *Pitman Puller or fork*
- *Jack and jack stands*

Materials:

- New Insulators

Procedure:

1. Jack up the corner you're working on and place it on jack stands by the frame, you'll need the jack for the spring install.
2. Remove the shock. See Shock Replacement.
3. Remove the wheel and disconnect the lower part of the spindle and sway bar end links.
4. Use your spring compressor to compress the spring. Now place your jack under the control arm to brace it and remove the bolt on the ball joint. Use your special tool and break the ball joint loose.
5. Lower the control arm and remove the spring.
6. Compress your new spring and install the new insulator on top & bottom. A piece of tape will hold them on b/c without it, the insulator will get misaligned and cause squeaking later.
7. After it is in place, raise the control arm back up and reinstall in the reverse order.

› **WARNING!!!** There is a possibility that the spring may slip while doing this. Catching a face full of spring will cause serious injury if not worse!!!

Coil Spring Replacement, Rear

These are MUCH easier than the fronts.

Tools:

- *Spring Compressor*
- *Pitman Puller or fork*
- *Jack and jack stands*

Materials:

- *New Insulators*

Procedure:

1. Raise the vehicle by the axle and place jack stands under the frame.
2. Leave the jack in place, lower the axle until it is at rest, and stop.
3. There should be enough room to simply pull the spring out by hand but if there isn't then remove the bottom of the shocks by unscrewing the nut on the end of the lower control arm and lowering the axle a little bit more.
4. Use a piece of tape to hold the new insulators in place while you put it back in.
5. Make sure the spring are set in the holders attached to the axle and not blocking the little drain hole.
6. Reinstall the nuts on the shocks if needed and raise the vehicle back up off the jack stands.
7. Remove the stands, lower the car, sit back and enjoy!

Rear Control Arm Replacement

Tools:

- Jack and jack stands
- Sockets and Ratchet
- Wrenches

Well, the lowers are very simple and the uppers are easy to remove as well, but the main thing you need to be concerned with is the alignment of the axle. DO NOT remove all arms at the same time. Go one by one, so it will be easier to reinstall the arms. You will likely have an adjustment to be done to get the bolts to line up but it shouldn't be more than nudge to the rear tires here and there.

Before starting to replace either the uppers or lowers, you'll need to decide if you want to remain stock or, if you want to get extended and center the rear wheels. Remember to select what brand you need. Also, don't forget that stock arms are okay but if you are going to use aftermarket arms, the extended arms may be a better choice. See Preferred Brands, Control Arms.

Now, when choosing extended or stock length, please keep in mind a couple of different things. The change does not help you any as far as performance, except maybe a longer stance and slightly better handling but no one has ever said it was noticeable. The main purpose is to center the rear wheels. If you haven't noticed already, the rear wheels sit a little forward in the wells. Some don't like this look and some don't care.

If you decide to go with extended arms, there are other issues. One is maybe getting a new driveshaft, or you can get a longer yolk, with getting a longer driveshaft being the better option. It will work for a while if you change neither, but the seal to the transmission will grow weak and soon you will be wishing you took more time researching this procedure.

Rear Control Arm Replacement, Lower

Procedure:

1. First, chock the front wheels and lift the rear of the car by the differential, then place jack stands under the frame. Lower the jack, until the axle is at rest, then lift back up a little and support the axle with the other two jack stands. It is important you support the axle in its normal position.
2. The lowers are a cinch. Remove the sway bar, unbolt and replace the arms one at a time. See Sway Bar Replacement.

Lower Rear Control Arms from UMI Performance

Rear Control Arm Replacement, Upper

Procedure:

1. The uppers are the same way but the bolts connecting the arms to the body are difficult to get to and are large, maybe 21 or 22mm. You'll need a socket in that size as well as a wrench to hold the nut. Removing those bolts from the holes is somewhat difficult but a few whacks of a hammer and they'll come out. If you flatten the threads, don't worry, the new arms come with new bolts but just check to be sure before starting.

Upper Rear Control Arms from UMI Performance

Now, the hardest and most time-consuming part of the replacement is the bushing removal. If you don't have a bushing removal tool like the one pictured here. This is definitely one of the times where the old saying "the right tool for the right job" applies.

Follow the rear end bushing removal instructions inserted below. It's recommended to use a bushing removal tool because you tend to beat the mess out of the new bushing if not. Also, when you use the puller to remove the shaft from the middle of the bushing, use a bolt laying around and drill an indention in the tip and let the bolt do the pushing and not the tip of the puller bolt. You don't want the place you rented it from, or yours, to get damaged.

Rear End Bushing Removal

Background:

When removing the control arms, there's no need to disconnect the brake lines and therefore, no brake bleeding.

Safety:

1. Jack up the car as high as possible, chock the front wheels and put jack stands under the car. **PLEASE TAKE ALL SAFETY PRECAUTIONS AS YOU WILL BE UNDER YOUR CAR FOR A WHILE.**
2. Remove the bolt holding the brake line to the axle housing (at the top of the diff).
3. Open the tabs along the housing to detach the brake lines from it.
4. While lowering the axle, bend the lines down for more slack. Be careful not to put and kinks in the line. Bend it smoothly and evenly.
5. Installation is the reverse.

Bushing Tool from HR Parts N Stuff

Tools:

- *Gear puller*
- *Sawzall or Jigsaw (Sawzall is preferred)*
- *Rubber mallet*
- *Hammer*

After you remove the control arms, lower the rear end and frame to work on it, do the following:

Procedure:

1. With the rear end as low as possible, put a block of wood (or similar) on both sides of the rear end to stabilize it.
2. Get a gear puller, which has the center bolt approximately the same diameter of the inner metal sleeve in the bushing. You'll place the puller on the backside of the bushing (facing the rear of the car) and pushing the metal sleeve towards the front of the car.
3. You'll notice that the bushing casing has an outer lip. Using a 3-prong puller and attach it there and centered the bolt on the metal sleeve. You can use a ratchet to push the sleeve out the other side. You can use an open-end wrench as well.
4. Depending on the type of puller you use and how long the center bolt is, you may need some extra length to push it completely out.
5. Once you have the sleeve out, now use a sawzall to cut a wedge out of the rubber bushing. You will only be able cut in certain areas due to things getting in your way. Alternatively, you can use a jigsaw but the blade won't be long enough to cut it all the way through. You'll have to cut it from both sides. Yes, the rubber will start to smoke and smell horrible.
6. Once there's a wedge out, cut the outer metal sleeve (facing the front of the car) through the wedge you've just cut out - cutting lengthwise from the back stopping at the axle. Make a few cuts. You can also cut the entire length of the metal housing but be careful not to cut into axle housing.
7. After you cut it, use a hammer to collapse the outer sleeve in. You don't have to completely collapse it. Just as long as the outer sleeve starts to come away from the axle housing.
8. Use a rubber mallet (anything with a big surface area) and hit it from the side facing the front of the car so the bushing flies out towards the back of the car.

Shock Replacement

Replacing the shocks is easy for these cars but you may run into a snag when it comes to the upper connections.

Tools:

• *Lisle Shock Absorber Tool*

Procedure, Front:

1. Raise the corner you are working on and place on jack stands by the frame.
2. It is easier to do by removing the wheel but you don’t have to take it off.
3. Look at the top of the fender well and you will see the retaining nut for the shock. Remove the nut. You may run into rust or the nut will stick. Spray with a rust breaker or penetrating oil and continue after letting set for a few minutes.

› Tip: The stem it is on will usually have a pattern so you can grip it with pliers to hold it while you remove the nut.

Lisle Shock Absorber Tool

4. Now go to the bottom and unscrew the 2 retaining nuts. The shock should slide directly out of the spring. Raise the vehicle some more if you need more clearance to get it out while on the ground.
5. Reinstall in the reverse order.

Procedure, Rear:

1. Raise the vehicle by the axle and place jack stands under the frame.
2. Leave the jack in place, lower the axle until it is at rest, and then raise it back up just a hair.
3. If you have another set of jack stands, you can put those under the axle while doing this, but if not a jack will do fine.
4. Remove the nuts at the bottom of the shock and slip it off the lower control arm.
5. Now, here is the tricky part. The more room you have, the better it will go. Remove the wheel and the spring. See Coil Spring Replacement.
6. Okay, two bolts hold the top in. Only one needs to be completely removed. The shock bracket has two sides, one is a complete hole and the other is a crescent so it will slide from around the bolt. Which one is it? Only you will know.
7. Use a LONG extension to your socket wrench to reach the bolts and use a small wrench to get to the get to the top side. You will be working blindly getting on the nuts on the top but be patient and you'll get it.
8. Reinstall in the reverse order. Usually people will turn the bolts around for the top part of the shock so it will be easier reinstalling them. Truth is, GM should have tack welded the nuts into place when they built the car. The most important thing to remember is to be patient through this process.

Sway Bar Replacement, Front

Procedure, Front:

1. Raise the vehicle and place jack stands under the frame.
2. Remove the end links that connect the sway bar ends to the spindle, but keep track of the order of the bushings and washers in case you are reusing your old ones.
3. Remove the four bolts that attached the brackets to the frame (two in each bracket). Be careful, the sway bar is heavier than it looks so don't let it fall on your face!
4. Reinstall in the reverse order. If you use urethane bushings, you can grease them up to lengthen their life and reduce squeaking.

Front and rear sway bars.

Procedure, Rear:

1. Raise the vehicle by the axle and place jack stands under the frame.
2. The sway bar is held on by 4 bolts to the lower control arms, 2 to each side.
3. Remove the bolts and don't let the sway bar hit you in the face! Remember, it is heavier than it looks!
4. Reinstall in the reverse order.

When you finish, take your beast for a ride. You WILL notice a difference.

› Remember, to fully optimize your new sway bar, get new bushings and/or end links when replacing. They are around $16-$20, purchased at your favorite parts store.

Cooling System

Bleeding The System

Tools:

- *Flat head screwdriver*
- *Rags and bucket*
- *Clear Hose (not required)*

1/4 Turn ball valve with hose barb and clear tubing.

Park your car where the rear is lower than the front if possible or even jack up the front end. The point is to get the bleed valve higher than the heater core. Let the engine cool preferably overnight. Slightly open the bleeder screw and let the air out. This may take a couple of tries but once all of the air is out, no more waterfall sound.

Another popular mod is to install a quarter turn ball valve (1/8-27 thread) and a barb in place of the original factory bleeder assembly (two-piece bleeder bolts). See. Attach a length of clear tubing, to see the bubbles, that will reach over to the coolant overflow tank or another suitable container. With this mod, it is easier to bleed the air out of the system without worry of coolant getting on the opti-spark or spillage. After bleeding, the hose should be replaced by a cap to help keep the barb fitting clean.

Flushing The Radiator

Here is a great way to change the anti-freeze / flush the system and not get the dreaded waterfall noise.

Tools:

- *Socket wrench*
- *Flat head screwdriver*
- *Rags and bucket*
- *Anti-freeze*

IMPORTANT!!! If your car is hot, do not pump cold water into the motor! Let the engine cool first! We will not be held responsible for someone cracking their block or head because they were impatient.

Procedure:

1. Place an appropriate sized container under the car to catch any spilled coolant.
2. Remove the plastic resonator on top of the motor (Home Plate) as well as the resonator between the air box and home plate (First Base) if you haven't deleted them already. See Home Plate Removal and First Base Removal for more detail.
3. Take the overflow breather off and let it drain into a bucket. This will siphon a 1/3 of the anti-freeze out of the motor.
4. Remove bottom hose to drain radiator. If you don't want to drain radiator skip to step five.

5. Put bottom hose back on and remove the top hose near the air box.
6. Start car and let it push the remainder of the coolant out of the system. Using a hose run water into the overfill container. It will suck it into the motor about as quickly as the garden hose can fill it. Continue doing this until you see no more coolant come out. You might want to cycle the heat on to get water through the heating core. It might take a little bit for the thermostat to open but when it does all the old gunk and coolant comes out. When finished, thoroughly wash off all of the anti-freeze off the front of your car. That stuff can't be good for the paint.
7. When all the old coolant is gone, stop putting water into the overflow tank. Let the motor pump dry. When the water starts to surge out of the hose shut her down. You still have about 2 gallons in the system.
8. Put all the hoses back on tightly, and start to fill the overflow container with straight anti-freeze. Remember there is still 2 gallons of water in the motor.
9. Start motor and let it suck everything in through the overflow. When it won't take anymore and the stat has opened (top hose will be warm) then open the bleeder valve going into the thermostat. See Bleeding the System.
10. Put the resonators back in place on the motor, if you are using them, and make sure all hoses are on and tight. Do not forget the little overflow hose.
11. Keep adding until you are at the cold fill mark and go drive for a few days. Top off some morning to the cold fill and you are done.

Heater Core Flush

Tools:

- *Socket wrench*
- *Flat head screwdriver*
- *Rags and bucket*
- *Bucket*

Procedure:

1. Put a bucket or pan beneath and slightly ahead of the serpentine belt tensioner. You may have to readjust the bucket once the draining starts.
2. Disconnect heater core hoses at the water pump. These are the two smaller hoses facing the passenger side, towards the battery. The lower hose and pipe will dump a bunch of coolant out of the engine into the bucket. Be sure it doesn't get all over the opti-spark behind the crank damper.
3. Take a garden hose, put it up against the lower hose, and run until it goes clear. Soon people believe that getting bubbles in the flow will help clean everything out.
4. Now switch to the pipe and back flush.
5. Repeat spraying water into the lower hose until the heater core water runs clear or it hacks up a hairball.
6. Repeat Steps 3-5 a few times to be sure you've cleaned everything out of the system.
7. Reassemble cooling system, fill up the expansion tank and screw the cap on.
8. Bleed the system.
9. At this point, the heater should start getting hot. Repeat until you've replaced all of the coolant you lost.

› BTW - keep the rest of the cooling system closed up when you do this. Do not try to be slick and hook a hose to your bleeder valve, open the reservoir cap and dump the extra fluid back in. It is self-defeating. Just open the bleeder valve and put a rag or paper towel next to it; leave it cracked open a turn until coolant starts coming out, then close it up. Drive around for a few heat cycles, repeat.

Temperature SSensor Replacement

Tools:

- *Socket wrench*
- *Adjustable wrench*

There are two different sensors. There is one on the water pump which sends readings to the PCM, and there is one in the passenger's side manifold that sends reading to you gauge on the dash.

Both sensors can be unscrewed with a crescent wrench but it is recommended that you use a deep socket. Both of these sensors may also be replaced at the same time as the water pump is without the need to worry about coolant leaking.

Water Pump Sensor

The water pump sensor is simple to replace. Simply unscrew the sensor from the water pump after disconnecting the electrical connector. Have the new one ready with Teflon tape on the threads and install it when the old one is removed. Coolant will leak so have some rags or bucket handy to catch any leaking coolant.

Manifold Sensor

This one is more difficult and the most common cause of gauge problems. Raise the vehicle, and feel around the middle of the engine around the headers. Do this when the car is cool. The sensor will be covered in a heat resistant silver coating to repel heat. Pull back the wrapping and disconnect the sensor harness. Slowly unscrew the sensor until loose enough to finish it by hand. Coolant will come out of this hole pretty fast so you will need to be quick and do not have your face looking directly up at the sensor or you will regret it. Once you get the sensor out, quickly install the new one, wipe off any excess coolant and reconnect the sensor.

Thermostat Replacement

Tools:

- *Socket wrench*
- *Flat head screwdriver*
- *Rubber mallet*
- *Rags and bucket*
- *Pliers*
- *New screw driven hose clamp for larger hose*
- *Siphon tool (not required)*

Procedure:

1. Remove Home Plate and First Base. See Home Plate Removal and First Base Removal for more detail. Once you have everything off, you will see the gooseneck coming out of the water pump. Your thermostat is underneath that neck.
2. Release the petcock at the bottom of the radiator on the driver's side to lower the level of coolant to prevent a lot of spillage. Not too much, just a little will do.
3. Now remove the hose clamp from the upper radiator hose leading into the water pump (you will need pliers for the original clamp). Before you remove the hose, have some rags and/or a bucket to contain the spillage.

4. Slowly pull off the hose. It may be stuck on it but a good twist will loosen it. When the hose gets loose, stick the end in the bucket or rags whichever you have handy. Stuffing a rag in the end of the hose will prevent coolant from dripping out.
5. Now for the gooseneck, you can look into the gooseneck and see coolant and the thermostat. Use rags or a siphon to get out the coolant around it.
6. Use a wrench to loosen the bolts of the gooseneck. If the gooseneck is stuck, then tap it with a mallet to break it loose.
7. Remove the thermostat and O-ring, and remove any old gasket material from the lip.
8. Install the new one with a new gasket.
9. Proceed in the reverse order.
10. After you replace everything, replace the coolant you drained or siphoned with new coolant. See Bleeding the System .

› Tip: This is a good time to replace any hoses that are cracked or deteriorated

› Tip: It is recommended to flush the radiator if it hasn't been done recently.

› Note: You can replace the stock thermostat (180-degree) with an aftermarket 160-degree thermostat. It will cause the engine to run cooler but will take the heater longer to warm up in the winter. Some say there is no difference without PCM reprogramming or you must have the PCM reprogrammed. Wrong. The thermostat is not controlled by anything but temperature. If you have the PCM reprogrammed, then the 160-degree thermostat will be more effective combined with the fan temperature settings.

Water Pump Replacement

Tools:

- *Socket wrench*
- *Flat head screwdriver*
- *Rags and bucket*
- *Anti-freeze*

Replacing the water pump is not too difficult. First, you will need to drain the cooling system. Now is a good time to replace any hoses that need replacement as well as the thermostat or even upgrade to a 160° thermostat. Before you begin, cover the opti-spark with some plastic or towels to protect it from coolant because it will damage your opti-spark.

Procedure:

1. See Flushing the Radiator; Steps 1-5.
2. Put a towel/rag under the waterpump and on top of the opti to protect it from any coolant that will spash on it. Antifreeze in opti = sad opti = $$$ = you not happy. In fact don't get coolant anywhere except in the bucket. If you get it on the paint wipe that stuff off with the quickness!
3. Disconnect the hoses from the water pump.
4. Remove your AIR pump and harness and the serpentine belt.
5. Remove the six (6) bolts from the water pump and gently work it free. Now when you pull the pump off, pull it towards you, not down or it will damage the splined shaft behind it. Watch out there will still be fluid coming out so make sure you DO NOT get it on the opti-spark. Also, watch out for the splined coupler.

6 Remove the thermostat housing (on top of the waterpump) and thermostat. Put these in the new waterpump. DO NOT OVERTIGHTEN THE BOLTS. The FSM says 20lbs of torque, this is incorrect, it should be 8lbs. If you start leaking from here after all is said and done you can tighten them down a bit more but DO NOT STRIP THE THREADS ON THE WATERPUMP.

7. Clean off all remnants of the old gaskets.
8. Now is a good time to replace the water pump drive seal. Use a pick and remove the old one. Install the new one using extreme care not to damage the seal around the shaft. A tool can be found on the forum that helps with installation.
9. Place the new gaskets. You need sealant on both sides of the gaskets.
10. Place the splined coupler on the shaft mounted to the cam.
11. Reinstall everything in reverse order.
12. Torque to 30 ft-lbs.
13. Fill the system and drive the car until it warms up.
14. Let it cool, but is still warm.
15. Refer to “Bleeding The System”.
16. Let car sit for several hours
17. Repeat steps 13 - 16.
18. Look for leaks, smell for antifreeze (you may smell some from have it dripping everywhere but it should go away in 24 hours unless you dumped it everywhere).

› Weep Hole Tip: For the weep hole on your water pump. Get a 1/8" NPT (National Pipe Thread) tap and run a thread in the weep hole. Be sure to use cutting oil and keep the tap straight. Also be sure to clean out all of the chips from the water pump. Then get a barbed fitting and run a short piece of tubing. If the water pump goes, it won't drip on your opti-spark.

Electrical

Headlight Instrument Panel Illumination

If the light goes out in your Headlight Instrument Panel, you have a choice to make. You can do it the easy way by buying a Honda bulb, changing the bulb itself, or the hard way paying for a completely new panel. If you've ever changed the mini bulbs out of Christmas tree lights (pre-LED) this will be a cinch. If not, then read carefully before beginning just to get an idea.

Tools:

- *7mm socket with screwdriver handle*
- *Jeweler's flathead screwdriver (or mini flathead)*
- *Tweezers*
- *Wire cutters or scissors*

Materials:

- *Radio Shack lamp # 292-1092 (2 per package)*

  OR
- *Replacement bulb P/N# 35505S84B02 (From Honda of all places)*

Procedure:

1. Remove the cluster bezel screws and lower dash screws (7mm socket).
2. After removing the cluster bezel and lower dash, remove the bottom screw (7mm) from the switch assembly, if present.
3. Once removed, pull the switch panel out. Peel back the black plastic tape on top of the switch to reveal the light bulb holder. It is the size of a shirt button.
4. Use a flathead jeweler's screwdriver (or mini-flathead) twist it to the left about a quarter turn.
5. Use a pair of tweezers to lift it out of the switch.
6. If using the Honda bulb Skip to step 10. If using the Radio Shack bulb continue. Take the bulb holder to a table and sit down.
7. Look at all the sides of the holder, you will notice the bulb wires come out of the top, and wrap around the sides, across the bottom of the holder and end in the sides going to the top edge.
8. Use either the tweezers or screwdriver to undo the wire from the grooves in the bulb holder. Straighten them out and pull the bulb out from the socket.
9. Thread the new bulb in, and thread each wire into the grooves in and around the bottom of the holder, finishing with the top. Use cutters to trim the excess wire. The bottom of the holder should have the wires across to make contact with the switch receptacle.
10. Put the bulb in, twist to the right a quarter turn.
11. Put your key in and turn the switch to the RUN position. The bulb should illuminate and be seen thru the plastic.
12. Turn the key to OFF, place the black tape back over it.
13. If the tape is no good, use black electrical tape instead.
14. Put switch back in and reassemble dash. The bulb should last many years.
15. Keep the extra bulb in a safe place if you ever need to replace it-or give it to a buddy for his B-Body.

Opti-Spark Installation

› When replacing the opti-spark, add the weep hole fitting.

Procedure:

1. First, disconnect your battery.
2. Drain your coolant. Be sure to open the bleed screws. This will help it drain much quicker.
3. Remove the rubber intake elbow.
4. Remove the upper radiator hoses.
5. Disconnect the bottom radiator hose from the water pump.
6. Remove the coil wire, and the electrical connections from the Opti-spark and water pump.
7. Pull the belt tensioner out of the way, and loosen the accessory belt.
8. Remove the water pump. See Water Pump Replacement
9. Check the weep hole on the water pump to make sure it's not damp.
10. This is the fun part (for me at least). Remove the three bolts from the balancer. Use a gear puller to do this. MAKE SURE you make a note of the position of the balancer in relation to the hub. Both the hub and balancer should be marked, but not keyed.
11. Remove the remaining plug wires. If they are old, you may want to replace them. Now is the time to do it!
12. Remove the three bolts that hold the Opti-spark in place. Pull it straight out. There is a shaft, which connects the Opti-spark to the Cam gear. This may or may not come out with the Opti-spark. At this point, you should look at the old Opti-spark and make a mark of where the notch (spline) is. This will assist you later.
13. This would be a good time to put some gasket sealant on one side of the gaskets, and place them on the water pump so they can dry. This will make reinstalling the water pump much easier.
14. With the old Opti-spark to compare, rotate the shaft on the new one until they match up. Some find it easier to insert the shaft on the camshaft, and then sliding the Opti-spark on top of it.

15. If there is any gap on any of the three mounting screws, you probably haven't lined the Opti-spark up correctly with the spline on the shaft. It should slide all the way on with no gaps on any of the mounting areas. Tighten the bolts, but do not over tighten.
16. Run your vacuum lines. The clip goes on the alternator bracket. MAKE SURE the hoses are going to clear the belt. The hose that has the filter and regulator is the vacuum supply. Poke a hole in the rubber bellow (on the top) and push the L into it. Put a T or something similar on the driver's side intake manifold, and hook the vacuum hose up.
17. Reconnect the plug wires.
18. Reinstall the three bolts on the balancer. Tighten the bolts to 60 ft-lbs. Make sure you line it up properly (see step above where you removed it).
19. Put gasket sealant on the remaining gasket material, and reinstall the water pump. Tighten to 30 ft-lbs.
20. Reinstall the belt. It is much easier to do it now before you do the next step!
21. Reconnect all the hoses, the coil wire and the other misc electrical connections (temperature sensor, Opti-spark connector, etc).
22. Lightly tighten the bleed screws.
23. Refill the cooling system until it is full. Place a rag around the bleed screws, and bleed off the excess air. Don't let any coolant get on your new Opti-spark!
24. Check and recheck everything.
25. Fire it up.

› You should also pull the hose out of the bellow, and check for vacuum. If it gets clogged, or a hose gets pinched, it will cause the cap to cave in, and burn up the rotor.

Opti-Spark Conversion

From 1992 - 1994 the Opti-spark was what is known in the gearhead world as "unvented". The reason it is called this is because it does not have the vacuum hoses connected like the newer 1995+ LT1/LT4 engines have. What the vacuum hoses do is, they pull the moisture out of the Opti-spark.

What a lot of people don't realize is the unvented Opti-sparks are actually vented!! Yes, they have 3 weep holes at the base of the Opti-spark to allow moisture to escape. Well, all this does is pull moisture back in. Put cold water on a hot Opti-spark, it's going to suck the water in! This is the BIGGEST problem with the design.

Before you go out and buy a brand new 1995+ Opti-spark, be forewarned. You CANNOT bolt a 1995+ Opti-spark up to a 1992-1994 LT1. The CAM is different. You could change the CAM, timing cover, CAM gear, etc. but this gets expensive, and is very labor intensive.

So, what is the solution? You can do 1 of 2 things:

Option 1: Change the Opti-spark out and be up and running again. However you risk damaging it again. There have been people who have had to replace a brand new Opti-spark because they got them wet.

Option 2: Change the Opti-spark out with a modified unit.

The conversion process is simple!

Buy an older style Opti-spark (the one you're supposed to buy), and simply change the cap! Of course, you will need to do a few additional things.

Parts:

- *Opti-spark for 1992-1994 LT1's PN - 10457702*
- *Cap and Rotor kit PN - 10457735 or*
- *1995+ Distr. rebuild kit (Pep Boys or NAPA)*
- *1996 Vacuum Hose Kit PN - 12556174 or*
- *1995 Vacuum Hose Kit PN - 12555323*

Tools:

- *Inverse Torx Bit - E4, deep well!! Snap-On part number STLE40. Stop a truck, or order online at www.snapon.com*
- *2-claw puller*
- *2 water pump gaskets*
- *Gasket sealant*
- *Vacuum T or a brass T that will screw into the manifold*
- *Long Breaker bar, or torque wrench*
- *Brass fitting for the base of the Opti-spark.*
- *3/16" Drill Bit (slightly bigger than the hole your drilling out)*

Recommended:

- *Plugs and Plug Wires*

Procedure:

1. Remove your cap from your new Opti-spark. Nothing like taking apart something brand new eh?
2. Remove the rotor from the Opti-spark. This should be a Torx T15. Carefully remove the rotor, and the metal disc. Do NOT remove the slotted one! Its spot welded on for a reason. Only the disc directly behind the rotor should be removed.
3. Remove the middle spacer. This is the center portion of the Opti-spark body. Set aside everything, but the back plate. Be careful when handling this. Try not to get any grease, dirt or anything on the disc.
4. You will notice 3 holes on the base. Fill the center one, and the one closest to the long pointed portion of the base in with JB Weld or something similar. Drill out the remaining hole. Try not to get the metal shavings in or on the Opti-spark.
5. Next, tap in a brass fitting. Do not use the center hole for this, as it won't clear the balancer hub. If you can find a brass L fitting, this would be your best bet.
6. Vacuum the metal shavings from the previous step. Make sure it's clean before you put it back together.
7. Reassembly is the same. Make sure you don't forget to put the metal disc back in place. If you leave it out, the gap for the rotor and cap will be way off. The rotor and disc are keyed, but still be sure you put them in correctly.

› Remove the old RTV Sealant, and put some new RTV on the cap at the electrical connection. Put it back together with the newer style cap. Lightly blow into one of the hose connections while closing off the other. You should hear no hissing. Also don’t allow the shaft to spin on the Opti-Spark.

Plug and Wire Change

Tools:

- *Floor jack*
- *quality jack stands*
- *Lug wrench and locking lug nut socket.*
- *Flathead screwdriver*
- *3/8" drive ratchet*
- *3/8" extensions of different lengths. Recommended sizes 4",6", 12", and 18"*
- *"regular" 5/8" plug socket, only necessary if you have headers*
- *3/4" open-end wrench (or whatever size appropriate for the above socket)*
- *"U-joint" 5/8" plug socket, 3/8" drive*
- *Set of metric 3/8" drive sockets, preferably deep well*
- *3/8" U-joint*
- *Wire cutters*
- *Needle nose pliers*
- *Dremel Tool with cutoff wheel (only if you have headers)*
- *A couple 3-4 foot lengths of 12-14 gauge insulated wire*
- *Flashlight with GOOD batteries*
- *Masking Tape*
- *Ink Pen*

Materials:

- *A good set of spark plugs and plug wires.*
- *Anti-seize compound*
- *Dielectric grease*

Initial Procedure:

- *Remove center caps, loosen front wheel lug nuts*
- *Set the emergency brake and put chocks under the rear wheels.*
- *Jack up the front of the car, place on jack stands and remove the wheels.*
- *Check the gap of the plugs (stock is 0.050"). Also, put a thin layer of anti-seize on the plugs before install. Doing this will keep the threads from seizing to the head, and make later removal MUCH easier.*
- *FYI, the plugs are numbered 1,3,5,7 (from front to back) on the driver's side and 2,4,6,8 (from front to back) on the passenger side.*

Changing Plugs, Stock Manifolds

Plug Procedure:

1. ALL EIGHT plugs are accessible thru the wheel wells. No one believes this until they try this, then they won't do it any other way!
2. Starting on the driver's side, working back (plug 1), simply unplug the plug wires and use the 3/8" ratchet, a couple of the long extensions, and the u-joint plug socket to remove and replace the first plug. Go THRU the wheel wells.
3. Continue this, working from front to back. Once done with driver's side, repeat on passenger side

Would you rather try it from the wheel well this way...

...or from the top like this?

A shot without manifolds or headers.

Changing Plugs, Headers

Plug Procedure:

› Note that this procedure is based on Clear Image Automotive Tri-Y Headers, so the info will be somewhat specific to them but, will apply to other headers

1. For plugs 1 and 3, it is easiest to just do them from up above. These plugs are possibly EASIER with headers than with stock manifolds!
2. Plug 5 is a bit of a bear. To do it, you need to take the "regular" sparkplug socket and modify it (with Dremel tool and cutoff wheel, hacksaw, or however else you wanna do it), cutting approx 3/4" off the end of the socket. This will let it JUST clear the header tube (the socket, unmodified, will NOT clear the header tube). You will also need to remove the rubber "tubing" inside the plug socket, and shorten it about the same amount (use wire cutters or something else appropriate here). Once modified, you can then slip the modified socket onto the plug and use the 3/4" box-end wrench to turn the socket and loosen it. Once "broken loose" a little, you can complete removal by hand. To reinstall, start the plug by hand and once it is "hand tight" you can slip the modified plug socket back on the plug and go from there.
3. Plug 7 is the same as with stock manifolds (thru the wheel well).
4. Plugs 2, 4, 6 are easiest thru the wheel wells, same as stock manifolds.
5. Plug 8 is another bear. Once again, put on the modified plug socket. Then, from UNDER the car, slip the 3/4" box end wrench up and on the plug socket and loosen it up. With the headers, there will be enough room between the header collector and the engine block to get your hand with a wrench up there. Install the new plug similar to #5 (by hand, then tighten with the socket and wrench).

Plugs and wires changed on Tri-Y's.

Changing Plug Wires

Procedure:

1. Before starting, note which wire loom is on which wire, and also note the order of the wires into the opti-spark. If you forget, the plug wire numbers ARE embossed on the opti-spark, next to the wire connection points. This info is also in the FSM and even in (somewhat cheaper, although often lacking) the Haynes manual.
2. Remove the accessory belt (13mm wrench on the idler pulley), and then remove the idler pulley assembly (helps on the passenger side wires) which is held in by two 10mm bolts.
3. Lay out your new plug wire set, and "prep" it by putting dielectric grease (a thin coat) in the inside of the boots on both the plug and distributor sides of the wires. Note that at least the Taylor Wire set includes TWO coil wires (one for 94-95, one for 96) so there will be an unused coil wire.
4. To figure out which wire goes to which plug is simple. For the Taylors, the distributor end boots are black while the plug end boots are the same color as the wires. The "straight" distributor-end boots are for the driver's side wires (plugs 1, 3, 5, 7) and the "bent" ones are for the passenger side wires (2, 4, 6, 8). Then, amongst the straight-end wires it is simply 1, 3, 5, 7 from shortest to longest, and similar amongst the passenger side wires (2 is shortest, 8 is longest).
5. Unplug all 8 plug wires from the sparkplugs, unless you just changed plugs and them wire ends are already unplugged of course (grin)
6. Start on the driver's side. Use a screwdriver and needle nose pliers (and just some brute force) to pop open the 4-wire holder that is a couple inches away from the opti-spark. This will be done from under the car. Remove the 4 wires from the holder.
7. Remove the #1 plug wire from the opti-spark, and remove it from the car.
8. Unplug the rest of the driver's side wires from the opti-spark.

9. For the rest of the driver's side plugs, I found it easiest to just remove the entire metal bracket that holds the wires (little holders, plus holds the #7 wire tight against the block) against the engine block. It is held on by two 10mm (I think) bolts, and at least with my car with the headers I could get to both bolts thru the wheel well with some socket extensions and u-joint.
10. Loosen the two bolts above, and remove the bracket from the car. It has JUST enough room to slide out the front, past the AIR pump.
11. Once the bracket is removed, it is a LOT easier to individually remove/replace the wires from the bracket. Just match up the wires, and get them back into the bracket with approx the same lengths on each side of the 3 and 2 wire holders as the stock wires had. Also swap over any wire look from the old wires to the new wires, or replace with appropriate length/diameter of new loom.
12. Reinstall the bracket assembly, with the 3,5,7 plug wires installed in it. Reinstall the two 10mm bolts that hold the bracket to the block.
13. Plug the #3,5,7, wire boots onto the plugs, feeling for a "snap" that confirms the wire boot is tight on the plug.
14. Reinstall the #1 plug wire onto the plug, and route the other end of the wire down with the 3,5,7 wires to the 4-wire holder.
15. Reinstall the wires into the 4-wire holder, and snap it tight. Reinstall rest of the loom pieces (or new ones) onto the wires.
16. Plug the wires onto the appropriate places on the opti-spark (once again, plug wire numbers are embossed on the end of the opti-spark).
17. Now to the "fun" side (grin). Slide over to the passenger side, and unplug the wire boots from the opti-spark. It works a LOT better if you start with the "top" one (wire 4) and work your way down to the bottom (wire 2).
18. Cut the opti-end boots off the plug wires. Trust me on this one!
19. Working from the motor side (mostly thru the wheelwell, some underneath), pull the old wires out from the plug ends. This is a LOT easier than ANY other way on these wires.
20. Collect all the pieces or wire loom that fell off the wires as you removed them in the above step.
21. With the wires NOT in them, it is MUCH easier to unsnap the wire holders. Unsnap the 4-wire holder (near the distributor), 2 wire holder that held wires 6,8 (approx below the #4 plug), and the 1 wire holder that held wire 8 (approx below plug 6).
22. For the 4 passenger side wires, LABEL the opti-spark boot ends!
23. On the passenger side, the easiest way to route the plug wires into place is to tie the 12 gauge wire (see the "tools" section) around the plug boot end of the wire, and route the 12 gauge wire up thru the space between the accessory bracket and the AC compressor where the plug wires are squeezed thru. You can much more easily push this "stiff" wire up thru the spaces than the "limp" sparkplug wires.
24. Start with the #8 wire, tie the 12 gauge wire to it and push it up and thru. Eventually, the 12 gauge wire will pop out near the #6 plug (can be seen from underneath) and you can use the wire to pull the plug wire thru to the #8 plug. Untie the #8 wire from the 12 gauge wire, and snap the boot onto the #8 plug. Then, put a piece of loom onto the #8 wire (with the loom between the plug boot and the 1-wire holder), and snap it into the 1-wire holder below the #6 plug. Making sure there is a little (but not much) slack in the #8 wire, snap the 1-wire holder closed. Be sure you have things right, as it is a beast to get this 1-wire holder back open if there is a wire in it!
25. Also put the #8 wire into the 2-wire holder, but DO NOT snap it shut yet!
26. Next, route the #6 wire up and thru with the 12 gauge wire, similar to how you did the #8. Snap the #6 boot onto the plug, and put it (with a little, but not much) slack into the 2-wire holder. Once you are

SURE that things are right, go ahead and snap shut the 2-wire holder.

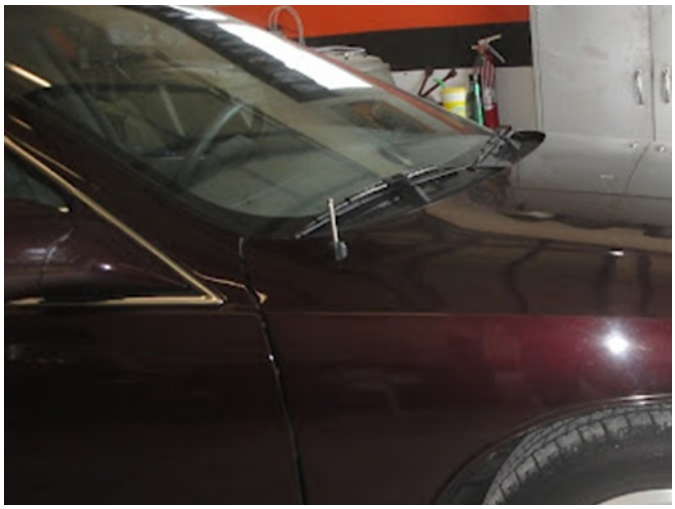
27. Put a piece of loom on each of the #8 and #6 wires forward of the 2-wire holder (i.e. on the parts of #8 and #6 wires that are running below the #4 and 2 plugs).
28. For the #4 wire, you wanna tie a piece of 12 gauge wire to BOTH ends of the plug wire. Route the plug boot end up as you did with #6 and #8, but you'll probably have to "overshoot" to get the boot far enough down to untie the 12 gauge wire. Thus you have the 12 gauge wire on the other end to "pull it back thru" towards the opti-spark. Snap the #4 plug boot onto the plug, and untie the 12 gauge wire from the opti-spark end boot.
29. Repeat the same as #4 on the #2 wire. Here, having the "other end" with the 12 gauge wire will be even more critical.
30. From underneath, you want to put a small piece of wire loom on each wire individually so that the wire is protected from chafing as it passes thru that small space between the AC compressor and accessory bracket.
31. DO NOT PUT THE WIRES IN THE 4 WIRE LOOM YET!
32. Put another piece of wire loom on each wire on the end closest to the opti-end boot. This will protect the wire as it is run up to the Opti-spark.
33. Starting from the bottom up, route the #2 wire up to the opti-spark and plug it in. Repeat for the #8, 6, and 4 plug wires.
34. IF POSSIBLE, put the wire ends into the 4-wire holder. Sometimes you can only get 3 of 4 to fit but the #4 wire was not QUITE long enough to go back in. So, just make sure its not touching nothing, and let it hang. Once you are SURE, then snap the 4-wire holder back together.
35. If you want, reinstall the heat shields from the stock wires onto the new wires. Since there is sufficient clearance and these heat shields are often a source of problems with the wires shorting to ground, most don't bother.
36. Reinstall idler pulley and accessory belt
37. Start car, and see if it is firing on all 8. If not, you probably crossed a couple plug wires or didn't get a plug or opti-spark boot on tight. Also, listen for a "tick tick" that would indicate a plug that isn't tight, and look for evidence of sparks jumping to ground.

Final

› Assuming all is OK, reinstall the wheels, lower the car, torque lug nuts to 100 ft lbs, and reinstall center caps. Go for a test drive to make sure everything is ok.

Power Antenna Replacement

Looking at the project at hand, you'll notice the antenna mast partially protruding from the fender. The mast got bent, and it would only go partially up and down.



Bad power antenna mast.

Looking at the project at hand, you'll notice the antenna mast partially protruding from the fender. The mast may have gotten bent, or it will only go partially up and down.

Tools:

- *10 mm socket and ratchet and extensions*
- *Needle nose pliers*
- *2x4 block of wood 6" – 8" long*

Getting ready to remove the wheel.

Procedure:

1. Remove the hubcap and loosen the lug nuts.
2. Jack up the car, and use jack stands.
3. Remove the lug nuts and the tire.

4. Next remove the fender well bolts. There are five 10 mm bolts along the edge of the wheel well.

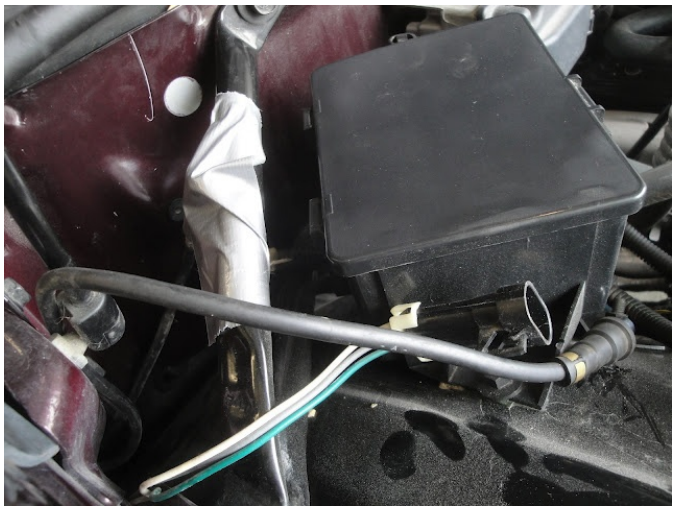
One of five 10 mm bolts.

5. Now remove the three 13 mm bolts inset into the wheel well.

One of three 13 mm bolts.

6. Remove the three 10 mm bolts with big washers, which are further into the wheel well.

Two of the 10 mm bolts with large washers.



Use #732 for duct tape.

7. Now open the hood and unplug the power and antenna connectors. It's a good idea to tape the antenna to the brace so it doesn't try to fall.

No bezel or nut.

8. Remove the top nut and bezel from the antenna. Some people use needle nose pliers and position the tips into the slots on the nut. Be careful not to slip and scratch your paint.

Get yourself in a jamb.

9. Remove the 10 mm bolt with a star style lock washer from the door jamb. The antenna should drop when the bolt is removed.

10. Prop the inner fender well open with the block of wood so you'll have some clearance. A good idea would be to tape the fender so you don't scratch the paint while working.

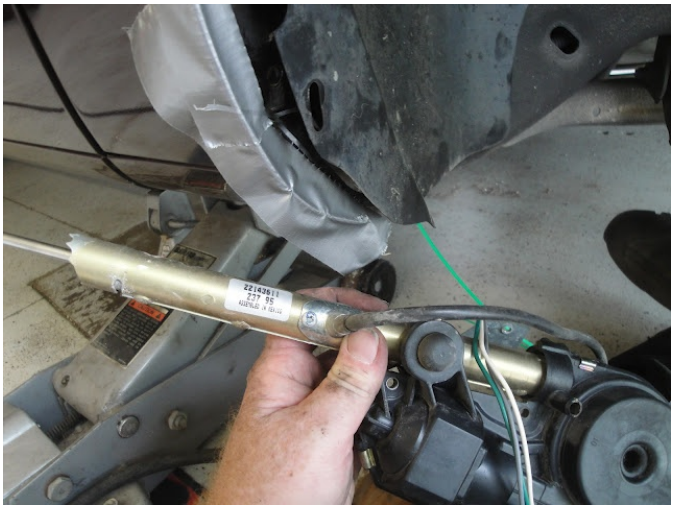
Using a block of wood to give a little room to work.

11. It will take some wiggling to get the antenna out because it tends to get caught on the fender brace.

› Be sure to test the replacement antenna before installing it. To do so just plug in the electrical connector and turn the radio on. Then turn off the radio and unplug the electrical connector with about an inch or so of the mast sticking out to add the repositioning the antenna. Everything to this point can be accomplished by one person. It's nice to have a helper while installing the replacement antenna.

Stuck on the fender brace.

12. Feed the mast up through the hole and loosely fasten the nut.
13. With luck the hole in the antenna bracket will line up will line up with the hole in the door jamb.
14. Install the star washer and bolt. Tighten it along with the bezel nut.
15. Now feed a wire, or whatever you choose, down from the engine compartment and through the fender.
16. Tape the power and antenna wires to the wire and pull them up to reconnect them to the cars wiring.
17. Retest the antenna. If it still works finish by reinstalling the wheel well bolts, put on the tire and lower the car.



It's out.

Rebuilding A Power Antenna

Source: http://www.cadillacforums.com/forums/cadillac-tech-tips/169176-how-rebuild-power-antenna.html
Much thanks to "N*Caddy" from Toronto, Canada for this guide!

In the last week I had problems with my power antenna (or power mast). At some point refused to retract.

Please be aware; if your power antenna is stuck immediately disconnect the power harness from the relay mounted on the antenna. Remove the liner to access the antenna and disconnect ANY of the two connectors attached to the relay. If your antenna does not locks to the end of the line (either fully extended or fully retracted) the battery will be drained (even if fully extended or retracted does not means is locked). Do not risk just disconnect one of the two connectors. If not locked the motor receives continuously power and will drain the battery (you can hear a low clicking sound once every 15-20 sec, that is the bimetal safety switch connecting-disconnecting the motor). Also the wires and the motor are warm to hot during this time (that is your battery draining).

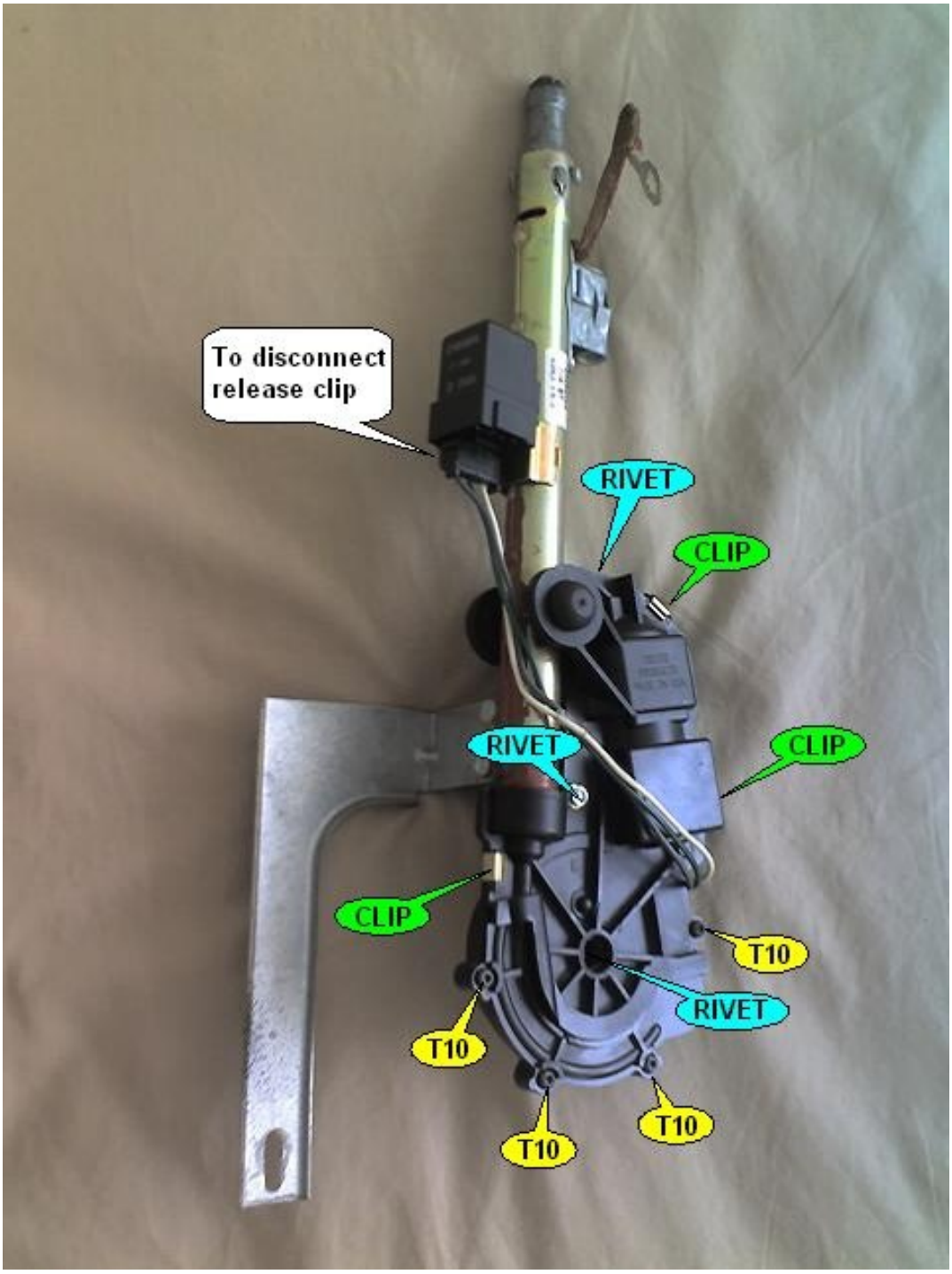
How to remove the antenna:

You need to disconnect the electrical connections (power and radio antenna), the drain tube and unscrew (no 10 wrench) the ground wire screw (topside) and the screw holding the antenna bracket to the body (lower side). Then slide the antenna down (to clear the rubber grommet). The antenna comes out from the trunk bracket attached.

Common problems to the antenna:

1. Burned Antenna fuse (20A trunk compartment)
2. Sticky antenna relay
3. Broken nylon wire lifting/lowering the antenna mast
4. Worn gears (motor shaft or plastic spooling wheel – worm screw assembly)
5. Worn brushes
6. Burned/dirty locking contacts (part of the brushes assembly)
7. Sized motor shaft due to water intrusion
8. Burned motor

1 and 2 can be eliminated once the antenna is removed by applying 12V ([+] to pin A and [–] to pin B to extend mast or [+] to pin B and [–] to pin C to retract mast) on the small pigtail harness connector that goes from the relay to the antenna motor (to be seen in fig.1, is a 3 wires connector A – White wire, B – Green wire and C – Gray wire). Never connect power between A and C (direct short)
If the mast is moving then either the antenna fuse is burned or the antenna relay is sticky or wiring issue on the car harness.
3. Can be detected easily by trying to manually extend the mast, if it extends then the wire is broken.
Any issue from 3 and down require disassembling the motor and gearing.

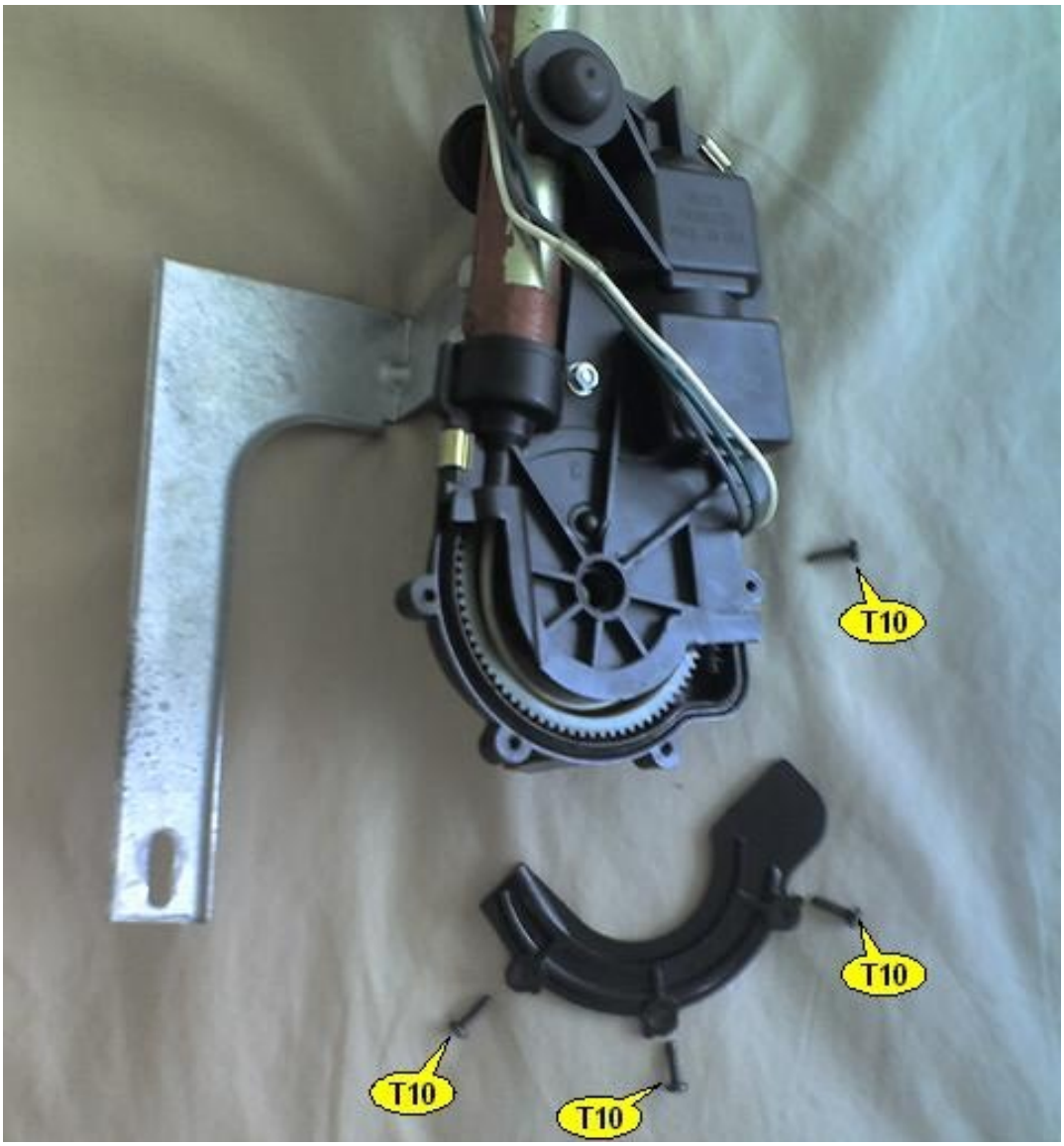


Power antenna parts.

Here you can see the screw, clips and rivets holding the two halves of the motor assembly together. If the antenna was never serviced, from factory comes with rivets. You will need to drill the rivets out and replace with screws. In my experience ½ inch long M5 screws with 2 washers are the best (you need 3).

Should you do exploratory surgery first, to prevent the wire from coming loose from the gear, leave attached the plastic piece shown removed below.

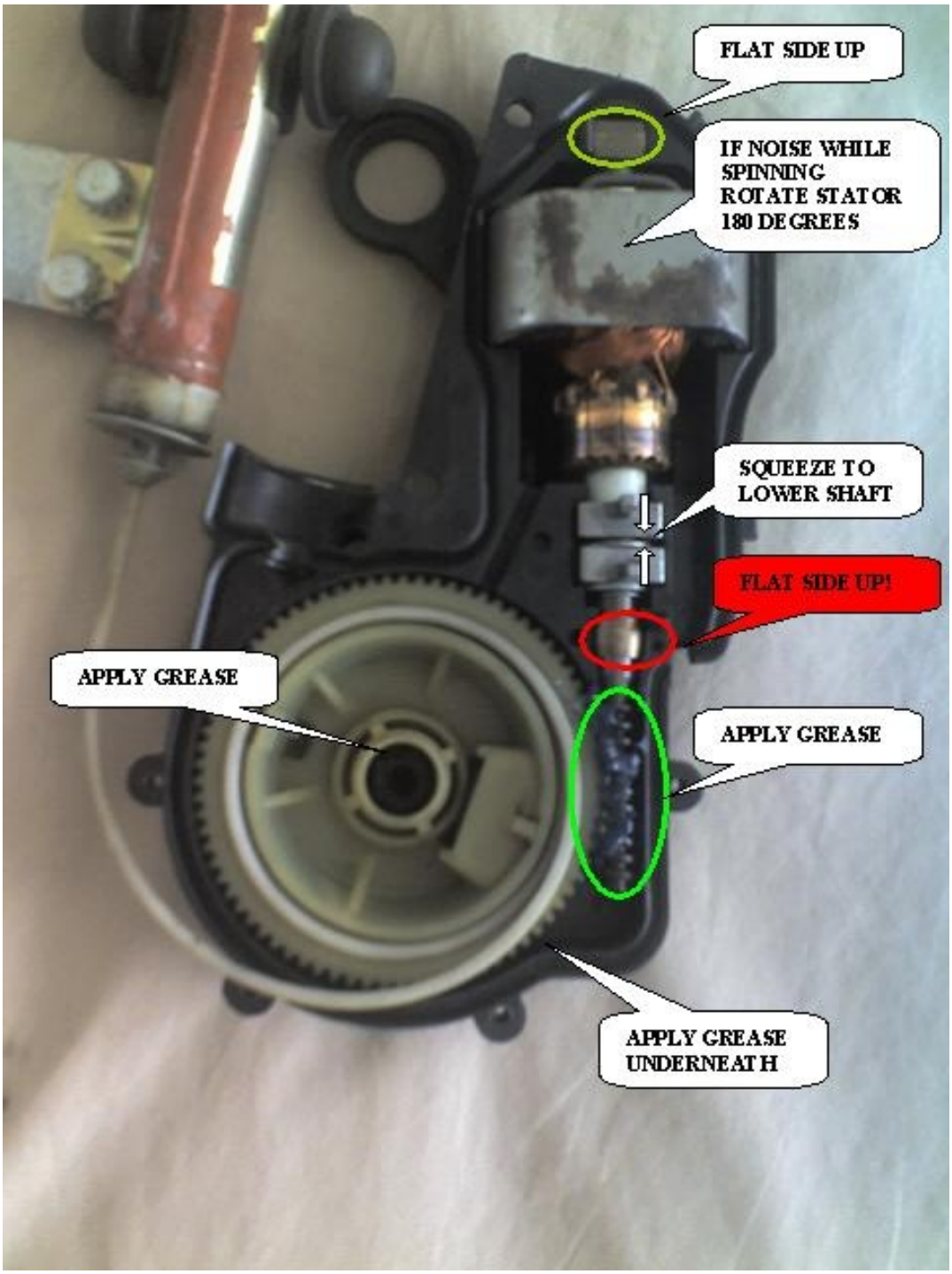
Drill the rivets, pop the 3 clips and unscrew the one T10 screw not holding the previously mentioned plastic piece.



In the next picture is the inside of the antenna mechanism with the cover removed. Please note the mast will come loose once the case is split.

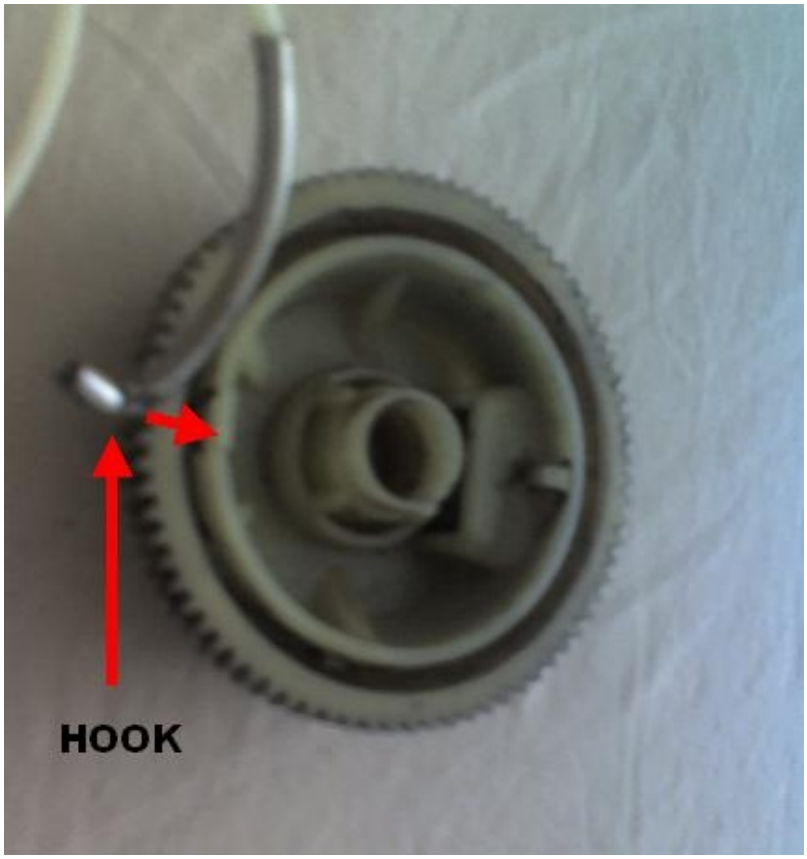
Inspect for signs of worn gears on the worm screw assembly. Replace the worn piece, if the shaft is rusted and worn then the whole motor shaft has to be replaced. The motor shaft comes out from the plastic casing after you take out the brushes/lock & safety switches assembly. Inspect the brushes if worn replace assembly. The stator (the big magnet shown in the next picture should slide out (just magnetic force hold it over the motor windings).

The shaft can be borrowed from ANY Delco power antenna motor used in various GM models in the ‘90s.


FLAT SIDE UP
IF NOISE WHILE SPINNING ROTATE STATOR 180 DEGREES
SQUEEZE TO LOWER SHAFT
FLAT SIDE UP!
APPLY GREASE
APPLY GREASE
APPLY GREASE UNDERNEATH

Here is the stator.

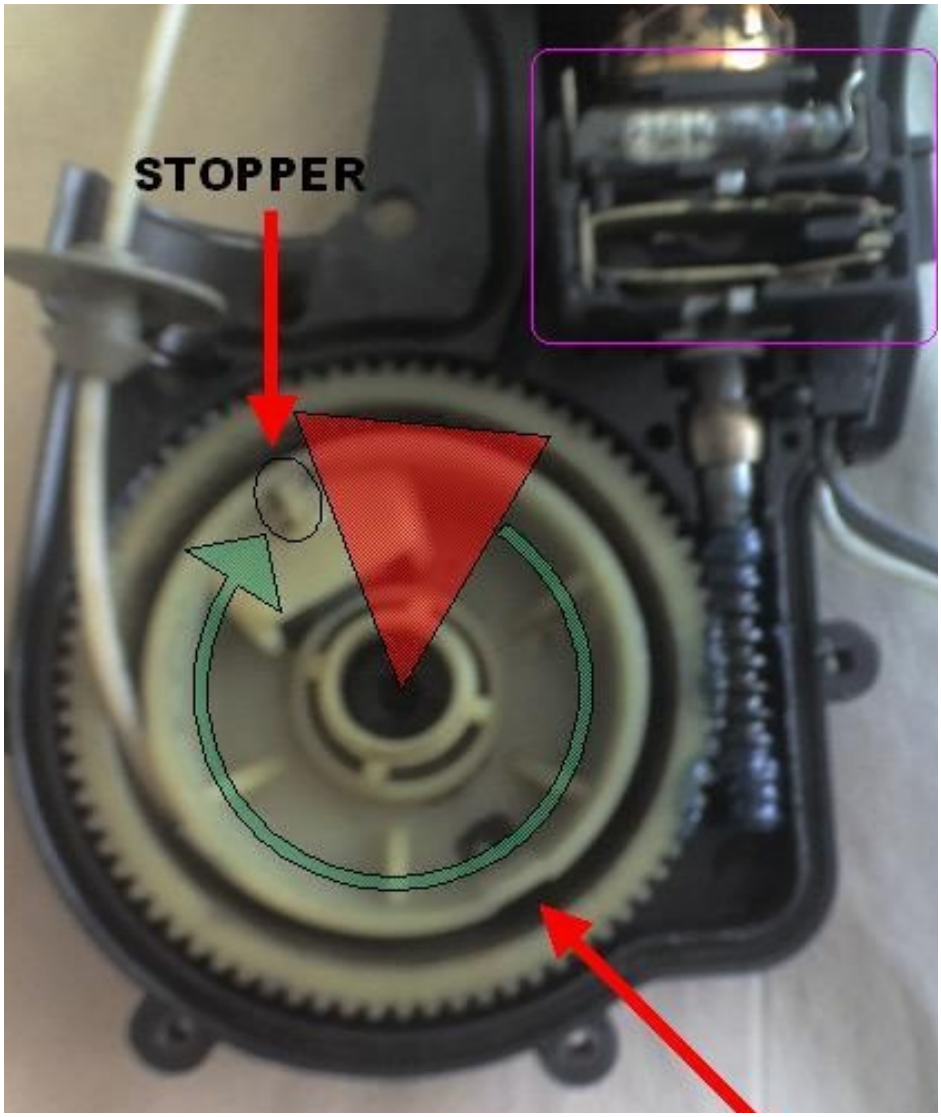
The stator can be reused (just slide-it in place over the rotor). Note on one side the stator has a small round rubber glued, that side should be on the bottom. To slide the rotor in place squeeze the two locking switch actuators and lower shaft. Make sure the two bushings (acting like bearings) are oriented with the flat side UP. If the stator is rotated around the shaft with the wrong side up then the motor will spin with grinding noise, if the bushings are wrong side up the motor will spin slower (friction after tightening the two halves of the plastic casing).



Plastic wheel and cable attachment point.

If its only the plastic wheel then disconnect the hook attaching the nylon wire to the wheel and replace wheel.

To attach the two halves of the case back together unwind the nylon wire and position the wheel EXACTLY as shown in the following picture.



Notice the notch called stopper, that notch can not be in the RED area. Can be positioned in ANY position around that green circle but better orient the wheel in the exact position as shown with minimum nylon wire on the wheel (notice the hook that is the end of the nylon wire, less than ¼ of a turn).

Observe the small wheel on the cover. Make sure the wheel is oriented in EXACTLY the position indicated (the missing tooth should be towards the red line shown in the picture below). That wheel is what stops the antenna when fully extended. If the wheel is randomly oriented the antenna will not extend all the way.

Lubricate with grease all teeth and the drive screw and the area around the little gear. Do not lubricate the cable or the mast.

Slide the brushes/switched assembly over the shaft (highlighted magenta). If brushes are loose re-gap as required, then put the cover back along with the clips and screws (replacing the rivets). At the same time make sure the round gasket over the nylon wire is placed in the correct location.

ALWAYS do a bench test of the antenna; apply 12 V as described above. Allow the mast to travel from fully retracted to fully extend (several times). Very important, you should hear a distinctive click at the end of the travel (in any direction). If no click, the shaft does not slides (up or down) disconnecting the power to the motor. You can observe the shaft sliding up or down with the cover removed. If no distinctive loud click start all over (something is not assembled correctly).

Hope this will save you $50 or so.

Reprogramming Key Fobs

Procedure:

1. Reposition rear compartment trim to access the programming connector located at the left of the rear compartment (trunk), for sedans. It should be a two pin connector hanging there going to nothing.
2. WAGON: Remove right back body pillar finish panel to access programming connector. THIS IS THE WAGONS PIN LOCATION SKIP THIS IF YOU DONT HAVE A WAGON.
3. Ground the programming connector by connecting the terminals together.

› The system will verify this has occurred by performing a lock all, unlock drivers door/unlock all, and trunk/endgate cycle

4. Press any key on either transmitter.

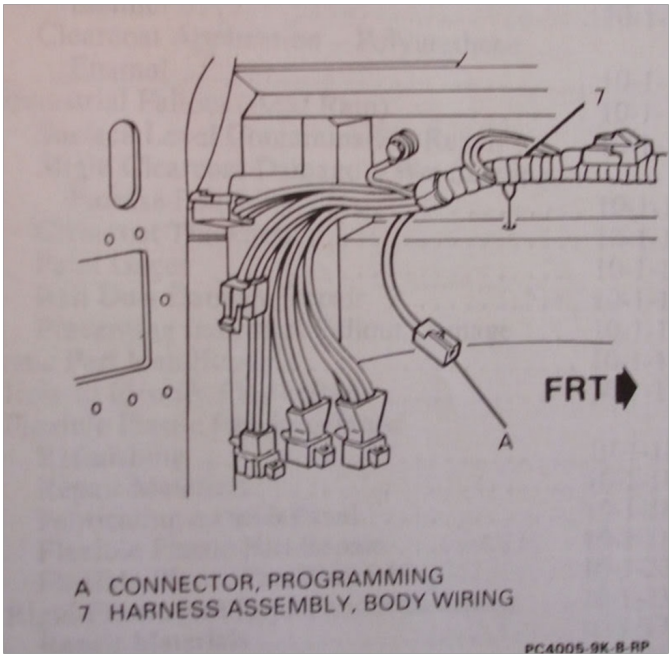
› This step programs that particular transmitter to the receiver. The system will verify by performing the same lock/unlock, lock/unlock cycle.

5. The automatic door locking/unlocking function is automatically enabled for this transmitter. To leave it enabled, skip to step 6. To disable the automatic door locking/unlocking function for this transmitter, perform the following sequence 3 times.

   A. Press the door lock button within 1`second of step C the 2nd and 3rd time through this sequence.

   B. Press the door unlock button within 1 second of step A.

   C. Press the trunk button within 1 second of step B.



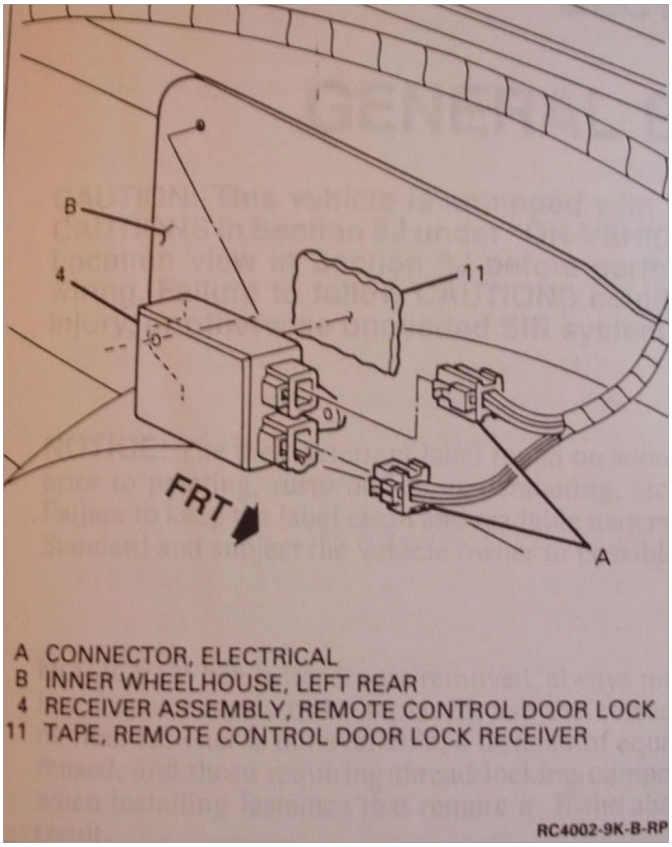
Sedan Reprogramming Connector

› The receiver will cycle through the lock, unlock, trunk sequence 3 times as verification.

6. To program a second transmitter to the receiver, repeat step 4 with the second transmitter. Otherwise, skip to step 7.
7. Disconnect the programming connector.

› System will not operate if ground connection is not removed.

8. Verify operation of each transmitter.
9. Reposition rear compartment trim, for sedan.
10. WAGON....Install right back body pillar finish panel, for wagons.



Wagon Reprogramming Connector

Exhaust

AIR Pump Disable

GM TSB for Air Pump Disable - http://www.impalassforum.com/tech/engine/air_pump/air_pump.htm

Technical - Water in AIR Pump and/or DTC P0410, P0412, P0415, P0416, P0100, P0101, P0102 or DTC 48 (AIR System Disable Procedure) #01-06-04-011

Water in AIR Pump and/or DTC P0410, P0412, P0415, P0416, P0100, P0101, P0102 or DTC 48 (AIR System Disable Procedure)

•1995-1996 Buick Roadmaster
•1995-1996 Cadillac Fleetwood
•1995-1996 Chevrolet Caprice, Impala SS with 4.3L or 5.7L Engine (VINs W, P -- RPOs L99, LT1)

Condition:

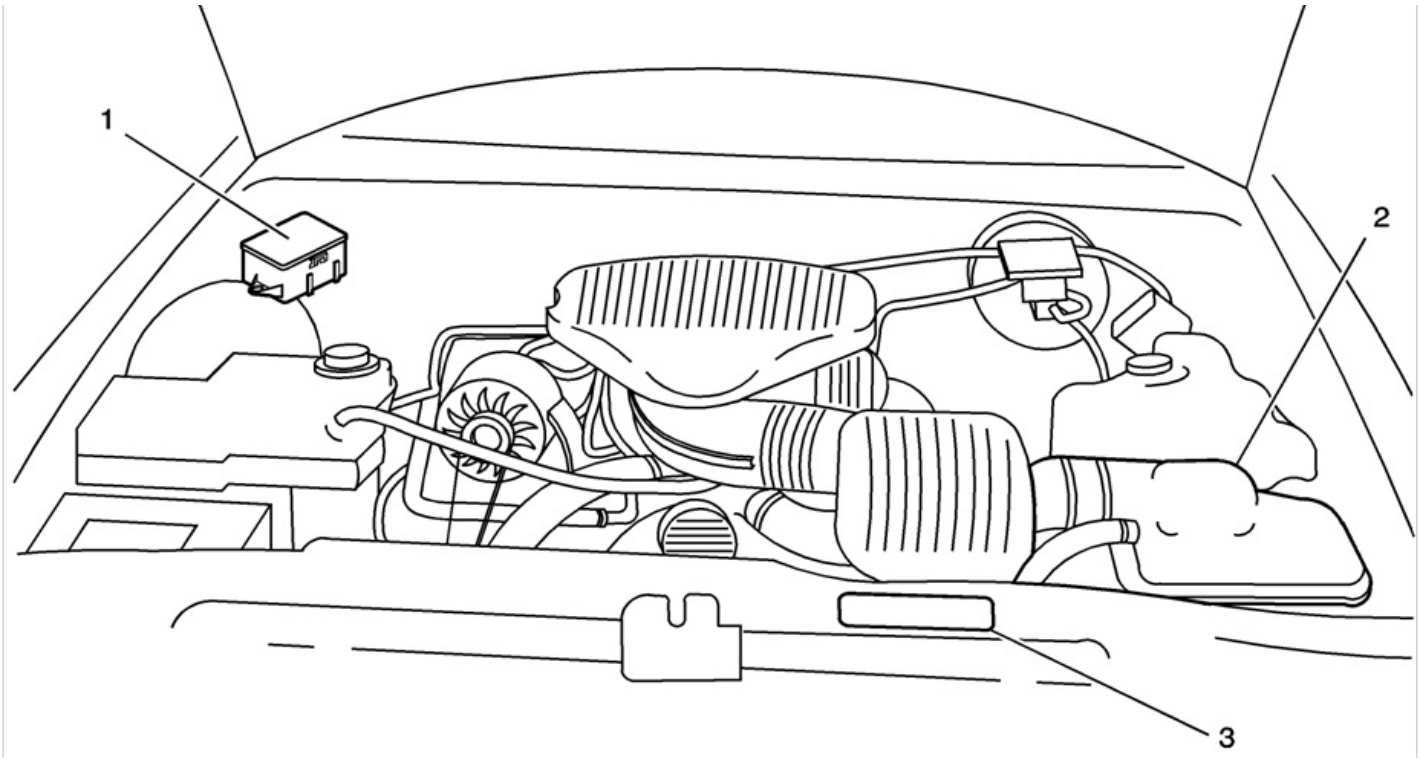
- *Some customers may comment of a hesitation during heavy/full throttle acceleration.*
- *A 1996 vehicle may also set any of the following DTCs:*
  - *P0410*
  - *P0412*
  - *P1415*
  - *P1416*
  - *P0100*
  - *P0101*
  - *P0102*
- *A 1995 vehicle may set a DTC 48.*
- *There will also be evidence of water in the AIR pump.*

Cause:

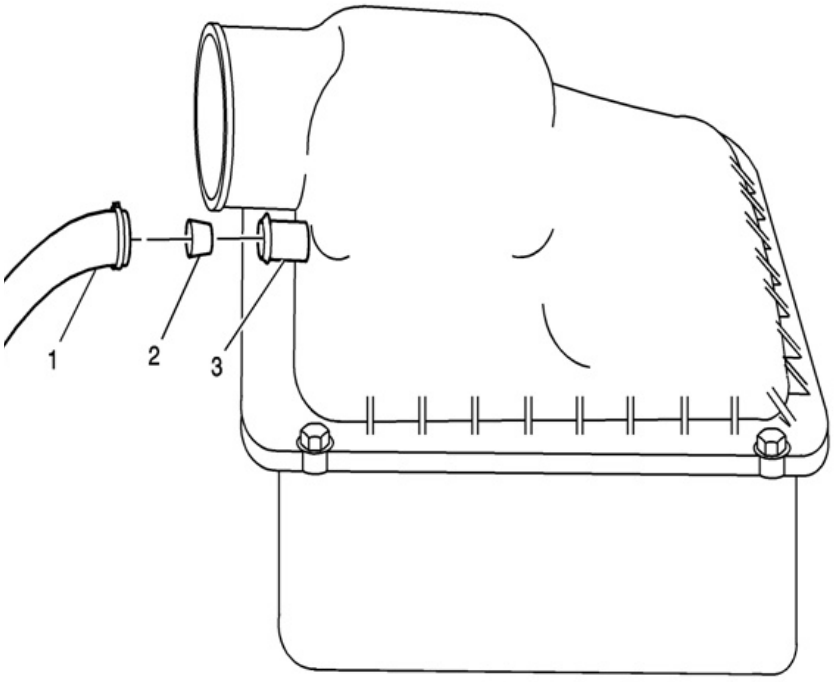
Under high engine speed and load conditions, hot exhaust gasses may leak past the air check valves. As the exhaust gasses in the air tube cool, water vapors collect into the AIR pump. As the vehicle is driven, condensation from the AIR pump may come into contact with the Mass Airflow Sensor through the AIR inlet hose. This condition may cause a hesitation on acceleration and may also set the DTCs.

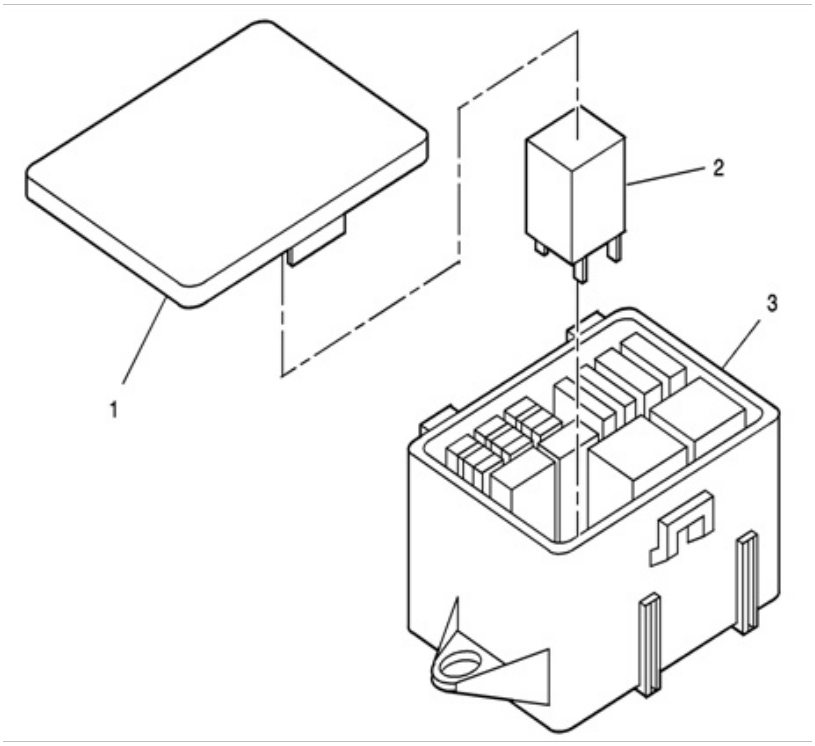
Correction:

To correct this condition, a Secondary AIR Injection Pump disable procedure has been developed. (It has been determined that the Secondary AIR Injection system is not required to meet emission requirements for these vehicles only.)



1. Locate the relay center (1) and air cleaner box (2).
2. Remove the AIR hose and clamp (1) from the air cleaner box.
3. Insert the plug (2) into the air cleaner box AIR hose inlet (3).
4. Install the AIR hose and clamp (1) to the air cleaner box.

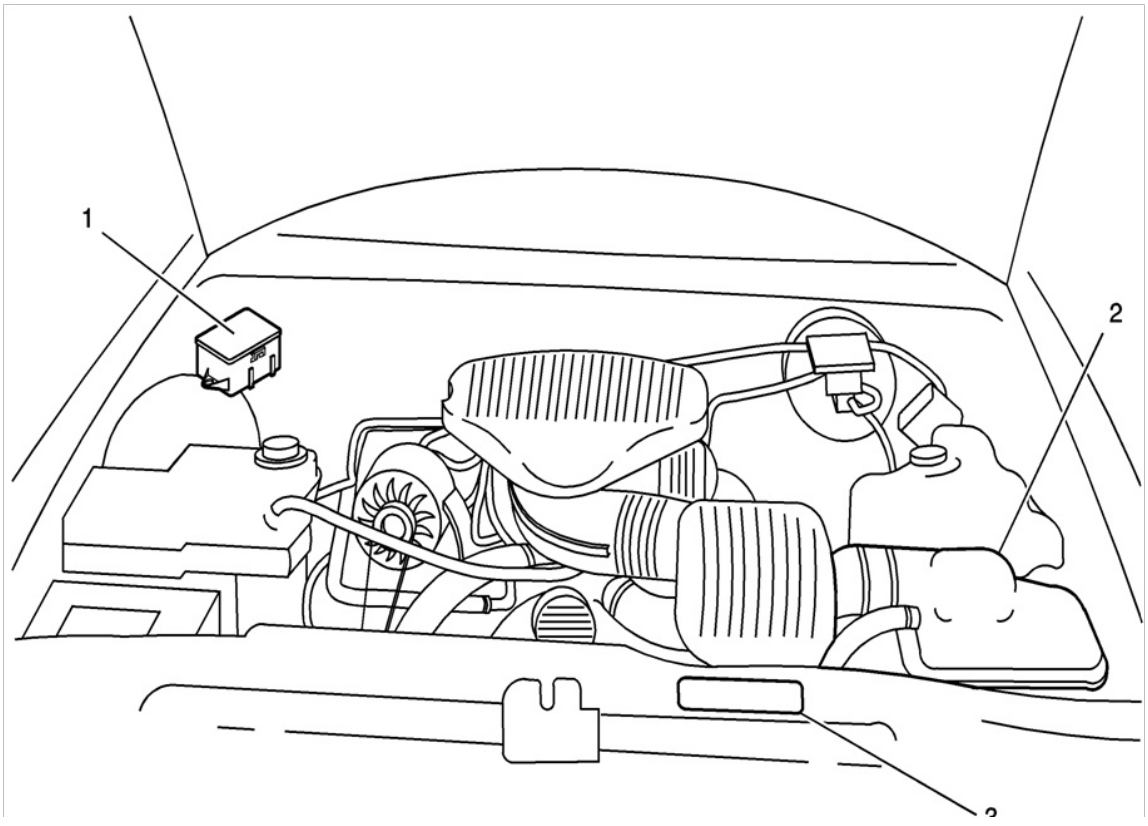




5. Remove the cover (1) from the relay center (3).
6. Remove AIR pump relay (2) from the relay center (3).
7. Install the relay cover (1).
8. Install new emission label to radiator support (3).
9. Update vehicle calibration. (1995 4.3 L L99 Caprice, and 1996 vehicles)

Parts Information

Part Number	Description	Qty.
12569122	AIR Inlet Hose Plug	1
12569123	New Emission Label	1



Parts are currently available from GMSPO.
Calibration Information

The Calibrations are electronic calibrations and are NOT available from GMSPO. Calibrations will be available from Techline starting February 2001, on the TIS 2000 version TIS 2.0/2001 data update or later.

Warranty Information For vehicles repaired under warranty, use:

Labor Operation	Description	Labor Time
J6930	AIR Disable Procedure	0.2 hr.

This is a unique labor operation number for use only with this bulletin. This number will not be published in the Labor Time Guide.

1995 4.3 L (RPO L99) Caprice and 1996 vehicles should also use this add time for reprogramming:

Labor Operation	Description	Labor Time
J6355	Powertrain Controller -- Reprogram -- On Car	Use Published Labor Times

Notes:

- For a 1994 – early 1995 with stock exhaust manifolds, and you delete the AIR pump system, you will need a ⅞-18 drain plug. Dorman P/N #65231, UPC #74956523159
- For a late 1995 – 1996 with stock exhaust manifolds, and you delete the AIR pump system, you will need a ¾-16 drain plug. Dorman P/N #65226, UPC #37495652261.

EGR Valve Replacement

A bad EGR is one of the common repairs to the B-body LT1. It will cause hesitation, stumble, and hurt gas mileage. It's an easy fix but a little pricey and annoying.

Get a new one or get the 6-speed EGR valve from the F-Body LT1. The F-body style tends to last longer and is the same price anyway. Also go ahead and get the solenoid as well, they're not that much and it's good to replace it while you're back there.

Tools:

- *13mm wrench*
- *13mm socket and ratchet*

Materials:

- *17113382 OEM EGR Valve (Good)*
- *17113381 F-Body EGR valve (Better)*
- *12337972 EGR Valve Gasket*
- *1997223 EGR Solenoid*

Procedure:

1. The valve and solenoid are located on the back of the engine on the driver's side.
2. It is held on by two bolts and connecting by hoses to the solenoid. The solenoid is connected by bracket to the engine that is secured a bolt.
3. Be sure to make note of how the hoses are connected while removing it.
4. Remove the old gasket from the valve and engine, and replace it with the new one and install in the reverse order.

EGR valve and gasket

Fuel System

Fuel Filter Change

The fuel filter needs to be changed every 15-20,000 miles under extreme driving conditions.

› Be sure to use either a LED work light or an explosion proof light. You don't want fuel to get on the bulb and possibly cause it to shatter. You'd be riding in your B-Body in paradise before you realize it.

Procedure:

1. First, you need to raise the vehicle where the driver's rear wheel is off the ground, the filter is located under the body in front of that wheel.
2. To relieve the pressure from the system remove the gas cap. It's best to unplug the fuel pump by the wiring harness directly under the body below the tank fill tube while the car is running and let it stop. It will take a second or two.
3. With the gas cap off, remove the bolts to the harness holding the filter in place.
4. Then use a set of pliers and a flathead screwdriver to unhook the hoses from each end. This is a little tricky, but give a good look to them and you'll see how they come off. Remember: There is still gas in the lines and it will pour out, so have a pan handy and then keep it there until the gas runs out. It helps to tilt it and remove the leftover gas in the filter.
5. Reinstall the new one in the reverse order making sure it is in the right direction and the hoses are secure to the filter.
6. Reconnect the harness if you chose to disconnect it and crank the car. Turn the key to the "Run" position and let the pump prime the lines before cranking.

Fuel Pump Removal

Tools:

- *Flat Head Screw Driver*
- *Ratchet and Sockets, 13mm*
- *A Couple long Extensions*
- *Fuel Line Disconnect Tool*

Safety:

1. Safety First - Chock the front wheels or put something in front to keep the car from rolling forward.
2. Raise the rear of the vehicle a good amount. The rear wheels of the Wagon should be at least 3" off the ground. This should be just enough to use a transmission jack and keep the tank mounted on it and slide it out.

Filler neck and vent tube.

Procedure:

1. Loosen both hose clamps on the filler neck and the one on the vent tube. When the tank mount end comes loose, tighten back up the other end.

Tanks strap mounts.

2. These are the tank strap mount bolts; they are 13mm and a pain to get back in place. Loosen and remove the nut, but leave the bolts in place for now. Take the cross strap nut off and push the tank strap out of the way.

Transmission jack.

3. Now position a floor jack or transmission jack underneath the tank to support it. Put some pressure on the tank to take the load off the bolts for the straps. The bolts should come out with little effort.

Zip-Loc bags over filler neck.

4. Lower the tank a little bit and slide the jack towards the rear as you lower to keep the tank balanced. Remove the hose connection at the filler neck and cover up the port to prevent a fuel leak using two zip-loc bags and safety wire or zip-ties. Be careful and it shouldn't leak much.

5. Now get under the car and disconnect the retainer for the fuel supply/return and evaporation lines. It's directly above the rear end.

Evaporation lines.

6. To fully remove the tank and then remove the fuel sender assembly. You will need to have a fuel line disconnect tool for this.

Fuel line disconnect tool.

7. With the tank lowered a bit you have easier access to the fuel supply and return lines. Move the rubber boot out the way and you'll see the QD. Use the disconnect tools. Select the appropriately sized one and with the sleeve facing up into the connection push it in. You might have to push the line a little to get it in. It should slide in and then pull the lines apart. If it's taking a lot of effort, stop you're not fully disengaging the quick disconnect.

Fuel line covers.

Fuel pump assembly loose.

8. Now you're ready to drop the tank and pull it out so you can work on it. Don't forget to disconnect the wiring harness from the retainers on the body. Once the tank is out you should clean the area above it before removing the retaining ring for the fuel pump and sender assembly. The retainer is held in place with six 10mm nuts. Pull out the fuel pump and sender assembly.
9. Remove the wiring and take the cap off of the fuel pump housing, there a few tabs. Be careful when pulling out the purple wire, it has a tight retainer and you wouldn't want to break the sender assembly. It is strongly suggested that you install a new in tank harness. Compare the new one to the old one and make sure the wires are in the proper terminal location.

Fuel sender removed.

10. Slide new fuel pump into housing and reconnect the wires. Install a new strainer to keep your warranty valid.
11. Use the new O-ring that comes with the fuel pump, install the sender, and pump assembly. Tighten the nuts in a cross over pattern to the correct torque specs. Put the tank on the jack and get it close to mounted. Connect the supply, evaporation and return lines and wiring harness. Time to perform an operational check. Under hood, have your fuel pressure gauge connected and some wire or terminal clips. The fuel pump "jumper" allows you energize the fuel pump by yourself from under the hood. Connect a lead to the battery + positive terminal and another to the fuel pump "jumper".

Fuel pump removed.

› The gauge should read 45 psi or better.

Now for the fun part is remounting the tank. The less difficult was is to completely remove the drives side strap and cross strap. It's held on with the 15mm bolt. You will need a long extension or two. Jack the tank up and get the passenger side strap bolted in. Now you will have to fight the filler neck hose back on, feel free to beat and kick the tank into submission. Use a set of tapered punches to help align the tank strap and mount holes. Loosely mount the driver's side forward tank strap mount, this will help you install the rear bolt a little easier. When all you hardware is loosely installed, then go ahead and tighten them all up.

Repairing the Fuel SSender

Tools:

- *Fuel Line Disconnect Tool*
- *Flat Head Screw Driver*
- *Ratchet and Sockets*
- *A Couple of Long Extensions*

Materials:

- *Zip-loc bag*
- *New Wiring Harness, like AIRTEX #WH3000*
- *Ketchup – The mild acid helps clean off the corrosion.*

Follow the procedures under "Fuel Pump Removal" but stop before removing the fuel pump from the tank. Before you remove the fuel sender assembly and before you do anything else, remove all the rust off the outside portion of your sending unit and paint it. You could bake it in the oven for 4 hours at low heat (170°) which really does a nice job curing the paint. Do not go any hotter than that or you could burn the paint.

Where they sit in the vehicle, these sending units get no breeze and so they are very susceptible to corrosion because dirt, salt, and moisture just sit up there.

Okay, now that it's rust-proofed, let's refurbish it.

Using an ohmmeter, ohm out your sending unit (purple and black wires) to see what it reads full (float up) and empty (float down). Factory spec is 90 full and 0 empty. Low fuel light comes on at 10 Ohms. This one was not doing so well:

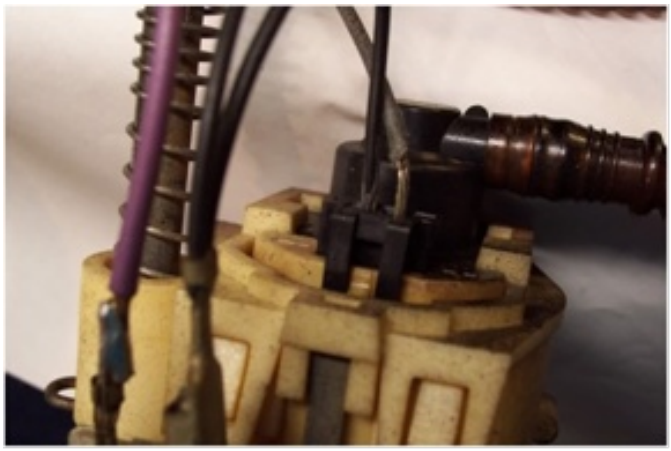
This is caused by a combination of things:

An example of a bad full reading.

- *Lousy connections filled with gasoline varnish.*
- *Corrosion and burn damage on the ends.*
- *The stock GM resistor setup isn't always calibrated right. You'll see as we go.*

You use whatever method you want to clean these metal areas shown in the pictures.

An example of a bad empty reading.



These got a little hot!

Look how heat-damaged the fuel pump wires were. See the insulation melted back?

Torx in action.

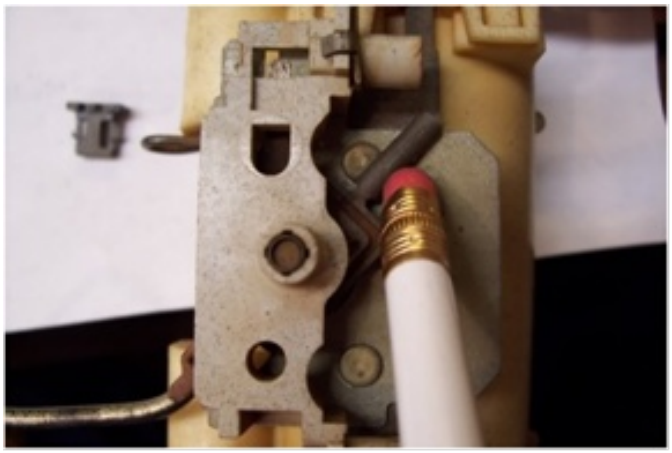
Procedure

1. Take the sending unit apart using a Torx bit. Under the cap is a spring, which may jump out if you aren't careful.

Spring

2. Current is conducted through the spring to the resistor. As the fuel sender ages, it builds up corrosion and that changes the resistance of the unit changing the reading on the gauge. Remember, don't lose the spring.

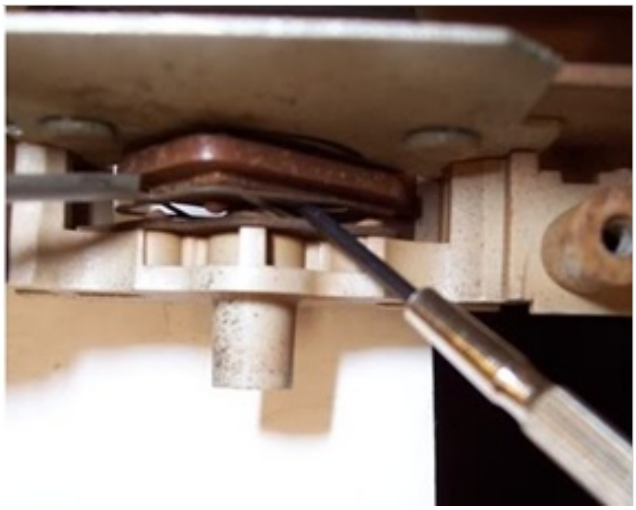
3. Start cleaning every contact but be delicate on the wiper. Using an eraser is a good idea. Just be firm enough to clean off the corrosion yet not bend or break the wiper. A clean wiper conducts current better and produces more accurate readings at the gauge.



A dirty wiper.

A clean wiper.

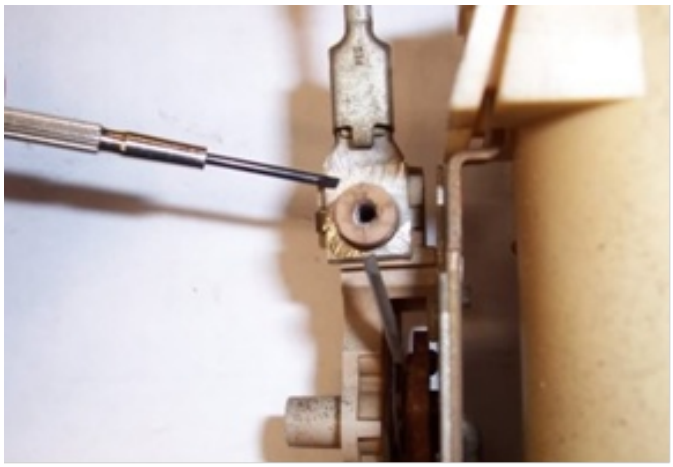
4. Once you are finished with the wiper begin cleaning the rotator connection any way that you can. Here it's being pointed to with a jeweler's screwdriver.



The rotor.

5. Fine sandpaper works well. It is suggested to use 2000 grit or higher to clean the rotor. Of course contact cleaner wouldn't hurt either. After cleaning the rotor with sandpaper, be sure to blow it off several times. You don't want to have any of the grit entering you engine and causing more problems.

Fine grit sand paper.



Spring mount.

6. Clean where the spring mounts to the assembly. The spring is sandwiched between the assembly and the resistor cap.

Cleaning the resistor.

7. Clean the corresponding resistor area with a pencil eraser.

   Be VERY gentle with the resistor. The wire isn't real strong so take your time. If you break it, it's dead and all of your work to this point will be for nothing. Also don’t forget to clean the edge where the wiper rides.

These got a little hot!

8. Carefully clean the spade connector at harness connection.

9. Once everything is clean, put it back together and check “EMPTY” with your ohmmeter. If yours is still reading more than zero ohms, it needs help. It may do this because the wiper never gets close enough to the spring to have no resistance in the circuit path. If that is case, you need to RECALIBRATE the resistor. If you're good with a soldering iron, this is no problem. Here's how to do it. Find the highest point on the resistor where the wiper travels, shown here with a pencil. Then, run a bead of solder all the way from that point up to the spring mount, so there is a direct, low-resistance path from the wiper to the spring when the gas tank is empty. NOTE that the jaw is NOT grabbing the resistor itself, but the plastic housing. Be gentle with that resistor wire!

These got a little hot!

10. Now, you need to run a bead of solder from the spring mount to that point. Use some good paste flux to make sure the wire is super clean so you get a good bond. Start at the mark and then work your way towards the spring mount. Be careful not to let the solder flow farther away, although all that will do is give you a slightly false low, which isn't really a bad thing. Cleaning carefully will ensure that the solder doesn't bond to anywhere you don't want it to. Solder HATES dirty metal and refuses to bond to it. With soldering just starting here and the solder quality doesn't look too good - see how it's beading up?

Not so good solder application.

11. Finished! See how the solder has flowed nicely onto the resistor wires, this is what you want to see.

A good solder application.

Here's the finished product.

12. Now, begin bolting everything back together.

No bodies just solder.

13. The next step is to install the new harness. Here are some more tricks.

› DO NOT install the plastic connector bodies. Just solder them directly to the top of the bulkhead like this picture. No more vibration or contamination on these connections! They'll never need to come off so don't worry. However, for the fuel pump, cut the connectors off the ends of the leads, strip 1/4" of insulation off the wires, and solder them directly to the fuel pump leads side-by-side so if you ever need to replace the fuel pump, you just touch the hot soldering gun to the joint and the wires come right apart.

Testing the sender.

› DO NOT heat-shrink any of these connections unless you have heat shrink tubing you KNOW is gasoline resistant. Most of them aren't, and if you're in doubt, just take a piece of what you have and put it in a little jar of gasoline and give it half an hour. If the surface feels gooey after the half-hour, it's not resistant. Honestly, you don't need to protect the connections. They don't move around any, so they won't touch.

14. Okay the moment of truth. Check at the sender itself. Empty should read 0 Ohms, this one looks good! Next you need to check the harness, which should read what the sender itself measured.

Checking the harness.

15. Lastly check the sender for its “Full” reading. Here you can see the meter reading 96.1 ohms. This is okay. Anything 90 ohms and above will show as a full tank. The real key is getting the “Empty” resistance as close to zero as possible.

    Okay, you're all done. Take the sender and go plug it into the vehicle harness, then turn the ignition on. You can verify the gas gauge circuit is working by watching the gauge on the dash respond to you moving the float. Then bolt everything back together and put the fuel tank back in.

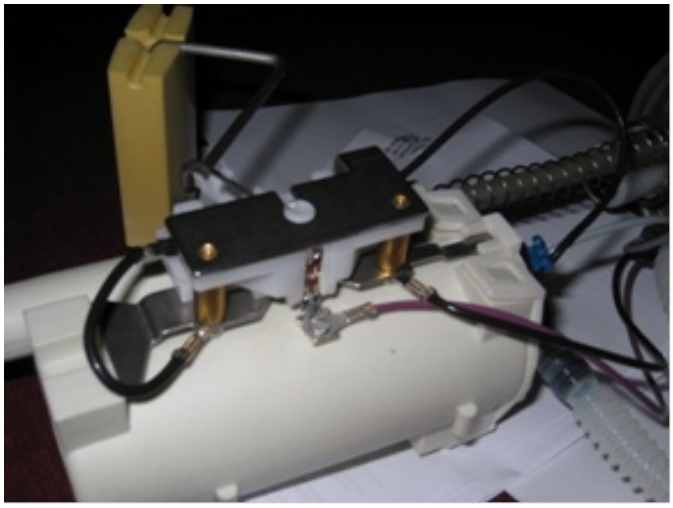
Checking "Full".

New Sending Unit

New Sending Unit part number ACD#FLS1072 GM#19179521 which is the part number to supersedes the original #25028955

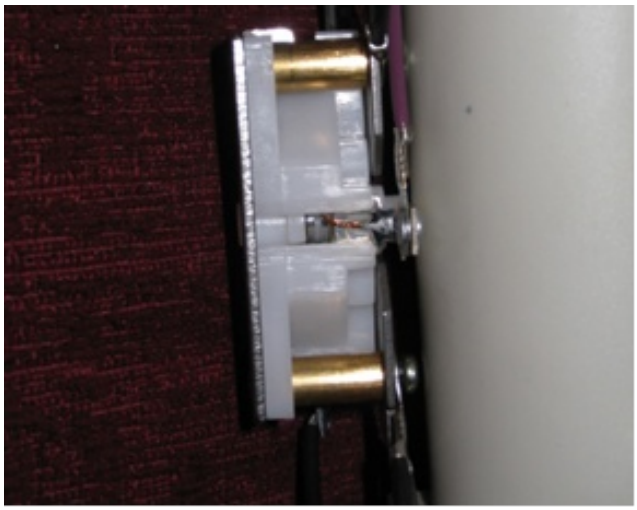
It looks like GM redesigned the sending unit, correcting everything that gave us issues with the old one.

The only contact that isn't well secured from varnish and corrosion is the one between the arm and resister and it appears to be self-cleaning. Below are a few pictures of the newer style fuel sender.

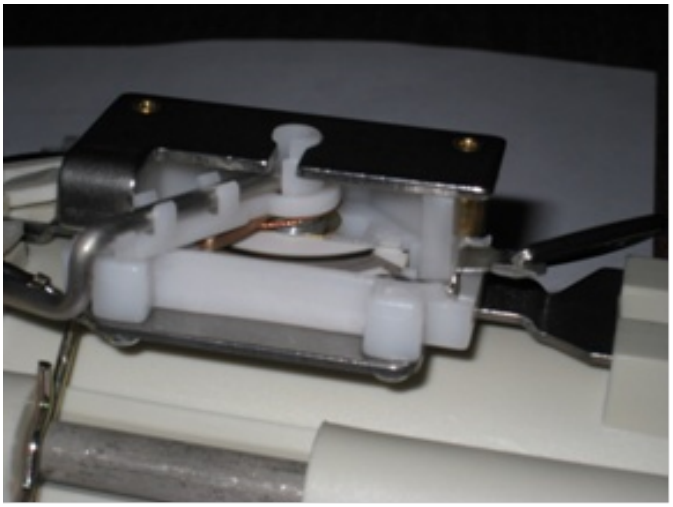


Newer style fuel sender.

A close up of the other side.



A nice side shot.



A view of the wiper.

General Maintenance

Air Filter Replacement

The air filter is located on the driver side of the engine compartment. Remove the two screws holding the air box lid in place and pull up, push down on the backside, and out to lift the lid. Pull out the filter and reinstall a new one.

Broken Window Roller Fix

Problem - The rear of your power window falls down out of the track or sags when the window rolls up. Any door can be guilty of this.

Solution - Replace both original "Rectangular" shaped window rollers with the newer style Round nylon rollers. It's nearly always the rear window slider that breaks, But If you really want to do this fix right, replace both Front and Rear sliders in the window track while the door panel is off!!! Rarely does the 3rd regulator arm slider break in the lower track.

Tools:

- *5/16" Drill bit*
- *2" C-Clamp*
- *Door pad plug tool*
- *Small flat screwdriver*
- *Short Stubby flat screwdriver*
- *Phillips screwdriver*
- *Channel lock pliers*
- *Hand rivet gun*
- *3/8" open end wrench (Only for Nut/Bolt hardware method)*
- *Bearing grease*
- *White spray lithium grease (Can)*
- *Blue painters tape*
- *Magnet tool (Just in case).*

Sample tools.

Materials:

- *Nylon Rollers (2) – GM #9666748 (Per door)*
- *Retainer Clips (4 or 5) – GM #10161510 (Per door)*

OR

Materials Optional:

- *Nylon Rollers (2) – Dorman part # 74444*
- *Aluminum rivets (6) - 3/16"*

OR

- *10-24 x 1/2" Bolts (6)*
- *10-24 "Nylon Insert" locking nuts (6)*

In this example, both sliders on the driver side door on a ‘95 Caprice. The process is similar on the other doors as well. Remember, these door panels, armrests and switch panels are fragile! So take your time and go easy on them when removing them!

Procedure:

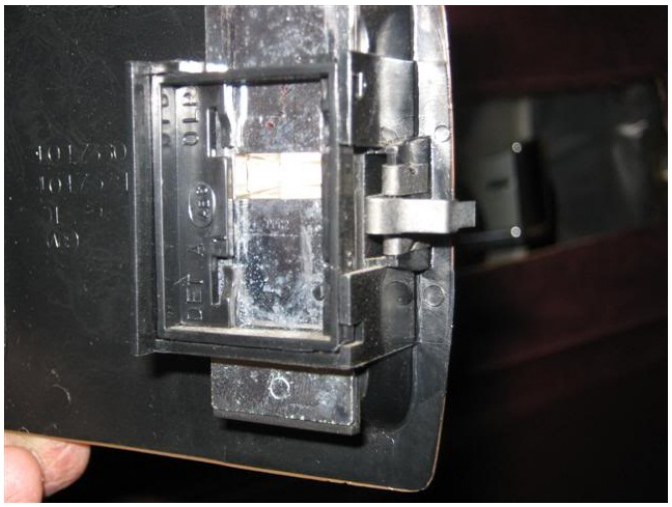
1. Remove the 2 screws that hold the armrest to the door, then gently lift the back of the armrest up a small amount and pull out and remove it.

Armrest screws

2. Remove the screw in the center of the door handle pocket (Behind the door handle).

Latch screw.

3. Then carefully insert a small flat screwdriver in either end of the pocket and press in on the clip that holds the pocket in, then pull out on the pocket until the clip clears the door panel. Repeat on the other end of the pocket, lift the pocket out and over the door handle. Watch out for the clips on the ends of the door bezels.



Door pocket clips on the ends.

Lower door panel screw.

4. Remove the Phillips screw in the door panel at the bottom of the back end of the door panel.

Typical door panel clip locations.These got a little hot!

5. Using a good door panel plug tool, locate the door panel plugs. The gently pull out in an area close to rear of the door panel, and pop out the 1st door panel plug with the tool. Repeat until all four door panel plugs are removed from the door.

   Now carefully grab the door panel near the top on both ends and lift up on the Rear of the door panel 1st until the inside seal comes out of the track, then lift up on the front end and gently work the door panel up and out of the doorframe.

Electrical connector for the window switch.

Remember, the window switch still needs to be disconnected before the door panel can be removed completely! Remove the electrical connector by pressing down on the light green tab, then pulling out on the connector (not the wire harness) to the window switch, while holding the switch in place in the door panel. Now remove the door panel.

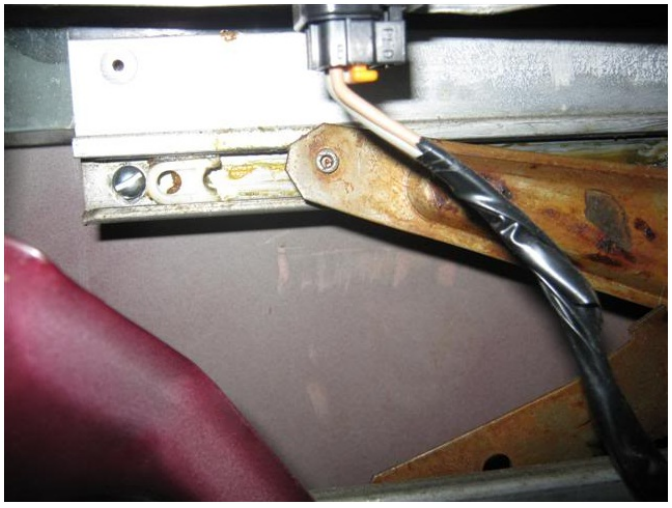
6. Now gently remove the plastic door paper from the inner door and set it aside. Remove the window switch from the door panel itself, then temp hook the switch back up to the wire harness connector. Key in the “On” position, slowly lower the window until you can see the broken slider at the rear of the window track thru the hole behind the armrest bracket.

Arm rest support.

› Note: Step 5 also involves removing the armrest bracket for greater access to the rear window roller area as explained below. This step is optional! Some people do it, some don’t. If you don’t intend to remove the armrest bracket....**Skip to step 7**

Stuff and old towel into the bottom of the inside of the door (To catch rivets and debris) and using a 5/16" drill bit.....Drill out just the center head of all 4 armrest bracket rivets, don’t go any deeper - all you want to do here is just remove the rivet head. Gently tap out the rivets, then remove the bracket and set aside.

7. Notice that the end of the track is crimped in slightly. These crimped in areas must be opened enough in order to get the old sliders out of the track, and the new round rollers in the track. Using a large flat stubby screwdriver, stick it in the rear of the track and pry open the crimped areas until the broken slider can be slid out and removed.

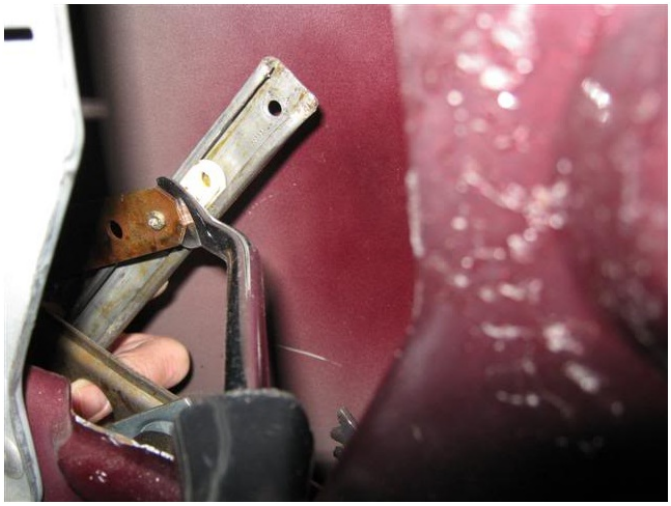


Crimped end and broken roller.

If you are replacing both front and rear sliders in the fix, then it is easier to drill out both rivets in the ends of window slider track using a 5/16" drill bit, and removing the track from the window and door itself. Do this after you have uncrimped the rear of the track. You will have to slowly raise/lower the window in order to gain access to the rivets. My vehicle had been fixed in the past on this window so they used nuts and bolts in the track instead of rivets for the fix.

Window supported by tape.

8. Once the two rivets have been drilled out of the track, get a roll of the "Blue Painters Tape" and by hand, lift the window up from the inside and outside of the door until it reaches the top, then tape the top of the window to the door frame to hold it up. Better to use the blue tape which comes off easier with no leftover adhesive like duct tape.



Popping out the ball stud.

9. Now you'll see that the track is free of the window, and ready to be removed from the door, but 1st you need to pop the remaining good slider out off the ball stud at the front. Use your door panel plug tool and carefully apply pressure to the slider until it pops out the ball stud. After closer inspection, the front slider had also already cracked in one spot, and needed to be replaced. Now guide the slider track out if the rear hole of the door.

Pressing in the ball stud into the new roller.

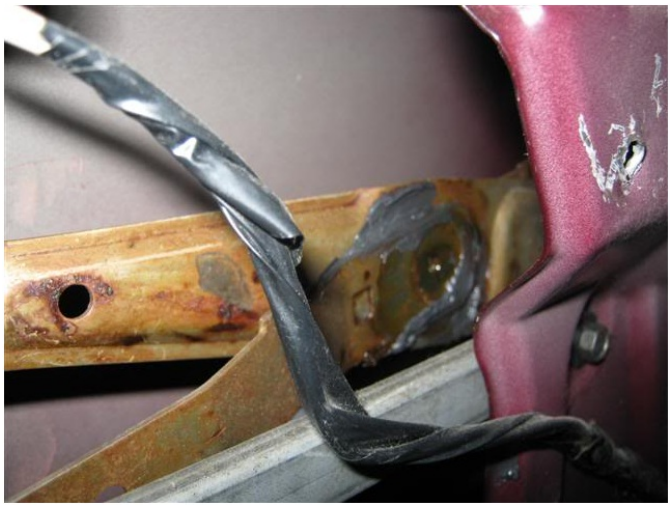
10. Now get some bearing grease and apply a small amount to the center holes of the new round rollers, then using a 2" C-Clamp, carefully align the C-Clamp, roller and ball stud of the rear regulator arm up, and slowly tighten the C-Clamp down until the roller pops onto the ball stud.

› If you are using the Dorman #74444 rollers you will need to drill them out using a 11/64" bit so they have the same inner diameter as the GM roller.

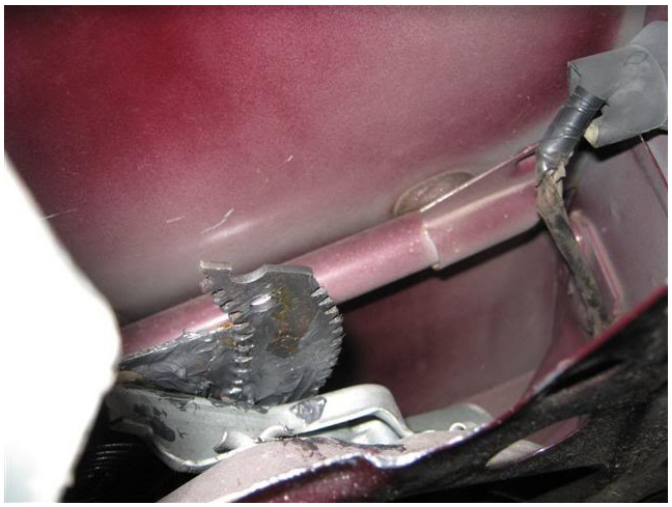
11. Repeat the process on the Front ball stud. This one is a bit harder, but can be accessed by "Carefully" lifting the regulator arm with the window switch toward the top of the door until you align the access hole in the picture below. The clamp will need to be slid into the inside of the door, but it will fit and work. Patience on this one!

Front ball stud is harder to get to.

12. Remove the old sliders from the slider track and wipe the track clean of any debris and old grease. Get your grease again and apply a thin new layer to the inside of the slider track where the rollers go. This is also a good time to lubricate the regulator sprocket and scissors arms area where they cross, and also grease the lower scissors arm track where the 3rd window door slider rides in. Also a good time to spray some white grease lubricant into the lock arm connections, face lock and lock mechanism parts that are on this inside of the rear door while the door panel is off! Any lock rods that were knocked off or adjustments needed to be made - Fix them now too!



Don't forget to lubricate the joints.



Lubricate the gears as well.

Aligning the holes.

13. Now insert your slider track back into the rear hole in the door, insert the rear round slider into the track, then guide the track thru the door and onto the front slider. If needed, the track can be rotated to get both sliders onto it, but if you opened both crimped ends of the track, you won't have to do this.

Pop rivets.

14. Once the track is back onto both sliders, carefully remove the Blue tape that holds the window up while holding the window in place so it won't fall! Now slowly lower the window until you can align the slider track back up with the holes in the window track. You'll likely have to slide the track left or right to line up the holes.

Screws and lock nuts.

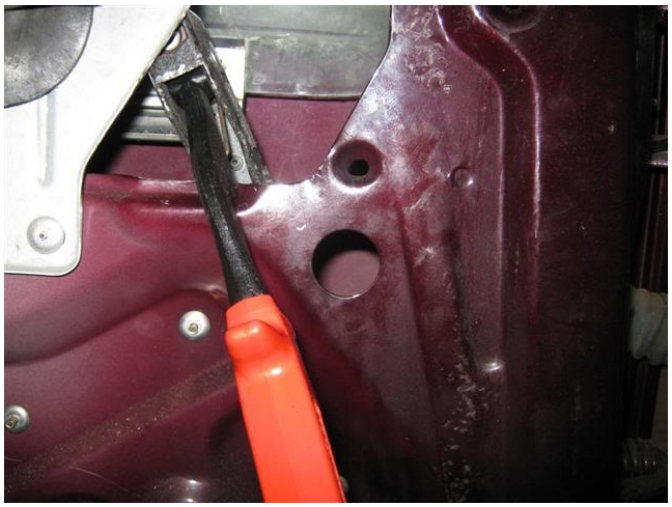
15. Now this part of the fix is your option. You can use 3/16" aluminum rivets to re-attach the slider track to the window frame, or you can use 10-24 x 1/2" Bolts and 10-24 "Nylon Insert" locking nuts for the job. This example used the rivets because they're a more permanent fix but, the locking nuts should work too. Do not use regular nuts they will come loose. Locking nuts are a must here if you aren't using rivets!

16. The rivets are kind of tough to get installed in the track, but you can get a hand riveter in both places in the door but you have to "slowly" adjust the window Up/Down to get the position just right to do it. Do the rear hole first if you are using rivets on this fix.

Rear rivet.

17. Once the Slider track is re-attached to the window frame at both ends, it's time to check your work and see if the new sliders are working and the window rolls up properly? If all is good, it's time to re-install the armrest bracket to the door. Again, you can use the 3/16" aluminum rivets or the 10-24 x 1/2" Bolts and 10-24 "Nylon Insert" locking nuts for the job. It's your call.

› Be sure that the window is in the rubber window track as well. You'll know its not if it doesn't roll up or down completely.



Front rivet.

18. After the bracket is back on, carefully remove the towel you stuck into the bottom of the door to catch any debris you may have dropped. Have a magnet or shop-vac handy in case you need it and DON'T leave any metal in the door that can rattle around while you're driving.

19. Now remove the window switch from the harness connector again. Time to re-apply the plastic door paper to the door. Some people think that you should use a hot glue gun and the clear glue, start at the top of the door and apply the whole top area 1st. It should be easy to tell where the plastic was before so just re-apply it. Once the top is in place, apply the rear area, then the front area. Now slide the electrical harness for the window switch thru the hole in the plastic, then glue the lower section down to the door

› Note: Some people use tape rather than glue to reapply the plastic. Again, it's your call but the glue works best and a more professional job.

20. The rest of the fix is basically reverse order: Install the window switch back into the door pad, Make sure ALL the door panel plugs are good and installed. A good idea is to use all NEW plugs because they keep the door panel tight on the door. Also, make sure the deadener carpet is still fixed to the door panel? If not, use the glue gun to stick it back on.

21. Get the door panel close to the door and then hook the electrical connector to the window switch back onto the switch. Carefully lift and tilt the top of the door pad window seal into the top door track, then install the pad back into the track, paying close attention that the door panel is fitted down in both ends of the door.
22. Now align the door panel plugs (1 at a time) and pop them back into their holes, then re-install the Phillips screw at the rear of the door panel.
23. Slide the door handle pocket back over the door handle, then pop the pocket back into the door panel and re-install the Phillips screw.
24. Re-Install the arm-rest and both Phillips screws that hold it on. You're done!

› Note: All doors are nearly the same process as in this example, but once you've done one door with no problems, the others will be easier.

Differential Oil Change

When changing the differential oil most people recommend against Synthetic lube with a limited slip differential (LSD) rear end. They say it's too slippery to allow posi to work right. Even the most diehard synthetic user use regular gear oil because of this. Check the option tag in the trunk, if it says G80 you have a LSD rear end and need to use quality gear oil but not synthetic and use the limited slip additive. If you don't have a LSD rear end, just use the lube of your choice synthetic is ok.

You can do this one of two ways:

1. Remove the cover w/ gasket replacement.
2. Siphon the fluid out by the filler hole.

Removing the Cover Technique:

Materials:

- *Differential oil 85W90 - Synthetic for NO Limited Slip Differential & conventional for positive traction*
- *New Felpro Gasket*
- *GM Slip Additive – Available from dealer for about $10*

Procedure:

1. Lift the car up on jack stands and chock the front wheels
2. Have a pan underneath the cover to catch the fluid, loosen the bolts by alternating the sides to prevent warping of the cover.
3. When all of the bolts are loose, but not out, pry an edge up and allow the fluid to drain.
4. Then remove the bolts and remove the cover.
5. Check to see what kind of gunk is at the bottom of the casing and inspect for any damaged parts.
6. Remove all of the old gasket from the cover and housing.
7. Reinstall the gasket and carefully replace the cover. Gradually tighten bolts to torque factory specs.
8. Remove the filler hole cap and add the "GM Slip Additive" then fill the differential with the recommended oil.
9. Replace the fill hole cap and you're done.

Using the Fill hole Technique:
Materials:

- *Differential oil 85W90 - Synthetic for NO Limited Slip Differential & conventional for positive traction*
- *Hand pump or siphoning tool*
- *GM Slip Additive – Available from dealer for about $10*

Procedure:

1. Lift the car up on jack stands and chock the front wheels
2. Remove the fill hole cover and insert the siphon tube and remove all the old fluid.
3. Fill the differential with the "GM Slip Additive" then fill the differential with the recommended oil.
4. Replace the fill hole cover and you're done.

Door Panel Removal

Tools:

- *Panel removal tool or large flathead screwdriver*
- *Phillips head screwdrivers, large and small*
- *Small flathead screwdriver*

Optional, but suggested:

- *Extra clips*
- *Stainless screws and finishing washers*
- *Patience*

Procedure:

1. Remove the window switch by prying the front end up and pulling it out, then disconnect the switch wire harnesses.
2. Pull the door handle, as if to open the door, and remove the small screw behind it, pry the plastic piece out, be VERY careful they tend to break by removing it this way. Its tricky getting it out due to the locking mechanism so be patient and careful! When it's out, disconnect the harness to the lock.
3. Next, remove the two large screws behind the caps on the gray pull strap.
4. Remove the two small screws in the armrest
5. Then remove the last two. One is at the bottom of the door panel under the storage pocket and the other is at the top of the storage pocket.
6. Now, pop out the clips. The removal tool is recommended BUT you can use a large flathead or drywall spatula but be careful, they tend to scratch the paint.
7. Work the clips out all around the panel, there are some in the middle of the panel too. If you break some clips don't worry, you can get them at a parts store.
8. To lift it off the door, pull gently upwards & out. You may need to pull the trim piece off the upper part of the door to get it completely off.
9. The reinstallation is the reverse but here are a few tips:

› Replace any clips that are broken or the feathers have come off. Go ahead and get a bunch, you will probably need them in the future!

› Take special care with the plastic, as I said before, they break very easy and they don't come cheap and junkyards have already been scavenged for them.

› For the small screws in the armrest, they tend to break through the gray vinyl. I used some stainless steel screws with a wide stainless finishing washer. It made a nice touch!

› The lock mechanism, be sure that it is aligned, locks and unlocks when you put it back on!

*The rear doors are essentially the same except you do not have power window switches except for one. It pries out easily.

Oil Change

Tools:

- *Jack and Jack Stands*
- *Oil Filter Wrench*
- *Oil pan or suitable container*

› You can go to the See Preferred Brands, Oils to determine your oil.

Ah, the old oil change. Well, if you don't know how to do this, then you're not a very mechanically inclined person and you may want to stick to labor charges.

Procedure:

1. Jack the vehicle up and place jack stands under the frame.
2. Remove the oil fill cap.
3. Remove the drain plug and let it empty into the oil pan.
4. Next remove the filter with an oil filter wrench and place it on its side or upside down so it can drain as much oil out as possible.
5. When installing the new oil filter most people use some of the old oil to lube the new filter seal. Go ahead and pour some fresh oil into the filter, this will help the engine regain oil pressure when cranking and not have to let it fill it up when you finish. Screw the filter on by hand and tighten a little, there's no need to wrench the sucker on, just make sure it's snug and not moving.
6. Reinstall the drain plug, lower the car and fill it up with new oil. Add four quarts and then check and add until you get in the crosshairs. Start the vehicle and let the oil flow for a few minutes. Double check the oil level and you're done. Please dispose of your oil properly.
7. Now reset your Change Oil light. It depends in the year how this is done.

Resetting the Change Oil Light

› 1994 – Open the fuse panel and find the yellow oil button. Turn the key to the "Run" position, but not running. Now hold down the yellow oil button for a few seconds. Turn ignition back to off. Now start the car, light should be out. Replace fuse panel cover.

› 1995-1996 – Turn the key to the "Run" position, but not running. Press the gas pedal three times within five seconds. You should see the "Change Oil Light" flash a few times and go out.

Oxygen Sensor Replacement

Oxygen Sensor replacement is recommended around every 100,000 miles. Although it is okay to change them whenever you want and they may go bad anyway. They will cause bad gas mileage, sluggish performance and build up due to reading the wrong fuel/air mixture. You cannot “rejuvenate” an O2 sensor or “clean” it. They will usually go bad during a season change.

For 1995 and before:

You have two O2 sensors, both in front of your catalytic converters. You will need an O2 socket or a wrench to remove them. It is good to replace them while the exhaust is still a little warm and spray them with a loosening agent i.e. PB Blaster, WD40. Sometimes they’re easy, sometimes they’re not.

For 1996:

Since a government mandate to help with emissions, the 1996 B-bodies along with all other automobiles will have O2 sensors after the catalytic converters.

You will have four O2 sensors since you are OBD II. Two are behind your catalytic converters and are useless except for emissions testing. If you do not have emissions testing in your state you can replace those with simulators. The other two are in front of your cats and, along with the PCM and a few other sensors control the entire fuel/air cycle of your car. You cannot replace those with anything other than real O2 sensors unless you want the car to run like crap. If you convert to OBD I you can leave out the rear O2 sensors entirely, not even simulators needed. Note: if you live in a state with emissions testing you will still have problems, as many states are moving to plugging into your PCM for 96 and newer cars and you'll fail if you have the OBD I conversion.

PCV Valve Replacement

The PCV valve, or Positive Crankcase Ventilation valve, is located on the driver’s side of the throttle body between the #3 and #5 fuel injectors (the ones in the middle). Many people tend to forget about this small valve, and it’s recommended to change it every 12 months to 12, 000 miles.

PCV Valve

The PCV Valve and Breather Element work together within the car’s emissions and ventilation systems. They serve as part of the emissions control system by re-circulating unburned gases and fumes back through the intake manifold to be re-burned. Therefore, these gases and vapors are not expelled through the exhaust system so air pollution is reduced.

Benefits of changing the PCV Valve:

- *Loss of power, oil dilution and even engine failure are avoided*
- *Oil life is extended and engine lubrication is improved*
- *Oil consumption, rough idle and air filter contamination are avoided*
- *Environmental pollution is reduced*

Transmission Fluid Change

This is a fluid many people don't remember to change. Rule of thumb is replacing fluid and filter around every 30,000 miles as per Shane Cobb "Dustman." at Carolina Performance Transmission.

Check the fluid while the car is running and at normal operating temperature. Make sure the fluid is pink/red and does not smell burnt. Even though the fluid is pink or red, does not mean that it is still good and this is where many people make the mistake of not changing it. It loses its viscosity and detergents over time and wears your transmission out. It will slowly deteriorate your clutch discs away. You will see the particles in the fluid, causing your transmission to slip. If this condition goes unnoticed for a prolonged period, changing it would NOT be a wise decision. Many people have their own theories about this and have a story of a car that had 300k miles on the same transmission fluid and after they changed it, everything was fine. This very well may be true, but you will hear more bad stories about this than good. Why else would transmission shops not change your fluid if they offer a guarantee? Such as AAMCO, they offer a guarantee that if they change your old transmission fluid, and then it croaks, they will fix it at no charge, BUT if they don't think it's a good idea, as in my situation, they won't. They looked at mine and said, "I don't think so, but in about 6,000 miles, come see me." Little did I know that I would be back in 6k miles slipping in overdrive. A lot of quick oil change franchises will not change it depending on the condition because they know about failure and have seen it happen. So, if you're in doubt, ask a professional, many places offer 50-60 inspections and if it checks out then they'll guarantee it. If not, start saving your money now and think T-56 manual replacement.

Tools:

- *Socket wrench*
- *Wide collection pan for fluid*
- *Rags*
- *Flat head screwdriver*
- *New filter and gasket*
- *Maybe some gasket seal*
- *Jack and Jack Stands*

Procedure:

1. Pull out the transmission dipstick about 6 inches to relieve pressure. Then raise the vehicle just as you would for an oil change. Support it and locate the transmission pan, .
2. Begin loosening the bolts around the edge of the transmission pan, but go in a crisscrossed pattern, loosening a little at a time. The pan is under pressure and you don't want to warp it in any way. Fluid will begin to seep out of the edges but don't worry.
3. After loosening the bolts a little, place your container under the pan and center it under a corner.
4. Now loosen the bolts more at that corner and use your flathead, gently, to pry the edge down and break the seal. Be sure not to mar the mating surfaces, which could cause a leak in the near future. You can loosen the remaining corners to allow it to drain more but it gets messier the more you loosen.
5. After the stream has become a trickle remove all the bolts and drop the pan.
6. Take that pan and clean it, **NO CLEANERS**, just use a clean lint free rag to wipe it off and clean the magnet thoroughly. The magnet collects loose debris and shavings so don't pick it off with your bare finger or you'll get metal splinters.
7. Clean off the entire old gasket from the pan and the surface of the tranny.
8. Now remove the old filter. Be easy on it, just twist it a little to break it loose and wiggle it as you pull

down gently. Now insert the new filter into the same hole.

9. Placing the gasket on can be a pain because it likes to move around and probably is deformed from being in the box. Some people use little stems that hold it in place by the bolt holes or it will stay in place if you use a sealant.
10. After you get a few bolts started, insert the rest to be sure you have everything lined up and the gasket isn't wrinkled or out of place.
11. Tighten the bolts to specs and **don't over tighten them**. The gasket will begin to squeeze out of the sides.
12. Pour about 4 quarts of fluid in the transmission. Lower the vehicle and crank it up. Move the shift lever through all of the gears a few times and let the run warm up.
13. Check the fluid while the car is running and slowly add fluid until the right level is obtained.

Modifications

Basic Modifications

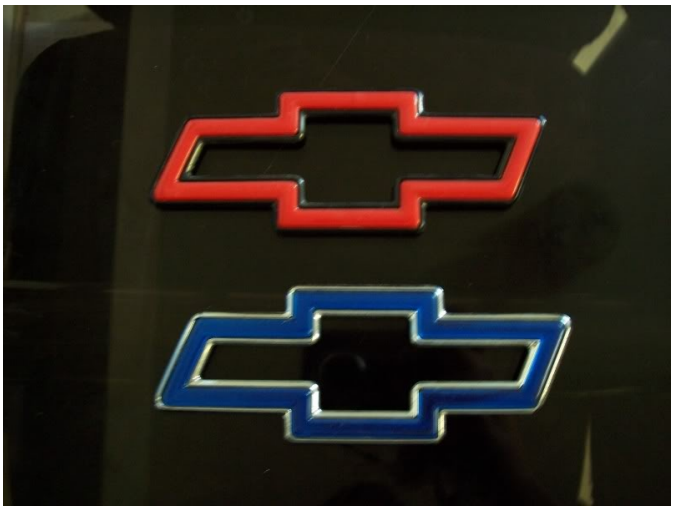
Bow Tie Install

Many people do not like the standard silver bow tie on the SS grill so many have chosen to go with a red one. You can buy the red bowtie a few websites or even form the dealer. Part numbers can be found in the part number section.

Procedure:

1. Lift the hood and look at the backside of the grill.
2. There is a hole behind the original bow tie. Use a rod or screwdriver to press the old bow tie out. It is stuck in place by two sided tape so push slowly while applying back pressure to the grill for leverage and this will also keep you power freaks from cracking the grill mounts.
3. Once you break a section loose, you can go back to the front of the grille and remove the rest with fishing line, using it like a saw, or a flathead screwdriver to pry it out.
4. After it is out, clean the surface and remove any of the old adhesive tape. Now install your new bowtie, stand back, and enjoy.

Stock bow tie.



Red and blue bow ties.

Throttle Body Bypass

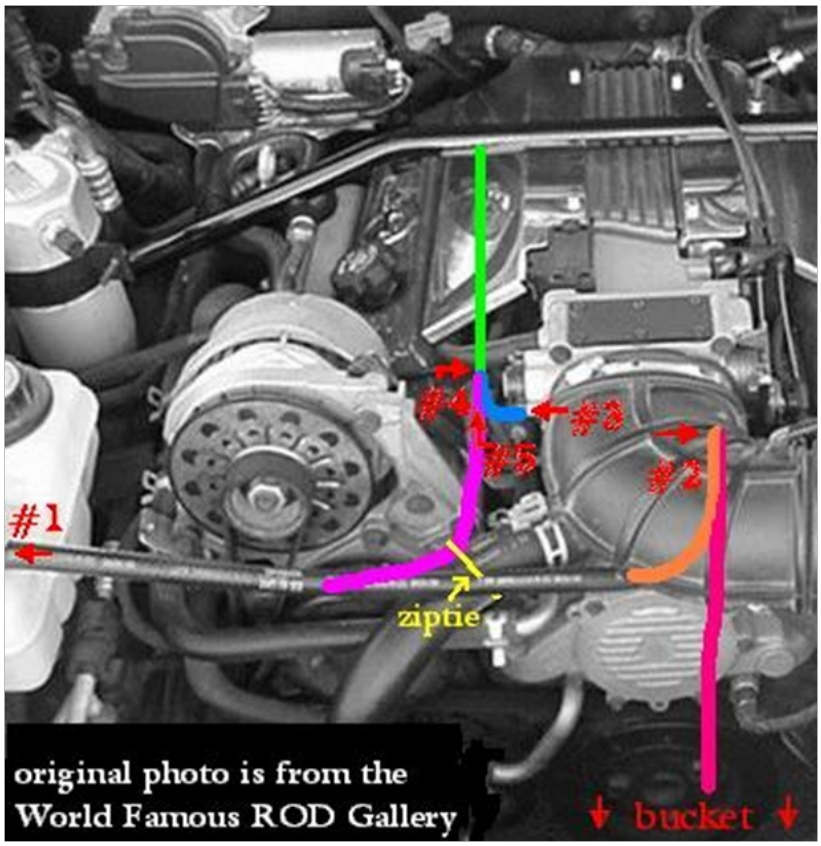
Here is the way most people suggest doing the Throttle-Body Bypass on a 94+ B-body LT1 & L99.(Instructions might be a little different on a '94, and the process might work on F-body and Corvette LT1)

Tools:

- *Socket wrench*
- *Flat head screwdriver*
- *pairs of pliers*
- *door panel removal tool (will also help whenever you remove one of your door panels)*
- *small clean bucket*
- *sharp knife or scissors*

Materials:

- *Spare rags*
- *1 ziptie (optional)*
- *2 caps (rubber from hardware store or billet from AutoCandy.com)*
- *A few feet of 7/16" ID rubber hose (fuel line) from a hardware store (optional)*



Simple image of bypass.

Now would be a good time to put in a 160 deg Thermostat and flush the system. Many people recommend using regular Anti-freeze (the green stuff) instead of the Dex-Cool that General Motors suggests. If you do decide to use Dex-Cool again, DO NOT PUT IN THE CLAY TABLETS! They will most likely dirty up the coolant and might even clog your heater core.

Preparation:

Turn the engine off and let it cool for a while before beginning. Leave off until finished. This will help to keep you from being injured, and the coolant will not be flowing. Put the bucket below the water pump (as indicated in the picture) Put spare rags on the intake manifold (or Home Plate) and stuff one under the small rubber elbow (blue) that connects the metal pipe (green) to the throttle-body.

Procedure:

1. Unscrew the screw-type hose clamp from the coolant resevoir. Remove the overflow hose and carefully lower the end into the bucket (as shown in pink). Coolant will probably begin spilling out of it. This should not last but a few moments. Reconnect the hose to the coolant tank and tighten the screw clamp.
2. Unscrew the screw-type hose clamp from the throttle-body side of the hose (orange). Disconnect the overflow hose, and move it to the metal pipe (green). Decide how much of the stock hose you want to trim off (just a few inches) and cut it. Remember: measure twice, cut once. You do not want the hose to hit the alternator or serpentine belt, so don't cut too much. Then reconnect the small length of hose that you cut to the throttle-body. This should keep any more coolant from falling on the water pump and Opti-spark. Let the long length of overflow hose from the coolant tank hang down out of the way. There should

no longer be coolant in it, so you should not have any problems.

3. Using the door panel remover, disconnect the rubber elbow (blue) from the throttle-body.
4. Get the two pairs of pliers. Use one to rotate the rubber hose (blue) and the other to rotate the clamp until you can see the ends of the spring clips holding the tube on the long metal pipe (green) that runs from the rear of the engine to the front between the valve cover and the intake manifold. Move the spring clip inward (away from the end of the hose) by squeezing the clip with the pliers. Then slide the hose off the pipe (green).
5. Take the long length of overflow hose (purple) from Step 2 and attach the unconnected end (the end that you previously cut) to the metal pipe (green). Use the screw clamp from the front of the throttle-body (also in Step 2) to hold it together. You might decide to use a zip tie (yellow) to attach it to the larger heater hose so it doesn't move around too much.
6. Start the car and let it run for a few minutes to make sure everything is connected properly. Double-check all the connections and clamps.

› If you do not decide to switch anti-freeze, or flush the system, you will need to add some more anti-freeze to compensate for the amount that you lost. Fill the tank to the appropriate marker on the reservoir. Bleed the system as it says in the Factory Service Manual or See Bleeding the System.

Electrical

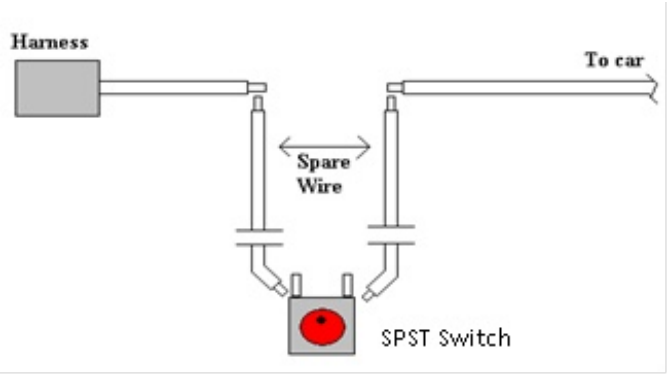
Antenna Switch

This is a good idea if you still have the stock radio and you want to lower the antenna while listening to CD's. You can put the switch in almost in location. Some people have mounted them in the coin holder, in the ashtray, or anywhere else, you can imagine.

Materials:

- *One SPST contacts Rocker Switch, toggle or slider, from Radio Shack Digi-key, Mouser or many others.*
- *Some extra wire of similar gauge*

Use the removal instructions from www.installdr.com



Sample switch schematic

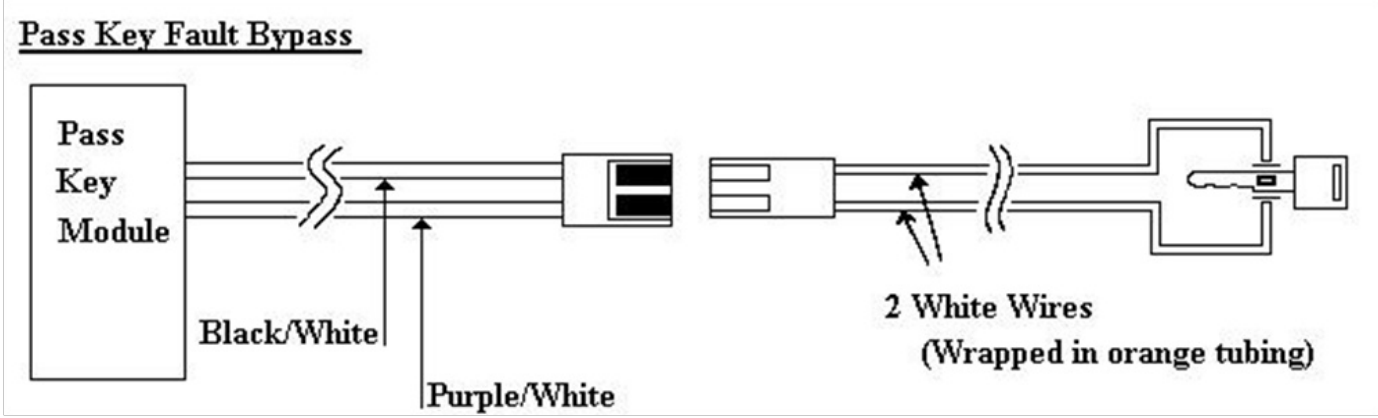
Procedure:

1. Begin by removing your ashtray and the lower dash.
2. Pull out the radio by removing the four screws that hold it in and unplug the two harnesses and antenna wire.
3. Select where you want your switch to go and drill a hole but don't mount it yet. Just test fit it.
4. Find the Antenna wire in the #8 position of the biggest harness. Schematics say pink but it could be green.
5. Tap into this wire and solder in a piece of your spare wire to each end that was just cut.
6. Now slide your wires through the ashtray slot and allow them to dangle.
7. Re-install the radio and lower dash, just snap it in place for now. There's no need to completely re-install it yet.
8. Position the ashtray and route your wires making note of the route you are going to take. It is very easy to place the wires where they are in the way of the ashtray closing.
9. Now solder some short wires, about 12 inches, to your switch terminals.
10. Install the switch into wherever you are going to put it, like the ashtray for example.
11. With your route set and switch in place. Mate your loose wires. Just twist them together at first to make sure it works.
12. Turn on the radio and see if it works. If it works, shorten your wires to a decent length, connect them and re-install everything.

Notes:

› It's recommended that you use connectors just in case you need to take things apart later.

Pass Key Fault Disable



Materials:

- *One or more resistors to match your key*
- *Two pieces of heat sink tubing sized for each wire, about ¾" long*
- *One piece of heat shrink tubing to cover the whole assembly*

Procedure:

1. Use a voltmeter to read the ohmage of the chip in your key. Do this by placing one lead on one side and the other lead on other side of the chip.
2. After determining your ohm rating, get a resistor(s) that equal the ohm you need. Ex: If your key measures 1.1 kilo ohm get a 1 K resistor and a 100 ohm resistor.
3. If you only need one resistor, go on to step 4. If you need multiple resistors, tie the resistors together as a chain link. DO NOT lay them side by side and twist together. A little solder will help hold these together.
4. Unplug the harness (above) located under the steering column. Insert one end of the resistor chain into one hole of the [purple/white & black/white] harness leading to the module. Then plug the other end into the other hole. The snugness of these wires may not be sufficient so hold them in place with some electrical tape temporarily.
5. Insert you key and attempt to start your engine.

If it works:

The car will crank and the Pass Key Fault LED will go out. It is suggested that you fully solder the connection then cover the connections with heat shrink tubing and shrink in place. Next, apply heat shrink tubing to the assembly and shrink the tubing in place. Be sure not allow them to touch each other with the exception of the solder spot. Next, you should zip-tie the wires out of the way so that they aren't snagged by anything else. After you do this be sure it still works and that you haven't altered anything in the process of cleaning up.

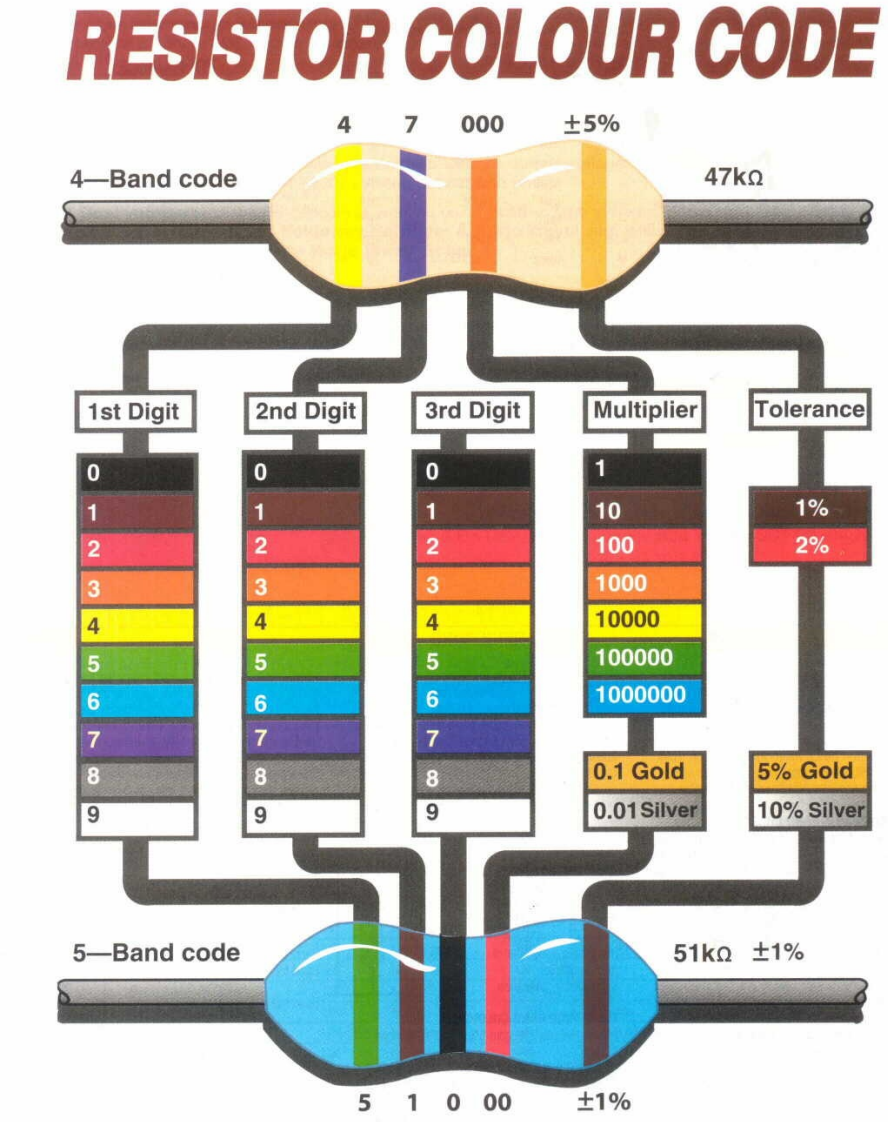
If it doesn't work:

The car will not crank and the Pass Key Fault LED will blink repeatedly or will stay on. If it blinks repeatedly, you are not getting a connection. Get a second hand to turn the key while you hold your resistors in place. Keep trying until it works or the LED at least stays on even though the car may not crank.

If getting an extra hand to help works, see above and finish cleaning up. If not, be sure your voltmeter is working properly (if you have one with a needle, make sure it is set at 0 with your adjustment knob) and then double-check the your ohmage from the chip in your key. Repeat procedure.

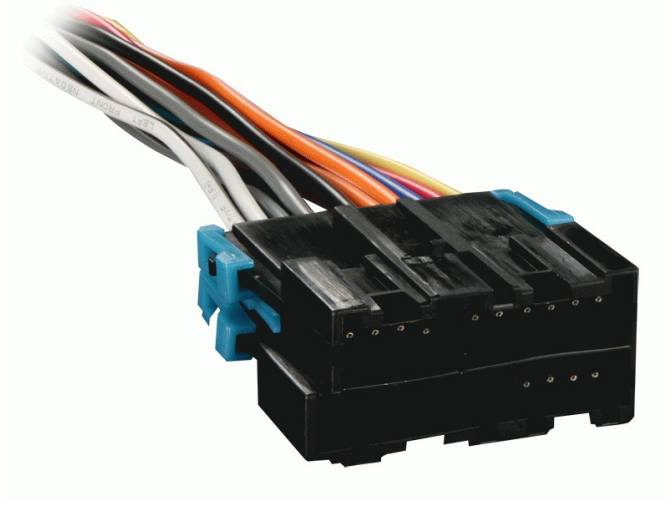
Notes:

- By chance, the car cranks but the LED stays on. It is because your ohms are slightly off. In other words, it is sensing that your key chip is losing its luster and that you need a new one but it's going to crank anyways. You don't need a new key, but you do need to recheck your ohms and repeat the process.
- Although the module has been disabled, you cannot crank the car with a key that does not have the chip in it.
- Here is a chart to help you decipher the color code on resistors.



Radio Wiring Chart

Metra 71-1858, wiring harness side. (Receptacle)



Metra 70-1858, radio harness side. (Plug)

10	9	8	7	6	5	4	3	2	1
20	19	18	17	-	-	-	-	-	-

Harness side pin out.

1	2	3	4	5	6	7	8	9	10
-	-	-	-	-	-	17	18	19	20

Radio side pin out.

Slot:	Color:	Purpose:	Slot:	Color:	Purpose:
1	Lt Gray	Left Front Speaker (Neg.)	8	Pink (Green)	Antenna Power
2	Tan	Left Front Speaker (Pos.)	9	Yellow	Ignition 12v switched
3	Lt Green	Right Front Speaker (Neg.)	10	Orange	12v constant battery
4	Dk Green	Right Front Speaker (Pos.)	17	Lt Blue	Right Rear Speaker (Neg.)
5	Black	Ground	18	Dk Blue	Right Rear Speaker (Pos.)
6	N/A	Not Used	19	Yellow	Left Rear Speaker (Neg.)
7	Gray	Illumination Dimmer Control	20	Brown	Left Rear Speaker (Pos.)

Tachometer

Advantages

Installing the tachometer allows you to monitor engine RPM, a feature that is sorely missed by some 94-95 owners. Other gauges can be installed in '96 models to monitor oil pressure or voltage levels.

Disadvantages

You have to install a non-factory gauge in the interior of the car. It requires some cutting of (replaceable) interior pieces.

Materials:

- *Replacement black dashboard instrument cluster bezel (P/N ???). Optional, but good insurance. About $15.*
- *A 2 1/16" tachometer. No matter what you get, make sure it is at most 2 1/16" wide and no deeper than 3 1/2".*
- *18 gauge wire and a length of black ribbed wiring conduit. About $5.*
- *Soldering iron or some other method of splicing.*

Procedure:

1. Remove the black bezel surrounding the instrument cluster by removing the two bolts at the top of it and pulling it back away from the dash. There are three clips at the bottom in the back and two guide posts. Be careful with the rubber ring that goes around the steering column as it is held on by some flimsy plastic rivets and cannot be reattached easily.
2. The tachometer will go in the right hand side of the black plastic in the bezel to avoid interference with the turn signal and tilt levers and to allow the sacrifice of one of the two clips on the right if need be (the left has but one). If you're careful, you can keep both of them. It will need to rest on or near the point where the smooth grey plastic ends and the molded grey plastic for the rest of the dash begins. Using the tabs and holes as a reference, find where the center of the tachometer should be if it would rest about 1/8" above the lip and mark the spot on the back of the bezel.
3. Using a 2" hole saw and starting from the back of the bezel, cut out the hole for the tachometer. If you screw it up, don't worry: the bezel is only $15 and you can always try again.
4. Trial fit the tachometer. If it doesn't fit, work around the exterior of the hole with an Exacto knife until it does. Don't cut too much: it should fit tightly.
5. Cut an identical 2" hole out of the grey plastic behind the bezel. You can re-insert the bezel and use it as a guide. The tachometer will angle downward slightly, so take this into account.
6. Again, trial fit the tachometer. You may need to cut into the two slots for the clips. Make sure the tachometer fits in below the clear instrument cover and does not bind. It'll be tight but it will fit. Keep trimming the grey plastic until it does. Repeat ad nauseum. You might need to cut into one of the rectangular holes for the clips to make it fit.
7. Once it fits in well, make sure the wires are routed so that they'll dangle into the are below the instrument panel and replace the bezel.
8. Remove the access panel below the steering wheel by removing the two screws on the bottom of it. Then remove the steel plate behind it by removing the four bolts and pulling it to the right. The wires for the tachometer should be dangling down there, or at least accessible from there. Installing a four-way connector here would be a good idea in case you ever need to remove the tachometer.
9. Tap in a "dimming" or "lights on" signal. The ashtray has both dimming lead and a ground wire going to its light. The wires are also free enough to work with. The grey wire is the dimming wire, and the black wire is the ground.
10. To get power to the tachometer, you might want to tap into one of the orange wires at the bottom of the fuse box. Check the Helm's manuals for details: you want one that is only hot during run.
11. To get the actual tachometer lead hooked up, you need to route it through the firewall using a factory, unused grommet. Look behind the LH wheel well. There is an oval, rubber piece there. Now remove the LH kick panel and look near the point where the hood latch cable exits. If you pull back the insulation, you'll see the same grommet. Use a sharp point to poke a hole in the plug in the firewall, and then squeeze the 18 gauge wire through it. You might have to fish it through using a coat hanger or something.
12. The tachometer can take its signal from the black and white wire (negative) terminal at the coil pack on the front of the LH cylinder head. Alternatively, another member has plugged the lead into fourth, unused female terminal on the coil. The both go to the same spot.
13. Another good place to get a tachometer signal would be from the PCM connector pin A13. All B/F-car PCMs output the tachometer signal on this pin. You will need a terminal p/n 12084913 (for 20 ga. wire) to install in the PCM A connector (the factory uses a white wire for this application).
14. The wires should be inserted inside of factory wire loom. You can cut a short length and route to one of the factory conduits from the firewall grommet, or route a new conduit all the way to the coil pack."

Tail Light, Add Center Brake Light

Tools:

- *Adjustable speed Dremel tool with following bit(s);*
- *Dremel #194, 1/8" barrel cutting bit.*
- *Sanding drum with #408 (60 grit) sanding bands.*
- *Rubbing alcohol in spray bottle (or sprayer attached)*
- *Green Scotch-Brite cleaning/soap sponges (Example: 3M Rescue II Soap Pad)*

Parts:

- *2x GM RA deep socket or equivalent (CalTerm #08583 or Conduct-Tite! #85867)*
- *2x 10 Ga. aluminum socket machined disc (May have to make your own)*
- *Loctite # 410 Industrial adhesive*
- *Loctite # 712 Adhesive accelerator*
- *2x Double-seal rubber socket O-rings*

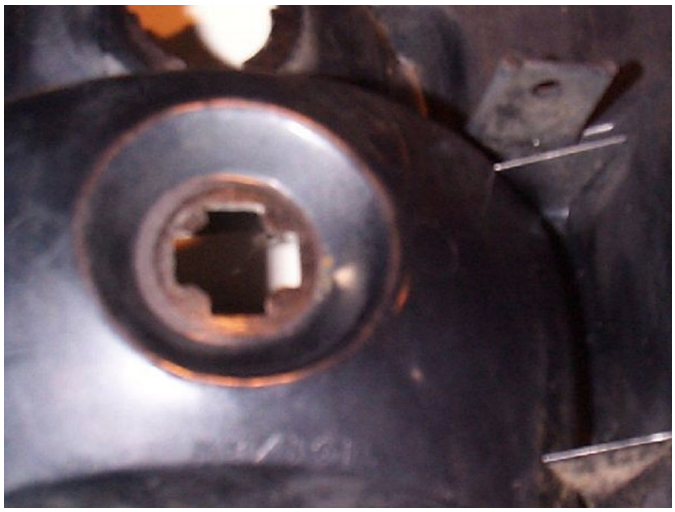
There are TWO basic ways to install the socket templates to fix the "focus" problem upon modification of the center parking light to a standard dual filament brake/turn signal light. One is quick and partially successful and one more time consuming and by far the best solution.

- ***Better / Quick:*** *Drill out the center parking light square/cross style parking light socket to 1-1/8" hole to accommodate 2057 type bulb size. Mount socket plate on back of bucket by centering and aligning the plate with socket/bulb in place and applying adhesive along back of plate to affix it to the rear of bucket.*

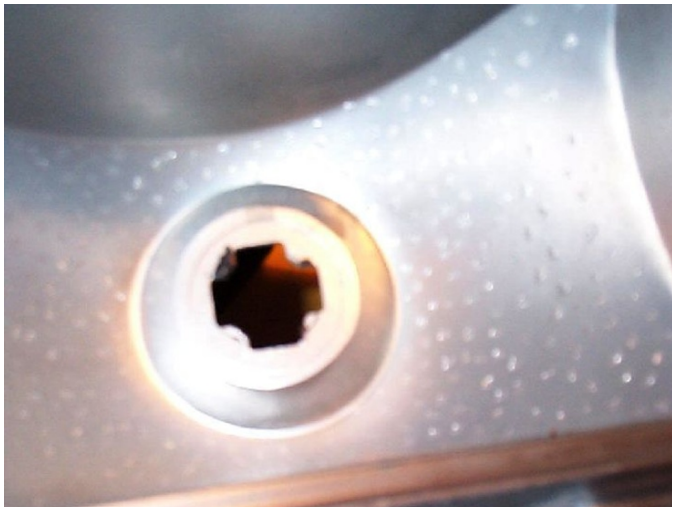
- ***Best / Time Consuming:*** *Remove red lens cover and using Dremel tool at MEDIUM speed, completely remove the center "indented" section of the bucket and attach socket adapter plate to back of bucket, while sealing both the back outside and center inside areas.*

› The latter procedure is best as it will yield the "best" results as you want the indented surface area of the bucket to be removed to allow the best and closest matching reflective properties similar to the other to associated brake/turn signal lamps.

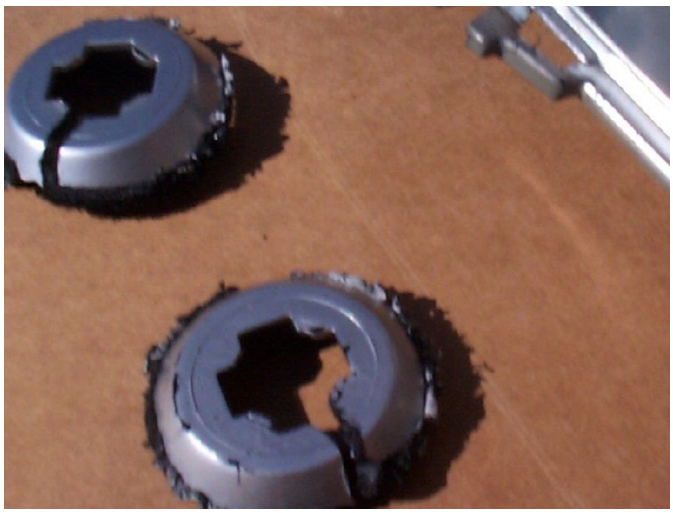
Parts/supplies used in the LBM for correct light focus.



Rear view of indented area.



Outer view of indented area.

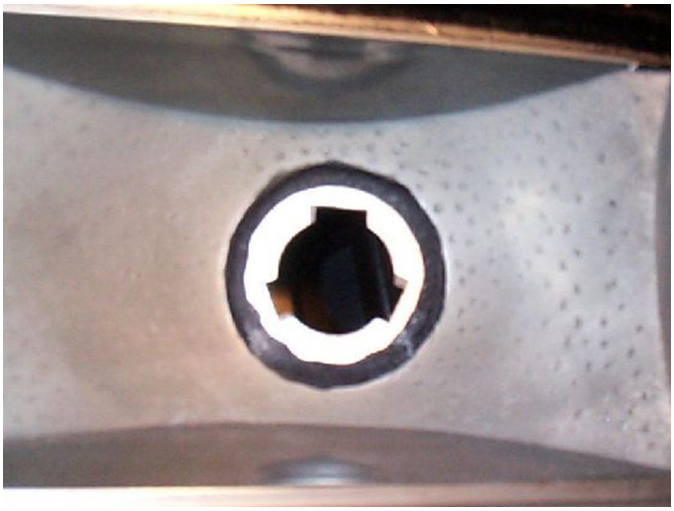


Scrap pieces.

Best Procedure:

1. After removing the red lens filter and sticky adhesive, turn the bucket facing up and note that the center bucket area has a distinct line at the "transition" to the raised center section. Use this line as a guide while cutting out the indented portion. Cut to the inside, closest to center leaving the line visible for reference. Note in the pictures, the back and front of the section to be removed.
2. With the bucket facing up and using the adjustable speed Dremel tool with the 1/8" barrel cutting bit, set the speed to a little faster than "mid-range". High cutting speeds will melt the plastic making it hard to guide and cut smoothly, and to low a speed will create a lot of black plastic powder making it hard to see to cut straight.
3. Cut from the inside of the cross straight out to the edge, but just short of the transition line. Leave the line visible as a guide and it will be used later while sanding. Cut along the line at a 45 degree angle as to have most of the edge facing the inside of the bucket. By holding the tool at this angle you will see how to cut easier and we will have more bucket edge to apply adhesive to on the inside for a stronger final assembly.
4. With a little trial and error, you will find the right speed and cutting pressure to yield a clean smooth cut, and you might want to have a set of ear-plugs handy as hitting some harmonics while cutting may make the bucket ring with a loud annoying high pitched rattle. This is normal and caused by high speed cutting. This also occurs at the correct cutting speed/pressure.
5. Once you have positioned the bucket. While cutting the middle raised section out, slowly rotate the bucket to keep true to the transition line. Take your time and keep steady even pressure and if you attempt to go to fast you'll melt the plastic! You will be forced to stop and clean out the cutting track to be able to proceed!
6. Once complete, you should have a nice round circle cut out with about 1/8" of the black plastic housing edge showing and a sharp clean edge on the back of the bucket.

7. Take the Dremel and using a medium grade sanding barrel and lightly sand the inside to very edge of the transition line to get a smooth surface around the inside. Clean up all sanding dust and use rubbing alcohol to wipe it down.
8. Take the aluminum socket template and note that one side will have the word “BACK” on it. Place the plate over the rear hole while looking from the inside and note the large key cutout position. Center the socket hole in the middle of the bucket and set the large key to the exact same position as the other two sockets on either side.
9. Tape the back of the socket plate to the bucket with electrical or duct tape so that it stays in the correct position or orientation and apply a bead of 410 adhesive about the inside of the bucket on the black edge to the plate. You only need about 1/4" bead here and as soon as you complete the circle, spray the adhesive with the accelerator to cover the adhesive, using more will only waste the 712.
10. Let the center cure for about 15-20 minutes before removing the tape. You will note that the accelerator will cause the adhesive to turn white, but this is easily cleaned off with rubbing alcohol sprayed on it and an old tooth brush to loosen it to be wiped off with a clean dry cotton rag/cloth.
11. Once the inside has been done and dried, you slowly remove the tape off the back while holding the socket plate. Now you can run a bead of adhesive about the outside of the socket plate and the area at the edge to fill the GAP to the bucket. The plates are slightly oversized to allow the adhesive to be used to fill up this area and provide more surface for adhesion.
12. Once you have done the basic mounting, you now go back with one or two more light layers of 410 to "build up" adhesive to complete the final assembly. Don’t use accelerator here as you want a nice "smooth" clean finish. Set the bucket aside to dry overnight for final strength. When done, you will have a very strong assembly and it will look much like the other two buckets. Note the pictures below of the adhesive rear finished assembly.



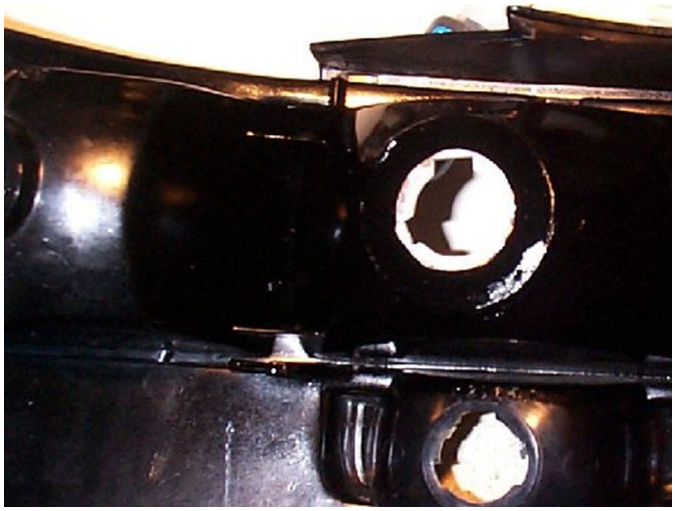
Cutout location.

Locking ring glued in place.

Side view of the locking ring in place.

Exposed areas masked off prior to painting.

Bucket now ready for next stage of modification.



Bucket now ready for next stage of modification.

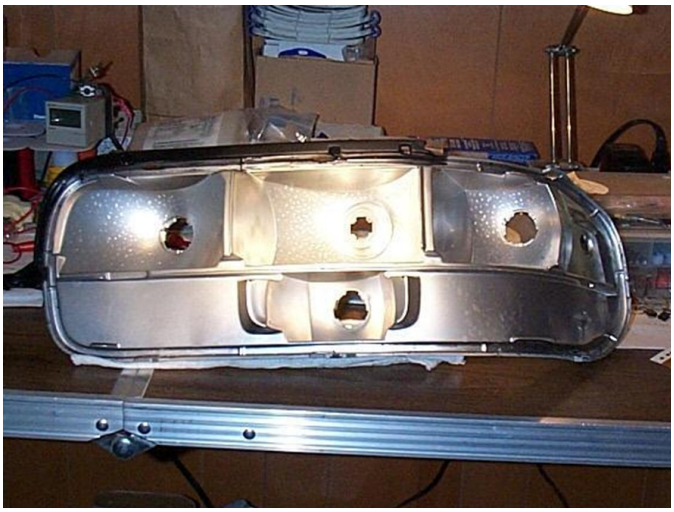
13. If you do not plan on installing reflective film(s), you will need to cover the inside area of the bucket in reflective type aluminum spray paint to cover the black adhesive. Once two or three "light coats" are sprayed over the inside, it will look and reflect light like the other two associated bulb reflectors sections.
14. To complete the socket installation, mask off and paint the rear reflector housing and use a good quality gloss black spray paint to cover the adhesive and exposed aluminum of the socket plate. Note the following pictures.

When installed, you will have to press down firmly while rotating the socket to its correct position. Look closely at the other two brake socket backs when installing the bucket and set the center one to the "exact" same position. This again is very important here to have the bulb filaments vertical in the reflector housing.

When completed, the combination of the socket plate and new deep type socket will now match the focus characteristics of the other two brake/turn signal lights making them all match in pattern and brightness. Dreaded Dim bulb effect is now eliminated!

Tail Light, Lens Bucket Modification

A viable way to squeeze more light power out of the rear light system is to improve the reflective and focus properties of the lens reflector assembly (buckets). The red plastic lens can be separated from the bucket assembly by removing the red lens. It is not permanently sealed as a black rubbery putty is used along with a few plastic tab clips to hold the assembly together. Using a small flat knife, you can easily able to separate the lens from the bucket and remove the old sealant and clean up the joining channels for later reassembly. Once separated the assemblies you will be disappointed in the overall quality and construction of the reflectors. Silver reflective paint sprayed over the plastic reflectors with small star impressed dimples for refraction is all that is in there. The paint can literally be wiped off with your fingers and did not have very good "reflective" properties on direct visual inspection. Below are some basic pictures of the before and after on a reflector bucket.



Junky factory silver paint.

You can plainly see silver spray paint that does not reflect light all that well (even with a flash here) and a small strip of aluminum separating the bottom backup light housing. The silver paint will come off readily and easily with a rag and some Isopropyl alcohol. Also note the different sizes, directions and angles that the three brake/turn signal bulb bucket housing were focused or aimed. Filament position also plays a role in the lamp reflector efficiency. Below is an "after" picture with the Chrome/Mylar mirror reflector tape installed.

Chrome / Mylar tape applied.

The mirror reflective tape used in this write-up is made by 3M and comes in various sizes and rolls. Different thicknesses were used to follow the molded bucket as closely as possible and temperature resistance is important here as well.

Depending on what your pocket book can stand look for the reflective tape at 50-80°C ratings.

Outside shot of the same lens bucket getting ready to have the red filter lens placed back on it.

Outside shot of a finished bucket.

Tail Light, Light Bulbs

Light Measurements?

Watts are not light. Watts are used to measure electrical power and in lighting systems is used in conjunction with a term called Efficacy. Efficacy = Lumens/Watts for a ratio of light output to electrical power input. This measures how efficient a system is as to how much power is consumes. Different types of light use different amounts of power and have different costs to operate.

› Quantity of light is measured in Lumens, Footcandles, and Candlepower.
Lumen: Measure of Light Flux or "volume".
Footcandles: Density of Light Striking a Surface (level of illumination)
Candlepower: Intensity of Light

Power Output/Footcandle test results:

The following bulb and lens assembly lumen power survey was conducted using a General Electric Model 214 (color and cosine corrected) light meter with direct measurement readout in footcandles. Reflector upgrade was accomplished using hi-grade chrome/mylar reflector tape used for industrial photocell detector applications.

Stanley #3496 LENS OUTPUT measurements in Footcandles
Before bucket MOD:

Output in Footcandles	Outboard	Driver Middle	Inboard	Inboard	Passenger Middle	Outboard
Parking Light	50	50	50	50	50	50
Brake Light	220	195	240	240	190	215
		Backup			Backup	
Stock # 2057		750			750	
Krypton #3496		940			930	

After bucket MOD:

Output in Footcandles	Outboard	Driver Middle	Inboard	Inboard	Passenger Middle	Outboard
Parking Light	60	75	60	65	75	60
Brake Light	280	300	300	300	300	275
		Backup			Backup	
Stock # 2057		900			910	
Krypton #3496		1000			1000	

Approximate average CP upgrade in performance

[Stock reflector bucket]

1 Brake filament from 2057 to #3496 is 30%

2 Parking filament from 2057 to #3496 is 50%

[Modified reflector bucket]

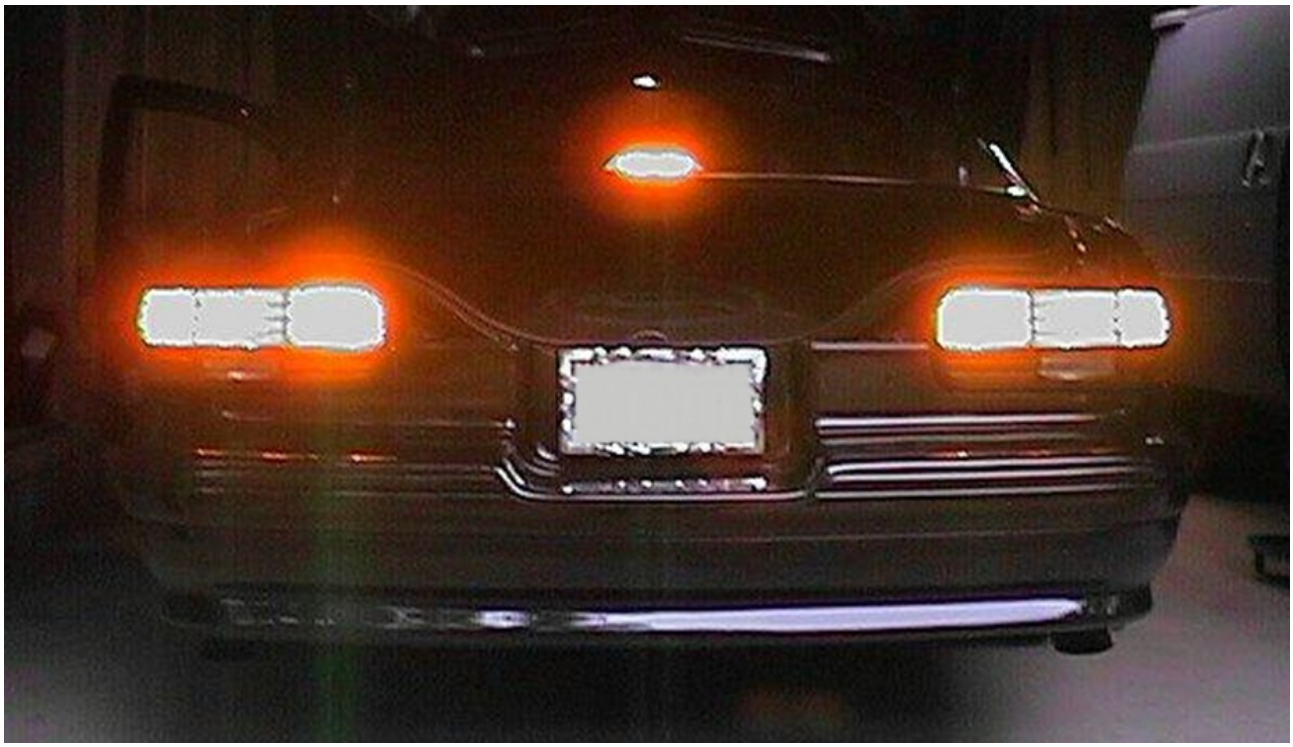
1 Brake filament using #3496 is 'additional' 34% with most improvement in center lamp bucket output.

2 Park filament using #3496 is 'additional' 20% with most improvements in center lamp bucket output.

3 Smallest increase was on outside lens bucket(s) due to smaller physical size reflector.

So, in short, you get more candlepower output for close to the same wattage used on upgrading to #3496, but when "combined" with reflector upgrade as well you get another 30% increase with much brighter (+100%) backup lights and center bulb output. Rear lamps appear to display multi-faceted lens characteristics as opposed to solid 'dull' lamp illumination. This look is considerably more eye appealing and distinct. Backup light output displayed the most of all with a whopping 100% improvement!

You can now get the "halogen" hi-power bulb look without the problems of wiring harness, brake switch, turn signal switch ratings and overheating sockets. Now, it will take some patience and a few hours to do the whole job. One of the interesting "side effects" is the viably appealing "jeweled" effect provided by the internal red lens itself. This is near invisible using the stock reflectors but when enhanced to focus the bulbs better the refraction through the red lens now looks like it has facets or a jeweled effect!



Exhaust

Exhaust Science Demystified

The fact is most cars are leaving horsepower on the table. We show you how to get it back.

From the February, 2009 issue of Super Chevy

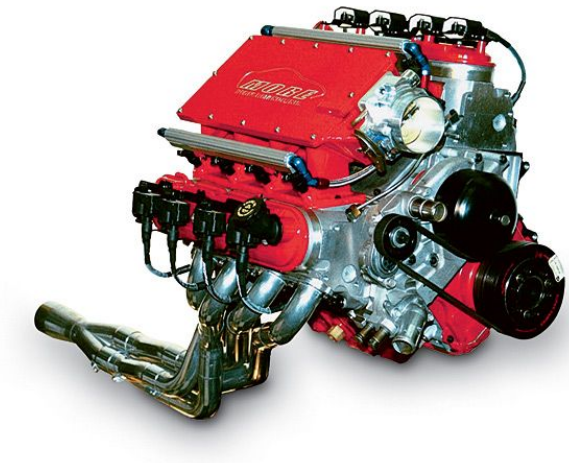
Photography by Various Manufacturers

All contributors: David Vizard

For me the first really serious look at how to muffle a high performance race engine without losing a significant amount of power started in 1980 when I built a 400lb-ft, 404hp 350 to replace the very lame 158hp 305 in my California-spec Pontiac Trans Am. Having worked very hard to build a pump gas fueled engine (gas was really bad in those days), that would cross the 400 hp barrier, I was very disappointed to find that, regardless of what mufflers were used, the output dropped by some 20 Ib-ft and 25 hp. Having had some experience designing a no-loss system for the original style British Mini Coopers, I felt confident I could pull off the same stunt for significantly bigger V-8 engines. The result, aided by an acoustics expert friend, was the Sonic Turbo. This design went on to be manufactured by Cyclone (now a division of Walker/Dynomax). After the smoke cleared from a big muffler shootout (done at Gale Banks facility and published by Hot Rod magazine), a pair of 2.25-inch Sonic Turbos (the 2.5-inch ones were still a couple of months off) sunk everybody else's 2.5-inch items. This, it seemed, was just what the hot rod fraternity wanted and they sold by the hundreds of thousandths. That was good, but more importantly; it appeared to spark the industry into aggressively pursuing significantly more functional mufflers and exhaust systems. The result is that 20-some-years later, all the necessary components to build a highly effective, no-loss system are at hand, and not necessarily that much money either. All that appears to be lacking is widespread know-how as to what is needed to achieve this happy state of affairs. As of now, we are going to make a start on putting that right.

Simple Steps to Success

Although the mode of function of an exhaust system is complex, it is not (as so often is believed, even by many pro engine builders) a black art. To help appreciate the way to get the job done I will go through the process of selecting exhaust system components for a typical high performance V-8 in a logical manner from header to tail pipe. Although the entire exhaust functions as a system, we can, for all practical purposes, break down many of the requirements that need to be met into single entities. Fig. 1 details the order of business. But before making a start, it is a good idea to establish just why getting the exhaust correctly spec'd out is so important. This will allow realistic goals, improved component choice, and a more functional installation. The V-8 engines we typically modify for increased output are normally categorized as four-cycle units. Although pretty much the case for a regular street machine, this is far from being the case for a high performance race engine. If we consider a well-developed race engine, the usual induction, compression, expansion (power stroke) and exhaust cycles have a fifth element added (Fig. 2). With a race cam and a tuned-length exhaust system, negative pressure waves traveling back from the collector will



This More Performance LS6 relied heavily on the effectiveness of the Nextel Cup-style Kook's long 4-into-2-short-into-1 headers to bring the entire power production program together. The result: 726 horsepower!

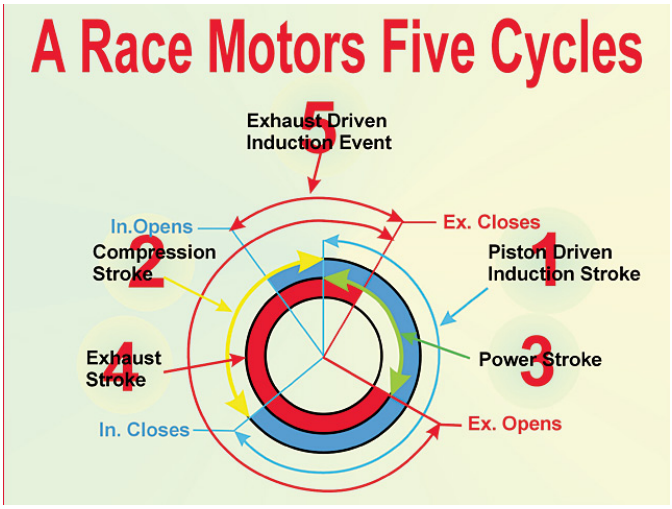


Fig 2 A high-performance or race engine relies heavily on an exhaust-driven induction cycle (the fifth cycle) to achieve those 100 percent-plus volumetric efficiency figures.

scavenge the combustion chamber during the exhaust/intake valve overlap period (angle 5 in Fig. 2). To understand the extent to which this can increase an engine's ability to breathe, let's consider the cylinder and chamber volumes of a typical high-performance 350 cubic-inch V-8. Assuming for a moment no flow losses, the piston traveling down the bore will pull in one-eighth of 350 cubic inches. That's 43.75 cubic inches, or in metric, 717cc. If the compression ratio is say 11: 1, the total combustion chamber volume above this 717cc will be 71. 7cc. If a negative pressure wave sucks out the residual exhaust gases remaining in the combustion chamber at TDC, then the cylinder, when the piston reached BDC, will contain not just 717 cc but 717 + 71. 7 cc = 788.7 cc. The result is that this engine now runs like a 385 cubic inch motor instead of a 350. That scavenging process is, in effect, a fifth cycle contributing to total output.

But there are more exhaust-derived benefits than just chamber scavenging. Just as fish don't feel the weight of water, we don't readily appreciate the weight of air. Just to set the record straight, a cube of air 100 feet square will weigh 38 tons! If enough port velocity is put into the incoming charge by the exhaust scavenging action, it becomes possible to build a higher velocity throughout the rest of the piston initiated induction cycle. The increased port velocity then drives the cylinder filling above atmospheric pressure just prior to the point of intake valve closure. Compared with intake, exhaust tuning is far more potent and can operate over ten times as wide an rpm band. When it comes to our discussion of exhaust pipe lengths it will be important to remember this.

At this time a few numbers will put the value of exhaust pressure wave tuning into perspective. Air flows from point A to point B by virtue of the pressure difference between those two points. The piston traveling down the bore on the intake stroke causes the pressure difference we normally associate with induction. The better the head flows the less suction it takes to fill (or nearly fill) the cylinder. For a highly developed two-valve race engine the pressure difference between the intake port and the cylinder caused by the piston motion down the bore, should not exceed about 10-12 inches of water (about 0.5 psi). Anything much higher than this indicates inadequate flowing heads. For more cost-conscious motors, such as most of us would be building, about 20-25 inches of water (about 1 psi) is about the limit if decent power (relative to the budget available) is to be achieved. From this we can say that, at most, the piston traveling down the bore exerts a suction of 1 psi on the intake port Fig. 3.

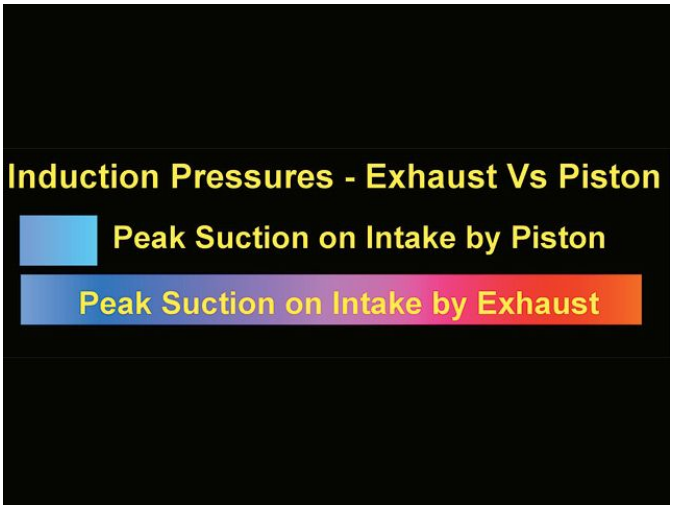


Fig 3 This comparison between the piston's suction on the intake compared with the exhausts indicates just how much potential there is in exhaust tuning.

The exhaust system on a well-tuned race engine can exert a partial vacuum as high as 6-7 psi at the

exhaust valve at and around TDC. Because this occurs during the overlap period, as much as 4-5 psi of this partial vacuum is communicated via the open intake valve to the intake port. Given these numbers you can see the exhaust system draws on the intake port as much as 500 percent harder than the piston going down the bore. The only conclusion we can draw from this is that the exhaust is the principal means of induction, not the piston moving down the bore. The result of these exhaust-induced pressure differences are that the intake port velocity can be as much as 100 ft./sec. (almost 70 mph) even though the piston is parked at TDC! In practice then, you can see the exhaust phenomenon makes a race engine a five-cycle unit with two consecutive induction events. With the exhaust system's vital role toward power production established, it will be easy to see that understanding how to select and position the right combination of headers, resonators, routing pipes, crossovers and mufflers will be a winning factor. This will be especially so if mufflers are involved in the equation. I first started putting out the word on how to build no-loss systems as much as 20 years ago and I am somewhat surprised that it is still commonly believed that building power and reducing noise are mutually exclusive. Historically, this has largely been so, but building a quiet system that allows the engine to develop within 1 percent of its open exhaust power is entirely practical. Be aware that knowing what it takes in this department can easily deliver a 40-plus hp advantage over your less-informed competition.

Headers -- Primary Pipe Diameters

Big pipes flow more, so is bigger better? Answer: absolutely not. Primary pipes that are too big defeat our quest for the all-important velocity-enhanced scavenging effect. Without knowledge to the contrary, the biggest fear is that the selected tube diameters could be too small, thereby constricting flow and dropping power. Sure, if they are way under what is needed, lack of flow will cause power to suffer. In practice though it is better, especially for a street-driven machine, to have pipes a little too small rather than a little too big. If the pipes are too large a fair chunk of torque can be lost without actually gaining much in the way of top-end power. At this point determining primary tube diameters is starting to look like a tight wire act only avoidable by trial and error on the dyno.

Fortunately, a little insight into what it is we are attempting to achieve brings about some big-time simplification. Our goal is to size the primary pipes to produce optimum output over the rpm range of most interest. The rate exhaust is dispensed with, and consequently, the primary pipe velocity, is strongly influenced by the port's flow capability at the peak valve lift used. From this premise it has been possible to develop a simple correlation between exhaust port-flow bench tests and dyno tests involving pipe diameter changes. This has brought about the curves shown in the graph Fig. 4 which allow primary sizing close enough to almost eliminate the need for trial-and-error dyno testing.

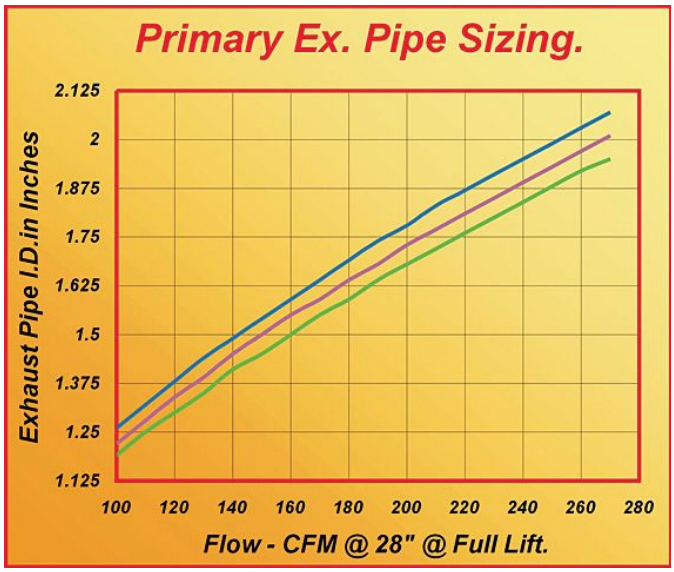


Fig 4 This chart applies to normally aspirated engines. For street headers, where low-speed torque is of prime importance (especially with a stock converter and high rear end gears), use the lower line to select the appropriate primary size. For hot street machines having reasonably big cams and decent compression, use the middle line to size the primary. For race engines, use the top line. If nitrous is involved, check out the nitrous header section.

Primaries for Nitrous Use

Since nitrous injection is so popular, it's worth throwing in the changes needed to optimize with the nitrous on. For a typical race V-8 the area of the primary pipe needs to increase about 6-7 percent for every 50 hp worth of nitrous injected. For street

applications, where mileage and performance when the nitrous is not in use is the most important, pipe size should not be changed to suit the nitrous.

Headers -- Primary Pipe Lengths

Misconceptions concerning exhaust pipe lengths are widespread. Take for instance the much-overworked phrase "equal-length headers." More than the odd engine builder/racer, or two, have made a big deal about headers with the primary pipes uniform within 0.5 inch. The first point this raises is whether or not what was needed was known within 0.5 inch! If not, the system could have all the pipes equally wrong within 0.5 inch! Trying to build a race header for a two-planed crank V-S with lengths to such precision is close to a waste of valuable time. Under ideal conditions it is entirely practical for an exhaust system to scavenge at or near maximum intensity over a 4,000 rpm bandwidth. Most race engines use an rpm bandwidth of 3,000 or less rpm. If the primary pipe scavenging effect overlaps by 3,000 rpm then it matters little that one pipe tunes as much as 1,000 rpm different to another. Since this is the case, then all other things being equal, pipe lengths varying by as much as 9 inches have little effect on performance. A positive power-increasing attribute of differing primary lengths is that it allows larger-radius, higher-flowing bends and more convenient pipe routing to the collector in often confined engine bays.

Apart from the reasons just mentioned, there is also another sound reason why we should not unduly concern ourselves about equal primary lengths. In practice, the two-plane cranks that typically equip V-S race engines render the exhaust insensitive to quite substantial primary length changes. Experience indicates inline four-cylinder engines are more sensitive to primary pipe length, but a two-plane cranked V-S is not two inline fours lumped together. It is two V-4s and, as such, does not have even exhaust pulses along each bank.

With a conventional, as opposed to a 180-degree header, exhaust pulses are spaced 90, 180, 270, 180, 90 and so on. The two cylinders discharging only 90 degrees apart are seen, by the collector, as one larger cylinder and accounts for the typical rumble a V-8 is known for. This means the primaries act like they do on a four-cylinder engine, but the collector acts as if it were on a 3-cylinder engine having different sized cylinders turning at less revs. (Doesn't life get complicated?) This, plus the varied spacing between the pulses appears to be the cause of the system's reduced sensitivity to primary length. These uneven firing pulses on each bank seem to work in our favor. Evidence to date suggests that single-plane cranked V-8s, which have the same exhaust discharge pattern as an in -line four-cylinder engine, make less horsepower and are more length sensitive. Dyno tests with headers having primary lengths adjustable in three-inch increments show that lengths between 24 and 36 inches have only a minor effect on the power curve of V-8s that you and I can typically afford, although the longer pipes do marginally favor the low end.

Secondaries -- Diameters and Lengths

Well, so much for primary pipe dimensions and their effect on output. Let us now consider the collector/secondary pipe dimensions and configurations. The first point to make here is that the secondary diameter is as critical as the primary. A good starting point for the collector/secondary pipe size of a simple 4-into-1 header is to multiple the primary diameter by 1.75. Fortunately, the collector can be changed relatively easily and it is often best optimized at the track rather than the dyno.

As for the secondary length-that is from about the middle of the collector to the end of the secondary (or the first large change in cross-sectional area), we find a great deal more sensitivity than is seen with the primary. Ironically, few racers pay heed to collector length even though it is easy to adjust. In practice, collector length and diameter can have more effect on the power curve than the primary length. A basic rule on collectors is that shorter, larger diameters favor top end while longer, smaller diameters favor the low end.

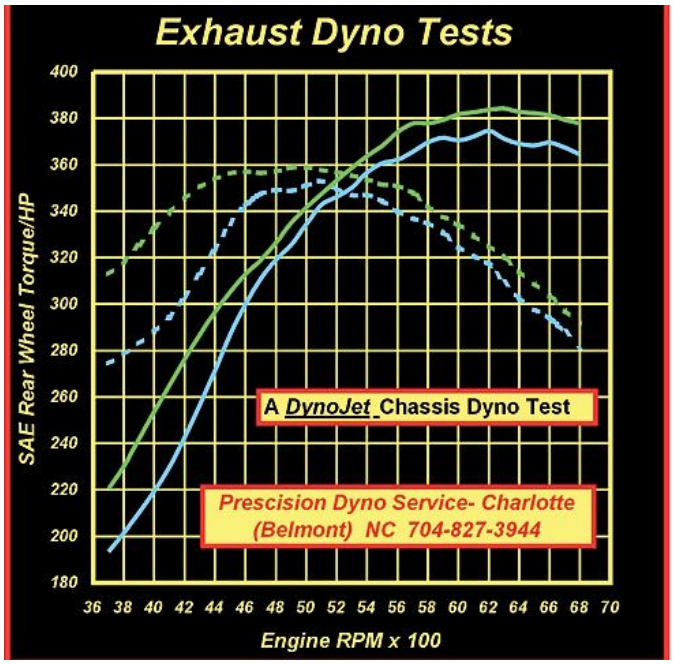


Fig 5 Here are the gains, as measured at the rear wheels, produced by the collector extension arrowed in the nearby photo.

Except for the most highly developed engines, many collectors I see at the track are too large in diameter and either too short, or of excessive length. For a motor peaking at around 6,000-8,500 rpm, a collector length of 10-20 inches is effective.

Getting secondary lengths nearer optimal can be worth a sizable amount of extra power as Fig. 5 shows. If you want to bump up torque at the point a stock converter starts to hook up the engine, you may want a secondary as long as 50 inches but something between about 10 and 24 is more normal. The shorter of these two lengths would be appropriate for an engine peaking at about 8,500 rpm whereas the longer length would be best for an engine that peaked at about 4,800- 5,000 rpm.

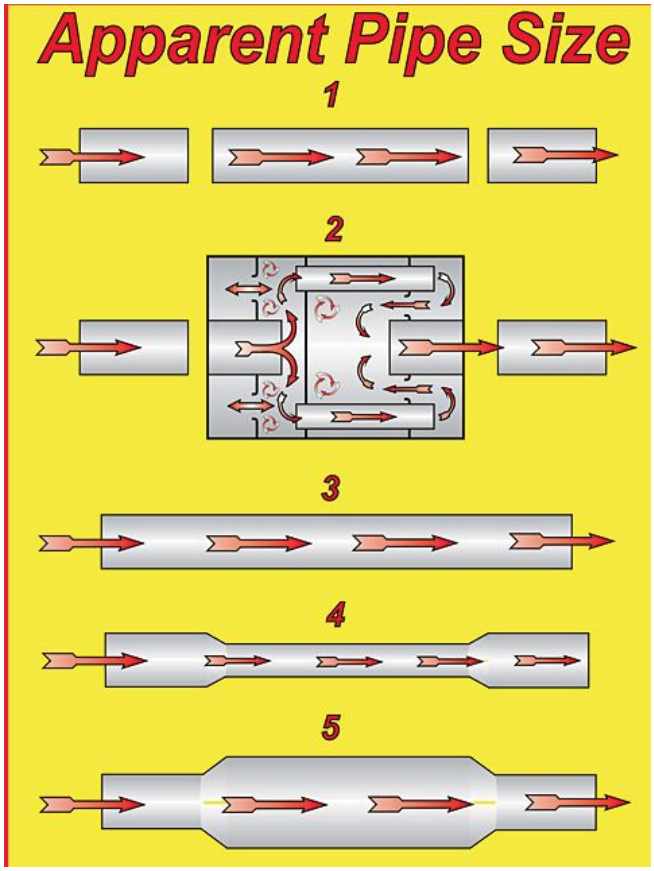


Fig 6 In terms of flow, an inlet, muffler and outlet that appears to the airflow to look like number 1 is what is needed. A real-world muffler (number 2) does not look like number 1, but number 4. This shows that the muffler, not the pipe, is the usual restriction. Some race mufflers actually have a core flow greater than the in/out pipe and look like number 5.

Mufflers -- Two Golden Rules to Avoid Power Loss

Inappropriate muffler selection and installation (which appears so for better than 90 percent of cases) will, in a very effective manner, negate most of the advantages of system length/diameter tuning. The question at this point is what does it take to get it right and how much power are we likely to lose if the system is optimal? The quick and dirty answers to these questions are "not much" and "zero." This next sentence is the key to the whole issue here, so pay attention. To achieve a zero-loss muffled high -performance race system we need to work with the two key exhaust system factors in total isolation from each other. These two factors are: the pressure wave tuning from length/diameter selection, and minimizing backpressure by selecting mufflers of suitable flow capacity for the application. If we do this then a quiet (street-legal noise levels) zero-loss system on a race car is totally achievable without a great deal of effort on anybody's part. Ultimately, it boils down to nothing more than knowledgeable component selection and installation, so let's look at what it takes in detail.

Muffler Flow Basics

We select carbs based on flow capacity rather than

size because engines are flow sensitive, not size sensitive. This being so, why should the same not apply to the selection of mufflers? The answer (and here I'd like muffler manufactures to please note) is that it should, as the engine's output is influenced minimally by size but dramatically by flow capability. Buying a muffler based on pipe diameter has no performance merit. The only reason you need to know the muffler pipe size is for fitment purposes. The engine cares little what size the muffler pipe diameters are but it certainly does care what the muffler flows and muffler flow is largely dictated by the design of the innards. What this means is that the informed hot rodder/engine builder should select mufflers based on flow, not pipe size. A study of Fig. 6 will help to give a better understanding as to how the design of the muffler's core, not the pipe size, dictates flow. Let's start by viewing a muffler installation as three distinct parts. In Fig. 6, drawing number 1, these are the in-going pipe, the muffler core and the exit pipe. Drawing number 2 shows a typical muffler which has, due to a design process apparently unaided by a flow bench, core flow significantly less than an equivalent length of pipe the size of the entry and exit pipe. Because the core flow is less than the entry and exit pipe then the engine "sees" the muffler as if it were a smaller and consequently more restrictive pipe as per drawing number 4. If the core has more flow than the equivalent pipe size, as in drawing number 5, it appears larger than the entry and exit pipe. Result: the muffler is seen by the engine as a near zero restriction. A section of straight pipe the length of a typical muffler, rated at the same test pressure as a carb (10.5 inches of mercury), flows about 115 cfm per square inch. Given this flow rating, we will see about 560 cfm from a 2.5-inch pipe. If we have a 2.5-inch muffler that flows 400 cfm, the engine reacts to this just the same as it would a piece of straight pipe flowing 400 cfm. At 115 cfm per square inch, that's the equivalent to a pipe only 2.1 inches in diameter. This is an important concept to appreciate. Why? Because so many racers worry about having a large-diameter pipe in and out of the muffler. This concern is totally misplaced, as in almost all but a few cases, the muffler is the point of restriction, not the pipe. The fact that muffler core flow is normally lower than the connecting pipe can be offset by installing something with higher flow, such as a 4-inch muffler into an otherwise 2.75-inch system

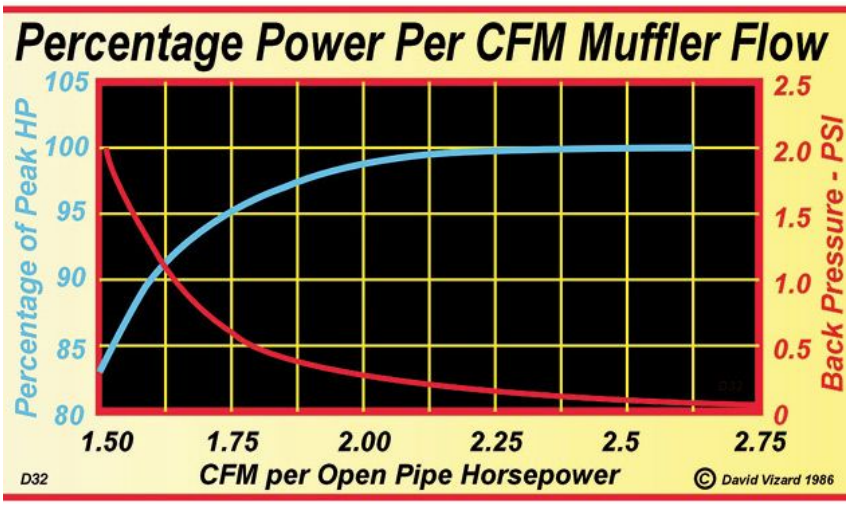
Muffler Flow - - How Much is Needed?

The first point to appreciate here is that optimally-sized collectors/secondary pipes are not sized so as to meet the engine's flow requirement, but more by the need to produce the desired pressure wave characteristics. For instance, a 700hp engine may have a dyno-optimized 3.75-inch diameter collector. This diameter, in conjunction with the length used, results in the system "tuning in" at the desired rpm. But from the standpoint of flow, a 3-inch pipe from each bank would be capable of handling all of such an engine's flow requirements.

Without data to the contrary, it seems safe to assume that the more a muffler flows, the better. This, fortunately, is not so and here's why. Increasing muffler flow unlocks potential engine power. Once all the potential power is unlocked, further increases in exhaust system flow will not produce any further benefits in terms of power. But what may be good for power may not be good for noise as any excess flow capability can lead to a noisier system. From this we can conclude that too much muffler flow serves no useful purpose and possibly costs more money than was really necessary. The trick here is to use just the right amount of muffler, no more and certainly no less. This allows the full power potential of the engine to be realized at the lowest cost without undue compromise in terms of noise. Now the question is how much flow is enough?

Some years ago, in anticipation of the fact that eventually almost all race cars would need to be equipped with mufflers, I embarked on a series of tests to establish what a race engine's minimum flow threshold was. Initially, such tests looked easy but, to get meaningful results, it was necessary, as far as possible, to isolate the effects of flow from the effects of pressure wave tuning. This can be done with a pressure wave termination chamber more commonly known as a resonator box. Knowing when and how to use a resonator box can be a

very important part of building a high -performance system and we will look at these shortly to see the role they play. For now, let us look at some flow-oriented test results. In Fig. 7 you will see the results of tests run on a number of engines of various types. The only common element of significance between these engines was the use of a cam with 290 degrees or more of seat (advertised) duration. As you can see, the trend is that as flow is added to an initially flow-restricted engine, power increases rapidly at first then gains tail off. Once the available flow exceeds about 2.2 cfm per hp, the gains possible by increasing muffler capacity drop to less than 1 percent. Knowing that 2.2 cfm per open-pipe hp means zero loss from backpressure allows us to determine how much muffler flow your engine needs. Just make a reasonable estimate of its open exhaust power potential and multiply by 2.2. For instance, a V-8 making 500 horsepower on open exhaust will require 500 x 2.2 = 1100 cfm. Two 550-cfm mufflers will get the job done and contain the backpressure induced power loss to 5 horsepower or less. With mufflers rated in cfm, see how easy making an appropriate choice gets?



The line rising from left to right shows muffler flow versus the percent of maximum power retained compared with open-pipe power. Once the flow reaches 2.2 cfm per hp, the output seen is as per open pipe output. The line descending left to right shows the typical backpressure seen. At 2.2 cfm per hp, the backpressure should be down to as little as 0.2 psi (a little less than 0.5 of an inch of mercury).

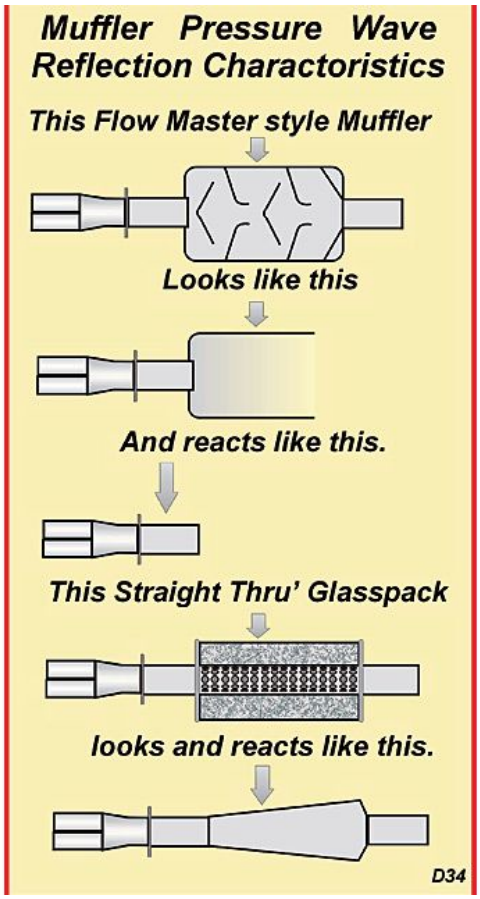


Fig 8 Understanding the concept outlined here is vital to understanding how different styles of mufflers affect the apparent tuned length.

Pressure Waves

With muffler flow requirements out of the way we can move on to methods of applying suitable capacity mufflers to the "system" without needless disruption of length -induced pressure wave tuning. Probably the best way to ease into this somewhat complex subject is to consider some of the published muffler test results done in recent years. These tests appeared to have shown that, sometimes, lower flow mufflers inducing at least some backpressure were required to make best power. In all such tests that I have studied, the conclusions (as opposed to the tests) were invalid. There turns out to be several reasons for this and all are relevant to building a near zero-loss exhaust system. The first point canceling the supposed validity of back-to-back test results is due to the varied internal designs seen amongst the test pieces Fig. 8. Many mufflers are made up of a number of interconnected chambers

having varying degrees of access ease by the exhaust. Others are of the "glass pack" variety. These types represent opposite ends of a spectrum and have a substantially differing response to arriving pressure waves.

When we dealt with collector length it was emphasized that it was, in most cases, more critical than the primary pipe lengths. Adding a muffler (even one with zero backpressure) to a system with already optimized lengths can alter the pressure wave response such that the tuning is now out of phase with what is required and as a result, power drops. The trick here is to install mufflers such that they don't alter the tuned lengths of the system. Let us assume that the test muffler is attached directly to the end of the collector. A pressure wave is reflected either at the end of the exhaust pipe or when a sizable increase in cross-sectional area occurs. Open chambered mufflers such as Flowmasters often appear to the pressure wave much the same as the end of the pipe. This means the pressure waves see no change in length and reflection occurs largely as it did prior to the fitment of the muffler.

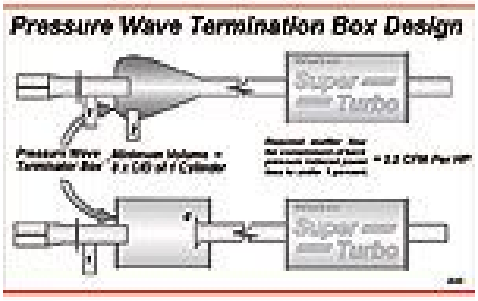


Fig 9 Follow the system construction guidelines shown here and you will be pretty much assured of a zero-loss exhaust system.

A glass pack muffler can act significantly different. It does not appear as a pipe end but as a substantial increase in collector length. Result: a reduction of power even though there is no measurable backpressure involved. From this we can see that many comparative muffler tests were in fact "pseudo pipe-length" tests. Although many invalid conclusions were drawn, these tests still demonstrated some important facts. The most important is that the engine's needs in terms of flow and pressure wave length tuning must be isolated, one from the other. This is easy to do by means of the pressure wave termination box (resonator box) mentioned earlier. Incorporating a resonator box into a system produces a layout along the lines seen in Fig. 9. With enough volume, the resonator box makes everything down stream appear invisible to the header's primary- and secondary-tuned lengths. With a flow capability of 2.2 cfm or more, the muffler appears virtually invisible from a flow standpoint. As a result, we have a muffled system that produces virtually the same power as an open exhaust.

Cross Overs and Balance Pipes

The object of the entire muffler tech so far discussed is to end up with an acceptably quiet system; otherwise the point of the exercise is lost. By using no more muffler flow than needed we are giving whatever mufflers are selected the best chance of doing the job. Unfortunately, mufflers can be a little inconsistent and unpredictable in terms of noise suppression from one engine type to another. Situations involving high compression ratios and long-period cams are usually more demanding in terms of noise reduction. Big cubic inches, shorter cams, and lower compression ratios are easier to muffle. The biggest problem in this area is knowing whether or not a possible combination is quiet enough. If you hit the Dynomax web site you can hear chassis dyno tests of a wide variety of mufflers (including stock) on an extensive range of vehicles.

Be aware that how the system is installed can also affect the sound level, especially in the vehicle's interior. Do not have the tail pipe ending under the car, as the bodywork will act as a sound box in much the same way as a guitar body. Either have them go all the way to the rear, with down turned exit pipes angled slightly in towards each other, or have side exits aimed 45 degrees to the ground. As far as power is concerned, tail pipe length after the mufflers has no measurable effect on the power if a large change in cross section is present up stream (toward the motor) of the tail pipe. An open-type muffler, or a resonator box,

provides this cross-sectional change. The tail pipe length exiting most glass pack installations is also of little consequence if a resonator box is used, but is of significant influence if not.

Virtually all V-8 exhaust systems can be refined by the addition of a balance or X-pipe. These have two potential attributes: increased power and reduced noise. Extensive dyno testing on both of these factors has indicated balance and X-pipes are 100 percent successful at reducing noise. The reductions amount to a minimum of 1 dB to a maximum of 3 dB with 2 dB being common. As far as power is concerned, things are a little less certain. With engines between about 325 to 550 hp, experience indicates that in about 60 percent of the cases (mostly with balance pipes), the engine can deliver as much as 12 additional hp, with 5-8 being the most common. The other remaining 40 percent tested showed virtually no change in output either up or down. Based on such results, we can conclude that a balance or X-pipe is always a positive asset and never a negative.

Balance pipe sizing seems not to be overly critical. The only really influential dimension is the pipe diameter. This needs to have an area at least equal to that of a 2.2S-inch diameter pipe (4 square inches) with 2.5 to 2.75 inches being preferable. Though limited to tests on engines up to a little fewer than 600 hp, there seems to be no measurable benefits to using a crossover pipe bigger than 2.75 inches in diameter. As for the crossover length, dyno results indicate that 18 inches responds in virtually the same manner as 72 inches long.

The Final System

Take a look at Fig. 10. This is a system I designed for a 700hp normally aspirated non-nitrous street/strip small-block Chevy that was installed in a 1986 Corvette. It produced acceptable street noise levels without any measurable drop in power. Although you may have to adopt some slightly different steps toward getting an acceptable installation, keeping sight of the principles involved will deliver similar results. Step outside the guidelines and you are on your own!

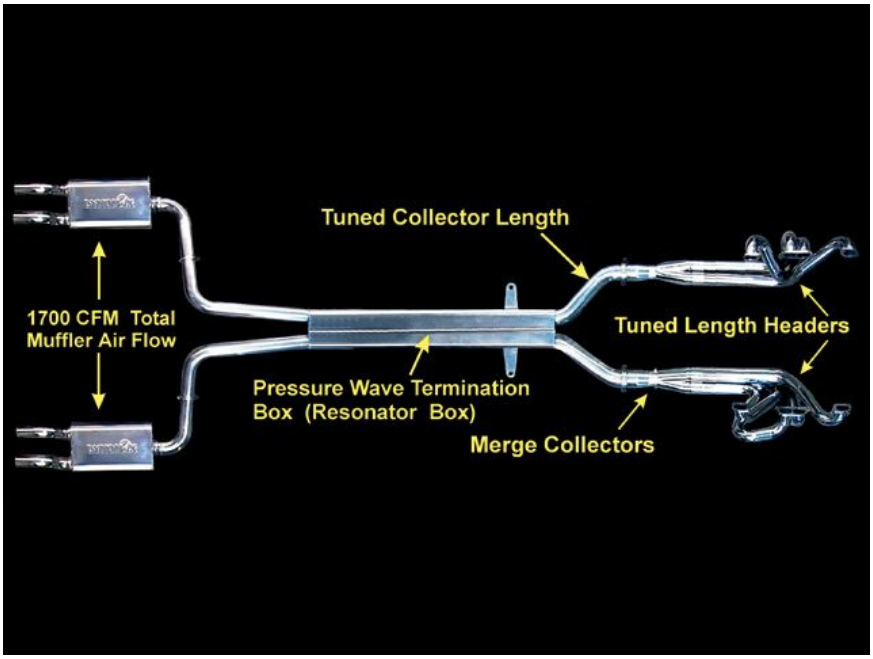


Fig 10 Here is what a complete zero-loss header/muffler system looks like in finished form. A lot of work went into this but the results were worth the effort involved.

SOME HEAVY-DUTY QUOTES FROM ENGINE MASTERS WINNERS

John Kaase: "I used a straight-through glass pack muffler design specifically because of the high-flow they can deliver. My dyno testing left no doubt as to how important collector length was and that a straight-through glass pack contributes to that length. By getting the collector/muffler length right, which in our case was about 40 inches, the torque at 3,500 was increased substantially. That gain is probably what won the Engine Masters deal for me the first time. I have seen an incorrect length along with less than the critical minimum flow cost 40 hp. Short change efforts on the collector/secondary and it will short change you."

Joe Sherman: "If you are building a serious performance system, then assuming you have a near-optimal header set-up, the place that is most critical when it comes to avoiding power loss is from the collector back. Also, don't be fooled into thinking that big tailpipes contribute to power. In all my years of dyno testing, I never have seen that work. For me, the straight-through Magnaflows when used as part of the collector length, show only very small losses in power over an open pipe. It's all about the right length and sufficient flow. I have seen mistakes in this area cost 85 horsepower."

GOT CATS--NEED FLOW?

If, to stay legal your exhaust system must run catalytic converters, then the possibility of loosing power goes up dramatically, but it certainly does not mean the game is lost. The first rule of thumb here is if the cats must be in the original position, use the highest-flow components that can be physically installed. For high -flow, high performance cats, one of the first places I would try would be Random Technologies. Some of this company's key employees drag race late model-street legal machines and are serious about performance. Also in the business of marketing genuine hi -flow cats and cat systems are Walker (Dynomax), Magnaflow, Dynatech and, for a number of specialized truck installations, Gale Banks. These are not the only ones, but they are all the companies of which I have experienced the no-nonsense functionality of their products. If the position of the cats can be moved to such an extent that the length going into the cats represent the secondary tuned length, then we find that to an extent, the cat, if large enough, can, in part, act as a resonator box. Moving the cats to a more favorable position then is rule number 2 when cats must be used. Rule number 3 is that if there is room to put a crossover or an X-pipe before the cats, then that's almost always the best place. Anything after the cats will drop the sound level but is unlikely to increase power unless the flow of the mufflers you chose was significantly short of what was needed.

High-Tech Collectors

Technology to make a good header has been around for 30-plus years. These days, making a top-notch header is very much a question of refinements to eek out whatever potential may be remaining. One area of research that has paid dividends in the past decade is in the collector design. Example number 1 on a system built by Kook's Headers is a 4-into-1 merge collector (arrowed). Dyno testing this type of collector, versus a regular parallel one, shows that the merge collector tends to pull up torque from the lower speed range with ever decreasing amounts, thus delivering a fatter torque curve but not necessarily any more peak hp. Another header/collector worthy of note (our example is again from Kook's) is the type shown in photo number 2. This is much favored by Busch and Nextel Cup engine builders. Essentially it is a long 4-into-ashort-2-into-1 system. The parts that go to make up the system between points A and B are shown in the top right hand corner of number 2. About 10 years ago, Flowmaster introduced a collector that converted a regular 4-into-1 system into the system seen here. This was my introduction to testing this configuration of collector. The dyno indicated only marginal gains in peak power. Like the merge collector, this collector style fattened up the torque curve, but usually to a greater extent.

Intake Alternatives

Before doing any of the following procedures, be sure of exactly what you want first. There are many options available but these are the cheapest.

- *Chrome Exhaust Intake* – Uses a chrome exhaust tip to replace First Base.
- *Flat Panel High Flow Filter* – Replace the stock filter with an aftermarket high flow replacement.
- *Home Plate and First Base Delete* – Home Plate is a "home plate" shaped, hence the name, air baffle sits on top of the engine with "Fuel Injected V8" embossed on the top. The rectangular baffle that sits in-between the intake and the air box called First Base. Both baffles are used reduce engine noise and to quiet down the LT1 for the laid-back folks. Some people like things loud with more power. Along with decreasing the noise, they also decrease the horsepower. Therefore, if you want an easy way to gain a few ponies, delete them both. See Home Plate Removal and First Base Removal for more detail.
- *Sewer Pipe Intake* – Another cheap and simple intake.
- *Swiss Cheese Air Box* – One way of letting your air box breathe better.

Some of the other, more expensive modifications are:

› R.A.I.S.S. – http://www.impalaperformance.com

Places the MAF sensor and filter directly onto the throttle body for quicker response

Encloses the filter to promote cold air

Air Force 1 option supplemented by the new Air Force II that is a shroud that directs the airflow through the grill and over the radiator

› RAMMIT Intake System

Forced induction from underneath car

› K & N Generation 2 Cold Air System

Replaces "First Base" and encloses the cone filter to promote cold air into intake

› SLP Ram Air System with Hood

This hood coils the intake around to the top of the throttle body, to work in conjunction with the SLP Ram Air hood.

› SLP Cold Air Intake

Much like the Gen 2 form K&N but has 2 cone filters and no heat shield

› SSRI - Super Stealth Ram Intake

Much like the R.A.I.S.S. but shroud is not as wide.

Chrome Exhaust Intake

Materials:

- *A 3.5" chromed exhaust pipe cut to 13".*
- *A 2"-3" section of 3.5" ID rubber hose. Check with a local heavy truck supply store for Gates hoses. "GATES Green Strip 3 1/2" I.D. (89 mm)", P/N 24256, seems to work great. You can also get a "no hub coupler" from a hardware store. Any sort of heat-resistant rubber connector will work fine.*
- *Two pipe clamps to secure the tubing to the MAF and the pipe.*

Procedure:

1. Take the air box lid off the air box base, remove the filter, and set them aside.
2. Unscrew the Torx head nut/bolt on the fender well.

3. Look at the air box; it's actually two pieces consisting of the square air box itself and a flat piece underneath that snaps down onto some tabs on top of the PCM.
4. Unsnap that flat piece and pull out the air box base.
5. Take a closer look at the air box after it's out of the car. You'll see two pushpins holding the flat piece to the bottom of the box -- one outside the box, one inside.

Exhaust Tip

6. By *carefully* pushing the pin back through the base, remove the pushpin that is outside the box. Leave the one inside the box alone. The air box should turn on the one remaining pin effectively providing a pivot point.
7. Snap the air box back into place on the PCM. You should be able to turn the air box somewhat.
8. Put the filter back in and put the lid back on the air box.
9. Turn the air box towards the intake elbow as far as possible without binding anything, and measure and install your pipe.
10. Originally, the pipe will come tapered on one end (the exit for the exhaust) and have a 2 1/2" "nipple" on the other to fit into the standard exhaust. You will have to cut both of these off so that it is just a straight piece of chrome pipe. If you can find such a piece without cutting, then you're better off. You'll need it to be around 13" long.
11. Loosen the clamps on both ends of the baffle.
12. Remove the baffle. You may need to remove the air filter cover to do this. Be careful not to damage the MAF (mass airflow sensor) as you remove the baffle. While you are doing this, make sure you remember (or mark) which way the MAF faces.
13. Clamp the rubber tubing to one side of the chrome tube.
14. The other side of the rubber tubing should be clamped to the side of the MAF that originally was connected to the First Base baffle. The hose should fit inside the rubber coupling that used to connect to the resonator.
15. Insert the pipe into the intake elbow. Secure the clamp on the elbow so that it is tight around the pipe.

First Base Removal

Tools:

- *Flat head screwdriver*

Procedure:

1. Loosen the hose clamps holding First Base to the MAF sensor and pull apart.
2. Loosen the hose clamp holding the other side of First Base to the intake elbow.
3. Remove First Base.

The car will not run without something replacing First Base. Now is the time to either continue with another project, like Flushing the Radiator , Water Pump Replacement, etc., or replace First Base with the Sewer Pipe Mod.

First basr air baffle.

Home Plate Removal

Tools:

- *Socket wrench*
- *Flat head screwdriver*
- *Elbow, plug or something to use as a hole filler, if deleting*

Home plate air baffle.

Elbow Options:

› 1994 1LE F-car Duct 25147210 for unvented opti-spark

› 1995 1LE F-car Duct 25147187 for vented opti-spark

Procedure:

1. Remove the two nuts on top of the home plate.
2. Then use a screwdriver to loosen the hose clamp where the home plate attaches to the intake elbow right in front. Pull the baffle off and you will expose the engine to its full capacity. You will probably need to clean it after you complete this procedure.
3. Next, remove the rack that held the home plate on the engine. The two stems the plate sat on can be unscrewed using a wrench or a pair of pliers.
4. Then remove the four screws that hold the rack as well as the fuel rails onto the throttle body.
5. Work the rack out of the way; be careful not to tear any wires.
6. Once removed, reinstall the four screws back into the fuel rails. Otherwise, you will have problems later. Use zip ties to strap down any loose hoses or wires so they will not dangle onto hot parts of the engine.
7. Now for the final piece, this will all depend on your money and taste. If you have not noticed already, there is a big hole in the elbow where the home plate once sat. You have many choices of what to place in the hole. Whatever it is, it needs to be strong and not easily affected by heat. People have used many things; jar lids, hockey pucks, coasters, PVC plugs, etc. There are many designs available, but some get pricey. When you get your plug, set it in the hole and tighten the hose clamp to a good seal.

Sewer Pipe Mod

This is a cheap alternative Air Intake system. This is also a common beginner mod. The example described in this explanation is not the only way to do this particular mod. Please feel free to try out other ways to accomplish the same result.

Tools:

- *Saw*
- *Flat head screwdriver*
- *Sandpaper*

Example of the Sewer Pipe Mod as described in text.

Materials:

- *2 – PVC street 45° elbows, 3 inch diameter*
- *1 – (3") of PVC straight pipe, 3 inch diameter*
- *1 – Rubber coupling, 3 inch diameter (with hose clamps on either end)*
- *PVC cement*
- *1 – Can of either black spray paint or black spray undercoating.*

Another example of the Sewer Pipe Mod.

Most of the materials can be purchased at your local home improvement store, Home Depot, Lowe's, ACE Hardware, etc. for about $8, with exception of the undercoating. The undercoating can be purchased at an auto parts store for about $2. Total cost $10. Prices will vary. This picture shows you the basic materials for the Sewer Pipe Mod explained in this example.

Procedure:

1. Mock up your intake first! Measure twice, cut once.
2. Once everything is aligned the way you want it mark the pipe with light scratch mark just deep enough to see.
3. Cut the straight section of pipe to approximately 3 inches.
4. Remove all sharp edges and be sure to clean all shavings and dust from the pipe sections.
5. Follow the directions for the PVC cement and glue together one joint at a time. Pay particular attention to the alignment of the elbows thus the scratch mark.

Materials listed in text.

Sewer Pipe assembled.

You can see the pieces cemented together, and the coupling is cut down to size. Use a sharp blade so you don't end up butchering the coupling edges.

Painted with undercoating spray.

In this example, thick black undercoating spray was used. The look is almost factory. Mask off the ends to have a clean surface to clamp to when installed on the car. The undercoating also should protect against heat and be water resistant. The only drawback is that it can easily be scratched or scraped off.

Don't forget to pay close attention to the coupling piece at the right of the First Base. This coupling clamps to the MAF and is notched on top to center the coupling. Yours may also need to notch your sewer pipe coupling to ensure a good fit.

Swiss Cheese Air Box

Another free mod is the Swiss Cheese Air Box mod. Many folks accomplish this by drilling several holes in the bottom edges of the stock air box. Just be sure that any holes that you intend to drill are below the level of the filter.

› In conjunction to the Swiss Cheese Air Box Mod you could also replace their stock filter with a high flow flat panel filter such as one from K&N or S&B.

Z28 Cluster Swap

The general purpose of this modification is to update the instrument cluster used in 94-95 Impala SS's, and 94-96 Caprice's. This modification is not easy, and requires extensive work and time to make it fit and look factory. Your time will vary on the install, based on you skill. Scott Mueller put it best, when he said it was the best mod he had done to his car. Keep in mind you lose a couple of minor idiot lights, nothing major and you gain a couple. The biggest thing you lose is a gear position indicator. A good substitute would be a shift indicator from someplace like Dakota Digital.

Your first question is probably, "Where do I get one?" Well, the answer is to check the forums. You'll need the cluster and adaptor harness. You buy the adaptor harness or make one yourself.

This write up assumes that you have a general knowledge and skill level with hand tools. If you are uncomfortable using some of the tools needed for this, please get someone else to help. Isn't that what fellow club members are for?

Now on with the write up.

Before

After

Tools:

- *7mm Socket*
- *16mm Socket*

Procedure:

1. Begin by removing the lower dash. Don't forget the one in the ash tray recess.
2. Next remove the cluster bezel and a few more screws that hold the old cluster in. It's a little bit difficult to get the cluster out the first time.
3. Optional, but suggested. Removing the dash pad is very easy. Just remove all the screws holding it to the dash along the front of the dash pad. Then unsnap the trim piece on the right side of the dash above the glove box, including the A/C vent. Remove the A-pillar moldings, they just pull out with small metal snaps. Once you get all the screws out, just pull back evenly on the entire pad about 3 to 4 inches, and lift the front of it up to clear the air bag assembly.

4. Optional, but suggested. Drop the steering column. This helps get the clusters in and out several times.

5. Next you'll need to cut some of the dash supports away. See pictures. To do this work slowly and check often to be sure that you aren't cutting too much away.

6. Keep test fitting the cluster. When it looks good, then cut the left side. You might think "Looks like it fits ok, why cut the left side?" The answer is, that's where the harness adapter plugs in.

Clearance for the new cluster.

7. At this point, you need to turn you attention to trimming the Z28 cluster itself. You must modify the cluster by rounding it as much as possible to match the factory cluster. Be sure not to cut into any of the circuit boards.

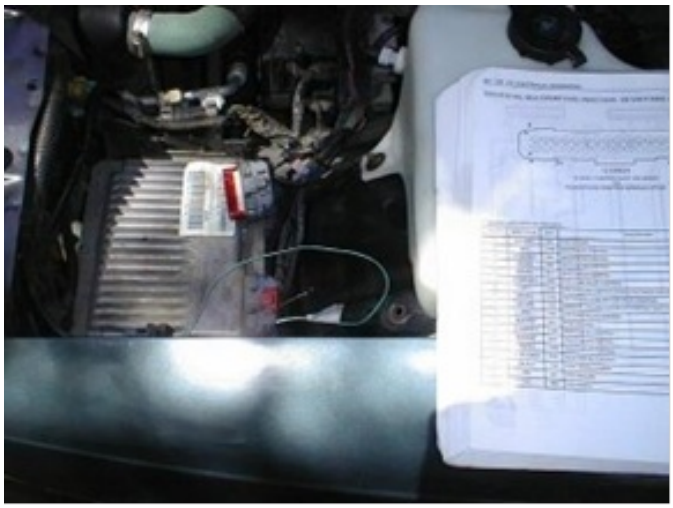
More clearance cuts.

8. You may notice the location of the speedometer needle.
9. Using gravity, flip the cluster around until the needle rests on zero. Reinstall it in the dash.

Speedometer needle on the right.

Speedometer needle on the left.

10. You may also need to create simple brackets once the trimming is finished. (Arrows) Brackets made from thin metal supports, like the ones used to support the rear of a radio, work nicely to fine tune mounting without removing factory connectors.
11. Once you get the cluster seated and fitting with the upper and lower dash, as well as the bezel, it's time to turn your attention to the PCM.



Red PCM connector.

12. To connect the tachometer you need to tap into the wiring harness from the PCM. You'll need to tap into the "RED" plug at terminal 13 using a mini-pack 100 series connector terminal.
13. Now reinstall the dash and any other trim you removed in reverse order.

The final look.

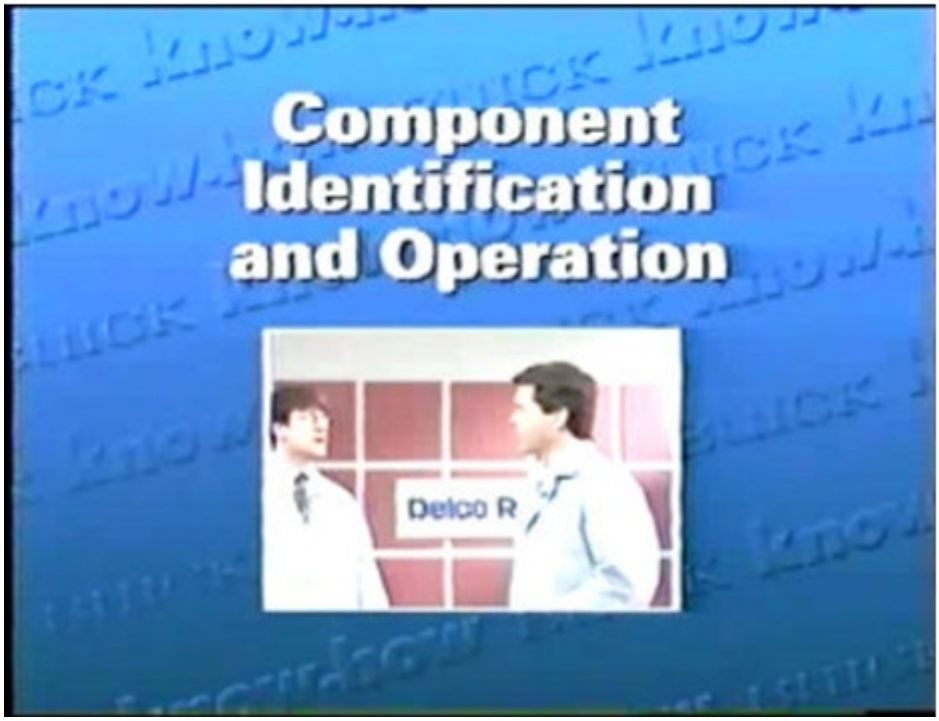
General Information

ABITS (Opti-Spark)

The purpose of this document is to provide very good diagnostic details with screen-shots, documenting each situation.

Author takes NO CREDIT for the information provided, all that was done was to cull it down to detailed text and screen shots taken from the original video (http://tinyurl.com/6cfcpnr)

› LT1 Optispark (ABITS) Distributor Operation and Diagnostics

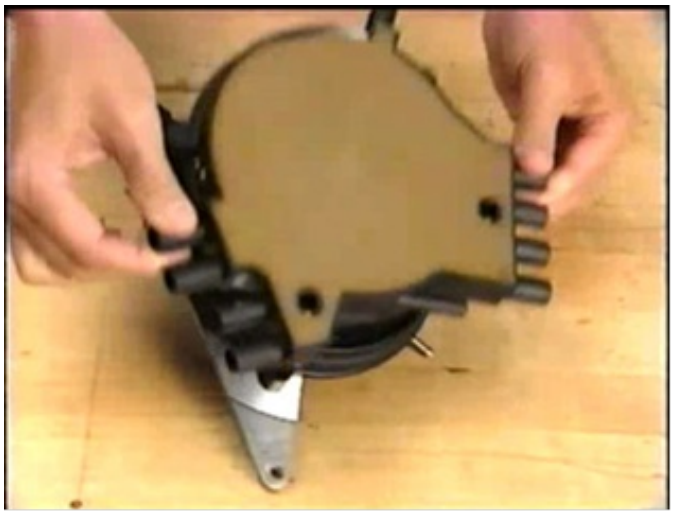


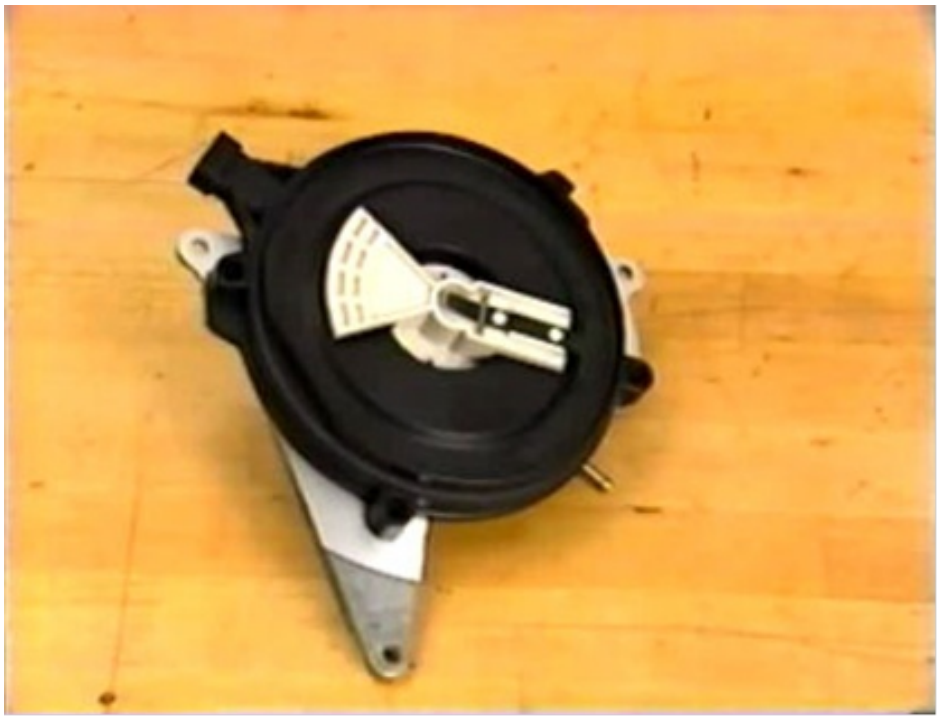
The distributor shaft is driven by the camshaft.

A pin in the camshaft sprocket engages a slot in the distributor.

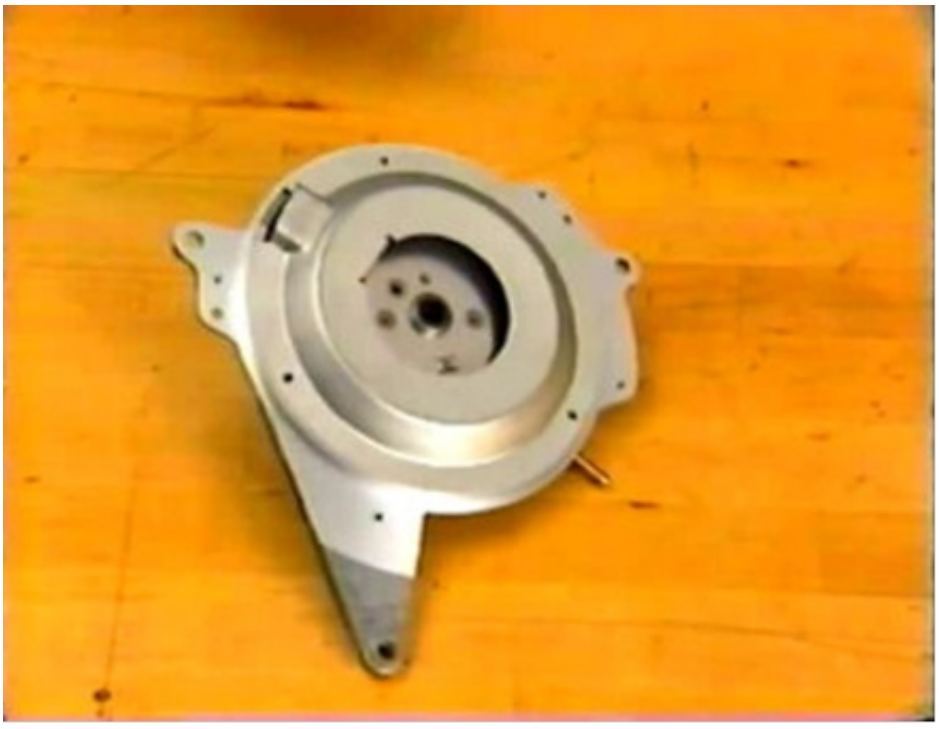
This is known as Pin Drive is a more robust design than spline drive distributors.

A Pin Drive unit can be identified by the Forced Air Ventilation System

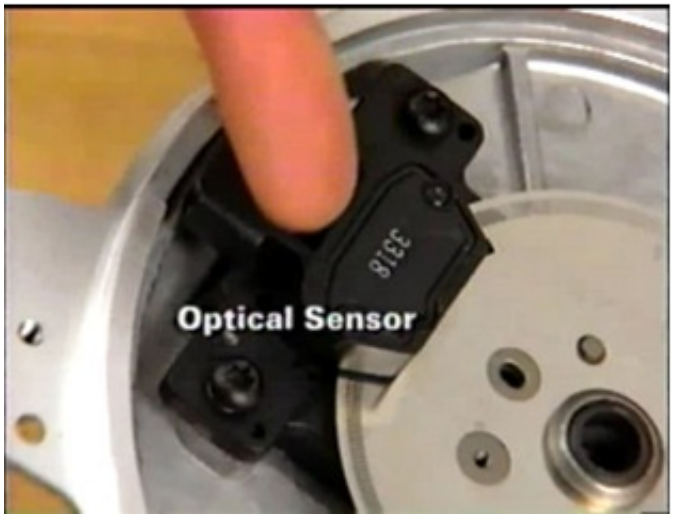




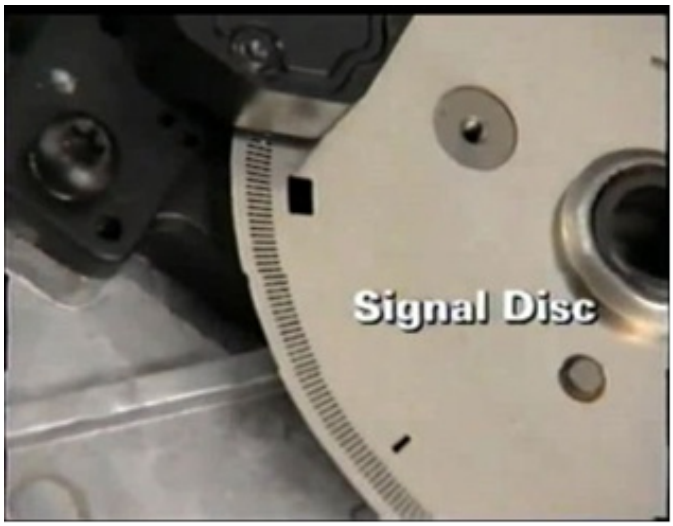
Inside the ABITS there's a rotor with a wide spark edge segment, making for a long life and reduced radio interferrence.



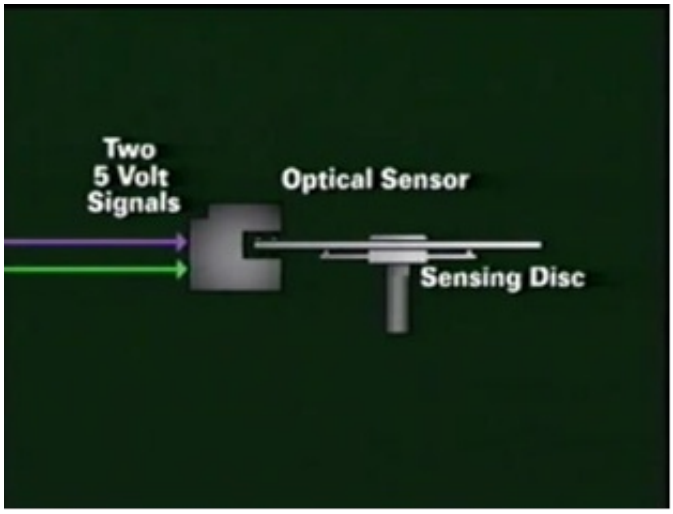
Underneath the rotor and protection shield lie the heart of the ABITS. Bolted to the pickup assembly is optical sensor.



The Optical sensor consists of two Photo LED diode pairs



The Optical sensor is mounted so a two-track signal is between the LED and the Photo Diode



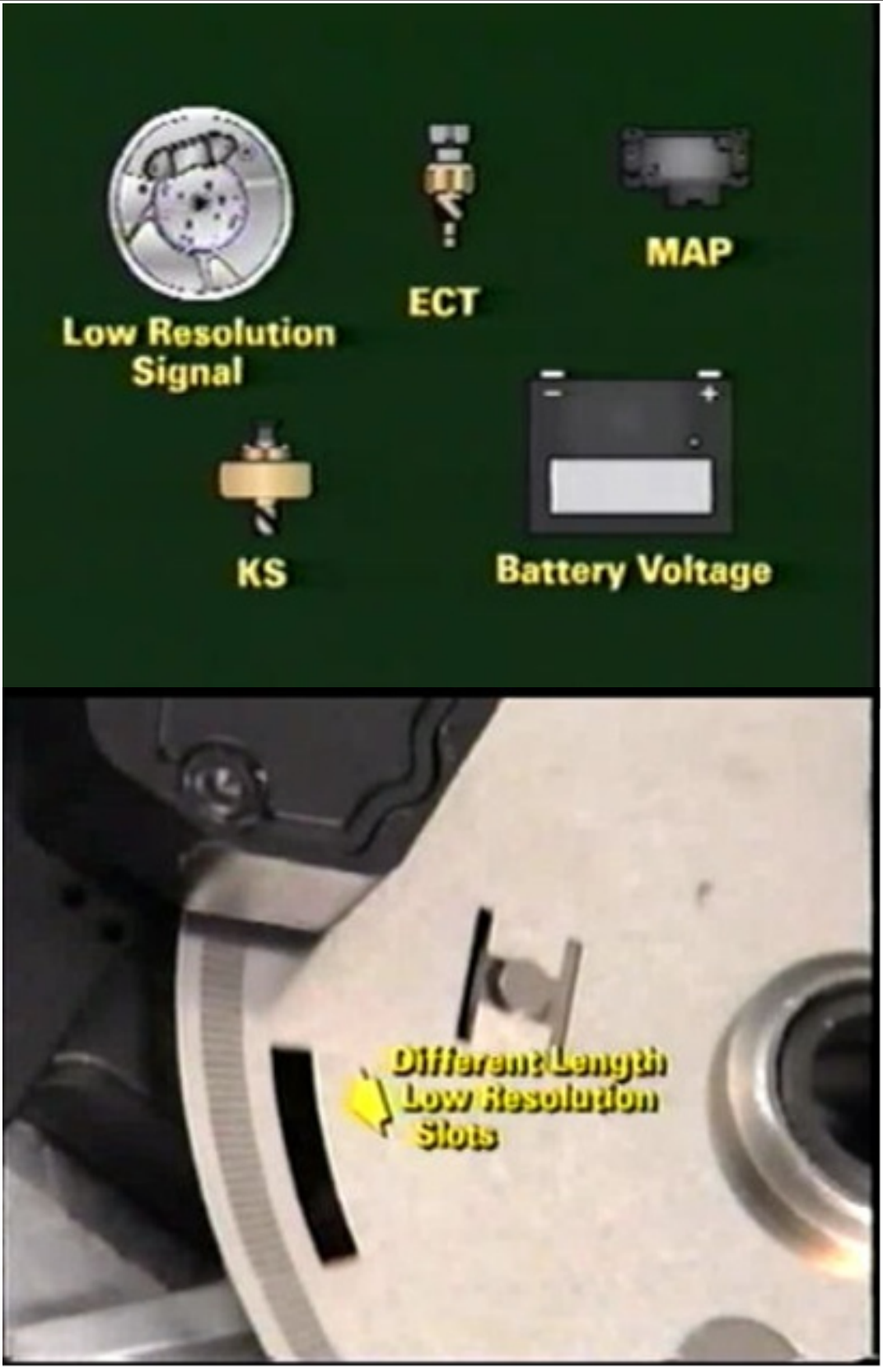
The Signal disc is connected to the distributor shaft and turns with the camshaft. The PCM sends two 5Volt reference signals to the optical sensor as the signal disc turns the two rows of slots on the signal disc pass beteeen the LED photo diode pair this results in two pulsing signals. They are used to toggle the two 5V reference signals that are sent from the PCM to ground or ZERO volts

The outer ring of the signal disc contains 360 slots, which provide 720 tiny edges for the PCM. This is known as the high resoultion signal.

The inner ring of the disc has 8 slots, each of which have a leading edge 45 cam degrees away from the next slot. These leading edges mark TDC for each cylinder.

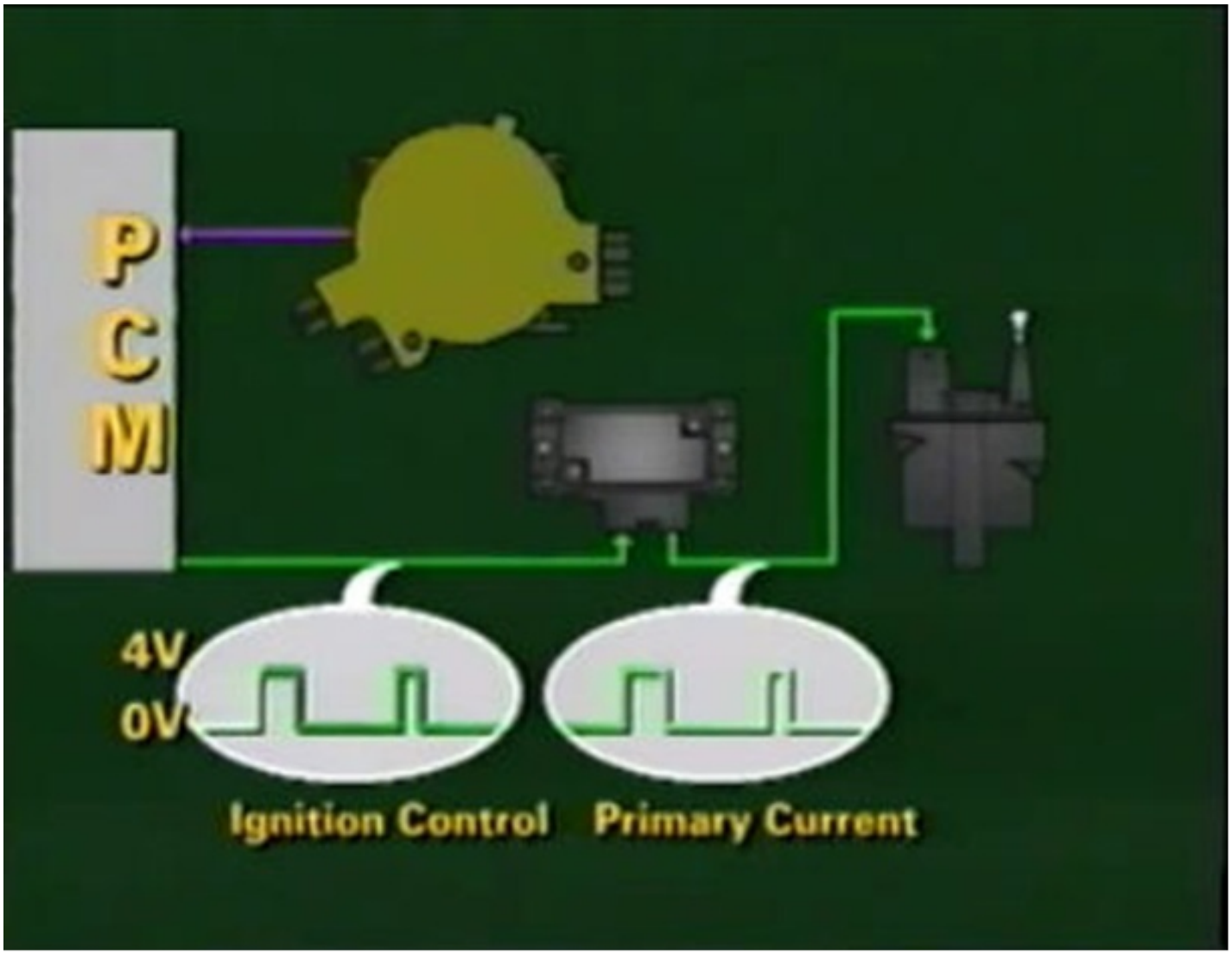
These leading edges mark TDC for each cylinder. The slots are different sizes, enabeling the PCM to identify specific cylinders.

The PCM does this by counting the high resolution signal as the low resolution slots pass the optical sensor. Different length low resolution slots allow the PCM to identify the different cylinders.



Using inputs from the low resolution signal Including ECT, MAP, KSs and battery voltage the PCM calculated coil dwell and spark advance.

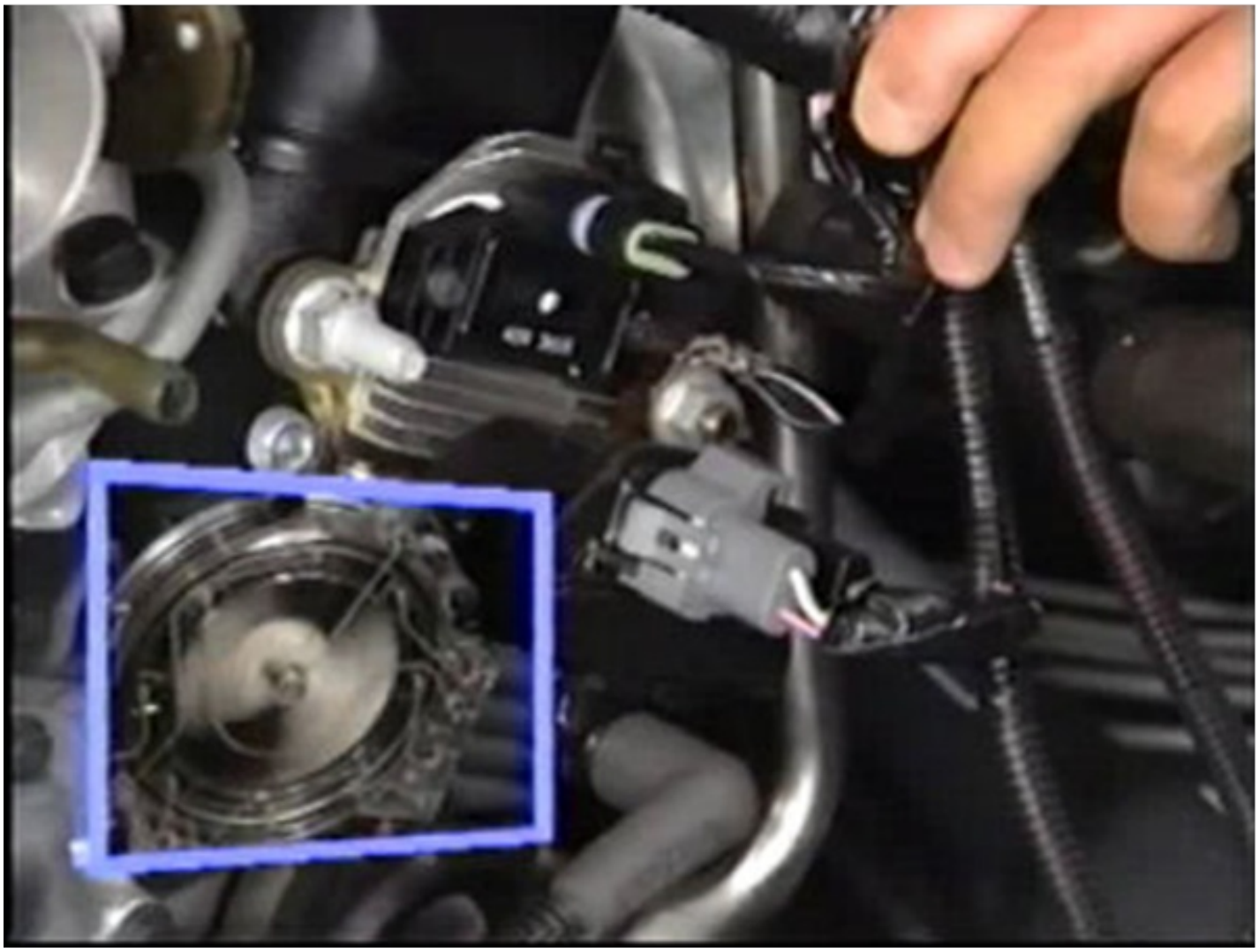
From a low resolution signal going high the PCM starts counting high resolution signals to the beginning of coil dwell and spark advance.



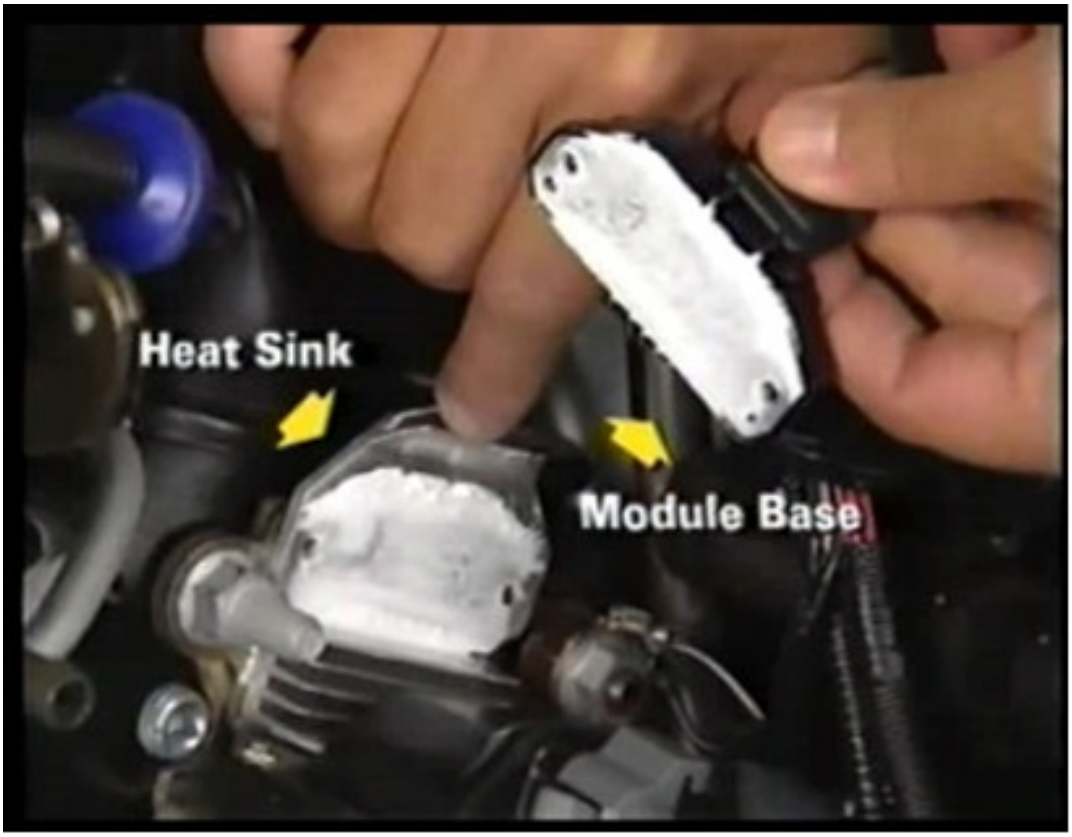
The PCM then generates an electronic spark timing, for the ignition control outout, for the ignition control driver module. The ignition control driver module turns on the primary current to the ignition coil when the ignition control voltage goes approximately 4Volts. When the PCM counts enough high resolution edges to reach the calculated spark advance it terminates the ignition control signal, and the ignition module turns off primary voltage to the coil.

When the ignition control signal stops the primary current in the coil switches off inducing high voltage in the coil's secondary winding. The high voltage runs from the secondary of the coil to the rotor and is distributed to the correct spark plug.

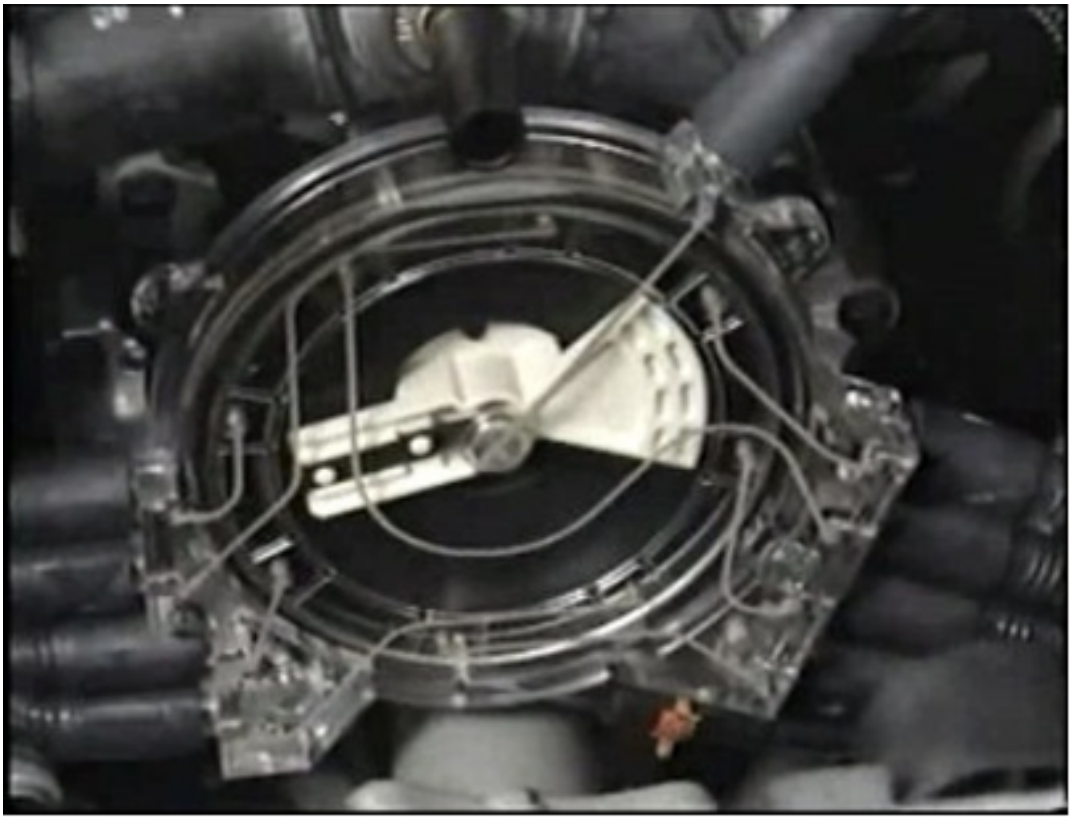
The ICM module doesn't provide a backup mode (I.E. Min function or minimim function).



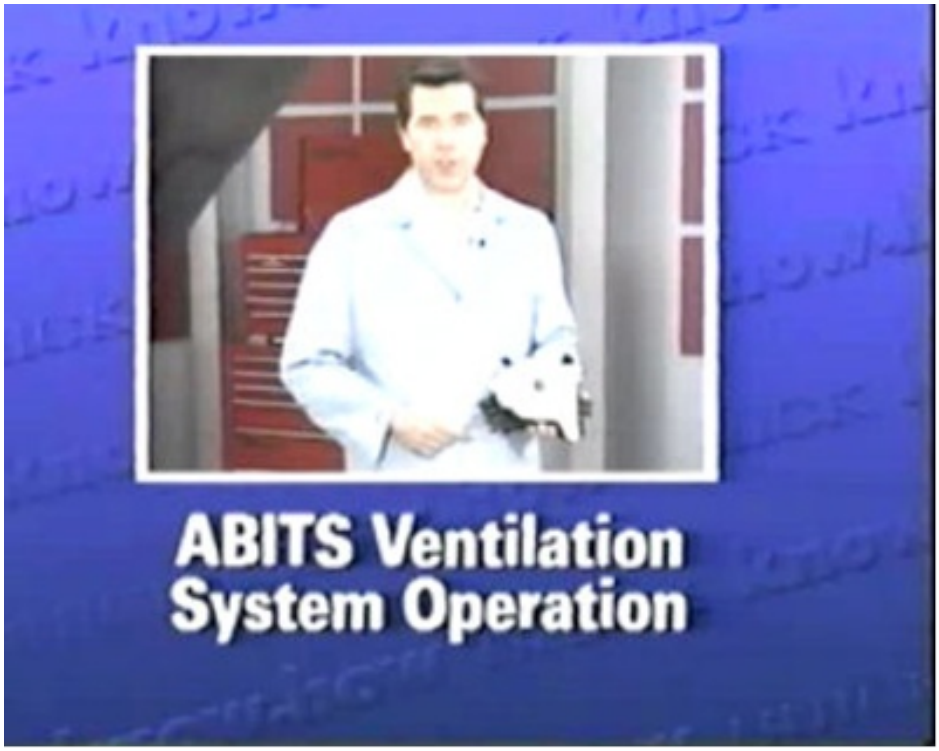

Ignition Coil Driver
Has Built In Current
Limiting Feature



While the Ignition control module is smaller than an HE distributor module, it is still important when installing a new module to **coat both the heat sink and module base with thermal conductive grease.** This helps the module disappate heat. Without the grease the module can over heat and that can lead to failure.



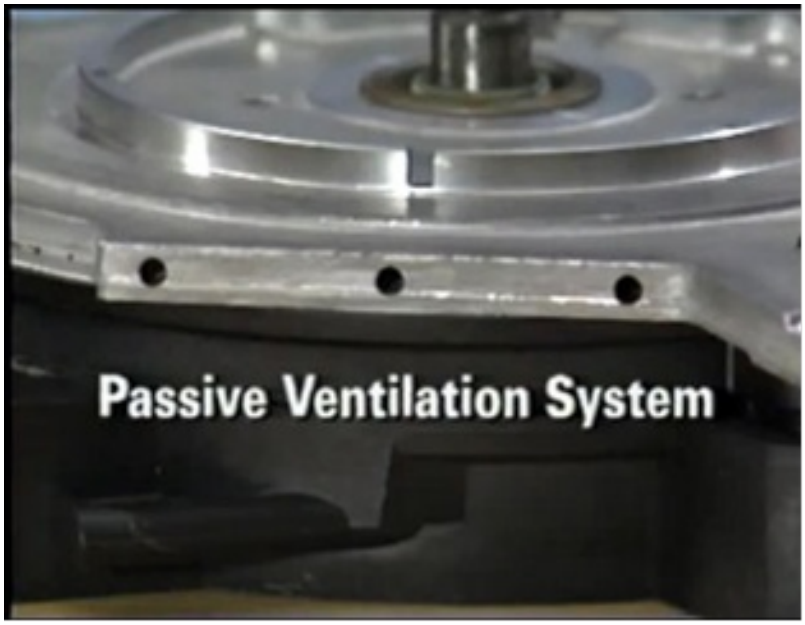
The ABITS distributor cap intruduces secondary towers on the distributor cap conductive traces connect to the spark plug by non radial paths using conductive ink. The ink traces are then encapsulated with epoxy. This routing allows 4 plugs wires on each side without causing crossfire problems.



Proper ventilation is necessarry to prevent moisture buildup corrosive gasses formed by the high voltage arc.

When ABITS was first introduced in 1992 it had ventilation holes drilled across the top.

Ozone is heavier than air so it settles on the bottom of the distributor. And when it forms noitrogen and moisture in the air it forms Nitric Acid. This can create conductive paths, and cause misfires and cross fires.



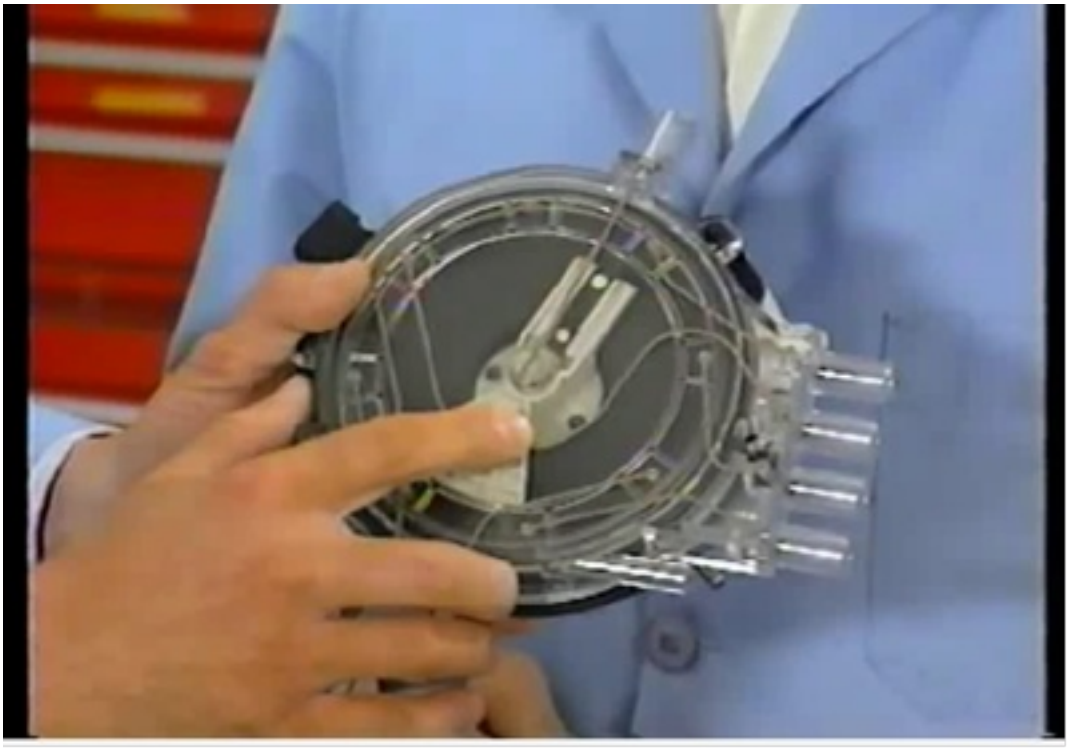
The corrosive problem was solved when the vent holes were moved to the bottom of the ABITS.

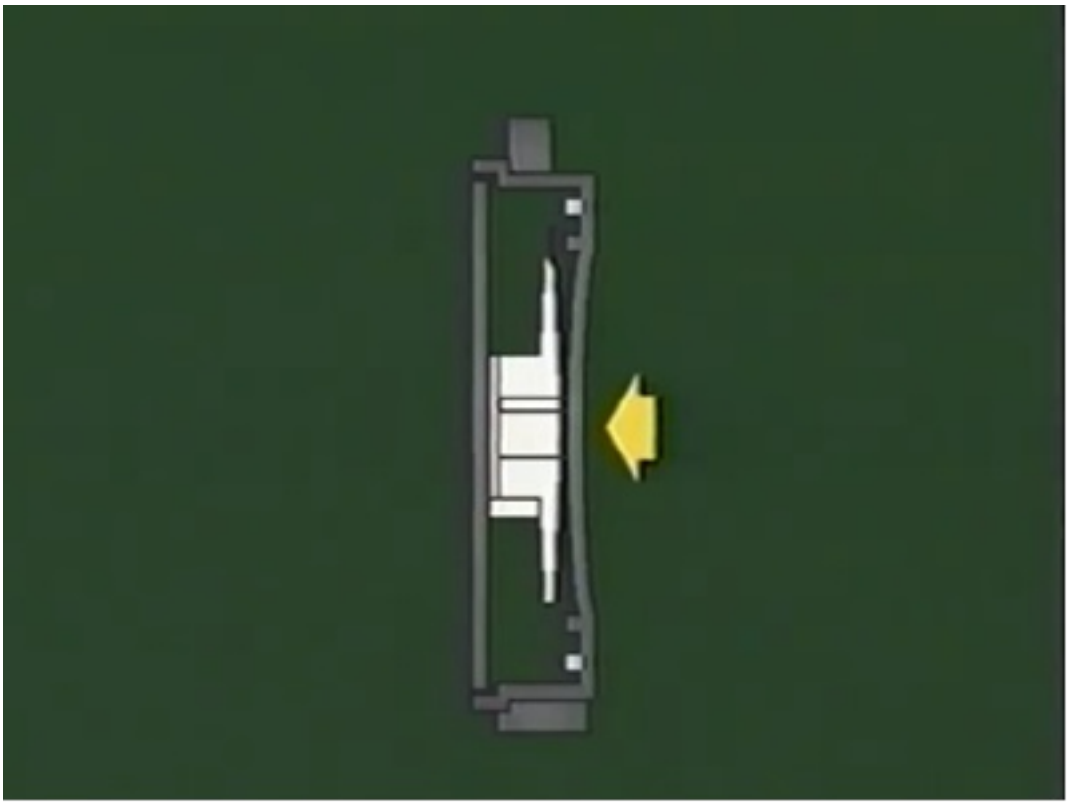
The ventilation is further improved on the RoadMaster design with a forced ventilation system has a fresh air system and a vacuum line.

The fresh air inlet runs from the distributor to the air inlet duct located just after the MAF sensor. By plugging into the line just after the MAF the clean filtered air is accounted for by the PCM and doesn't affect fuel mixture.

Just up from the orifice tube is a check valve. The blue side of the orifice tube faces the intake manifold. Just up from the orifice tube is a check valve. The check valve does not allow air to reurn to the distriubutor.

An inoperative ventilation line is a cause for misfire. If the fresh air inlet line becomes pinched or plugged for any reason, it will draw vacuum on the distributor. As the vacuum is created inside the distributor, the dielectric properties inside will go down, and as that happens, spark that would normally travel from the center of the distributor cap find it much easier to go to the fastening screws on the rotor, which is a goes to GND, causing a misfire..





Other problems may result if the air inlet line is plugged. In some cases engine vacuum is strong engough to collaps the cap until it contacts the rotor. There's enough vacuum to actually bend the distributor cap!

Any tips on checking the ventilation system? Yes, but first let's start the car.

1. Unplug the air inlet of the distributor, and put your finger over it checking for a slight vacuum (Don't forget to plug the hole in the snorkel at this time).

Checking with a vacuum gauge (Mity-Vac or equivalent), Remove the air inlet from the snorkle and hook a vacuum gauge up tho the inlet line. As engine runs the vacuum gauge should drop to very near intake manifold vacuum..

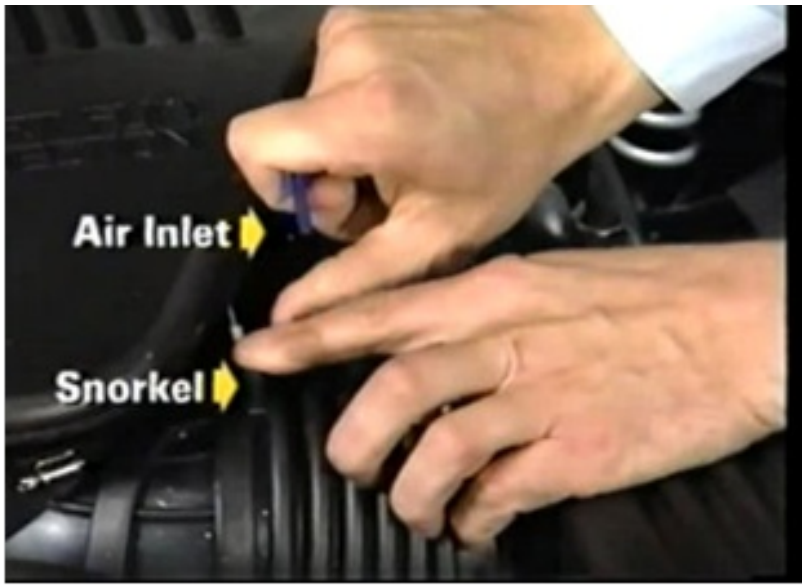
Check for pinched vacuum hoses and also check for:

- Pinched or damaged hoses
- Pinched or plugged orifice
- Plugged check valve
- Poor distribution cap seal

The harness is serviced as an assembly ONLY.
Upper ventilation is essential to good ABITS operation.
Fouled Plug vent systems may lead to:

- Fouled plugs & Misfires

A misfire may be caused by a ventilation system problem.
The causes of NO spark & Intermittent complaints require addition diagnosis.

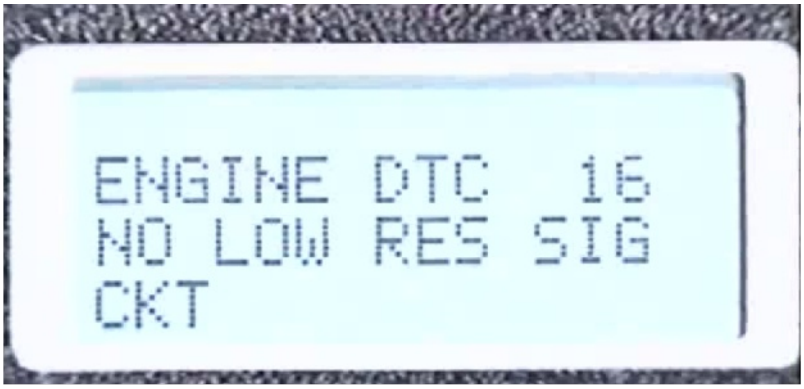


A Misfire may be caused by fouled plugs and plug wires

A Misfire may be caused by ventilation system problems. The causes of NO spark or intermetent complaints require additional diagnosis, Begin your system check with the ignition system check know how technican's manual.

The first step of this process is to check for trouble codes using the TECH-1.
In addition to code 42, found on most ignition systems, ABITS has 16, 36 and 41 to aid in diagnostics of problems

Code 16 is Set



16= Low Resolution

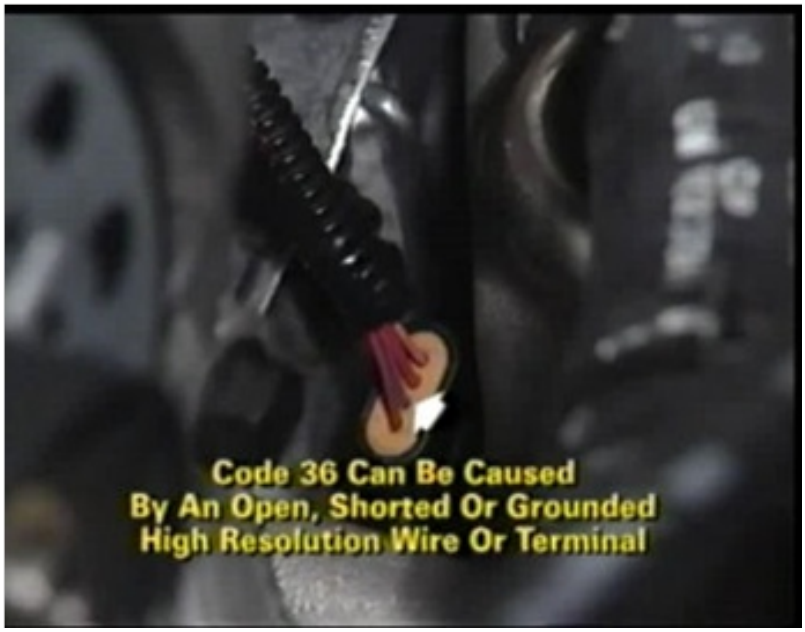
- If 720 high resolution signals are seen by the PCM without a low resolution signal)
- (If the camshaft turns 1 complete revolution & the ABITS doesn't provide high resolution signal for piston location, a code 16 is set.
- The optical sensor diode for the high resolution signal must operate before a code 16 is set.
- A code 16 can be set by: an open, Shorted, or grounded low resolution wire (Open Terminal), failed optical sensor, or a failed PCM.
- **ENGINE WITH CODE 16 WILL NOT START**

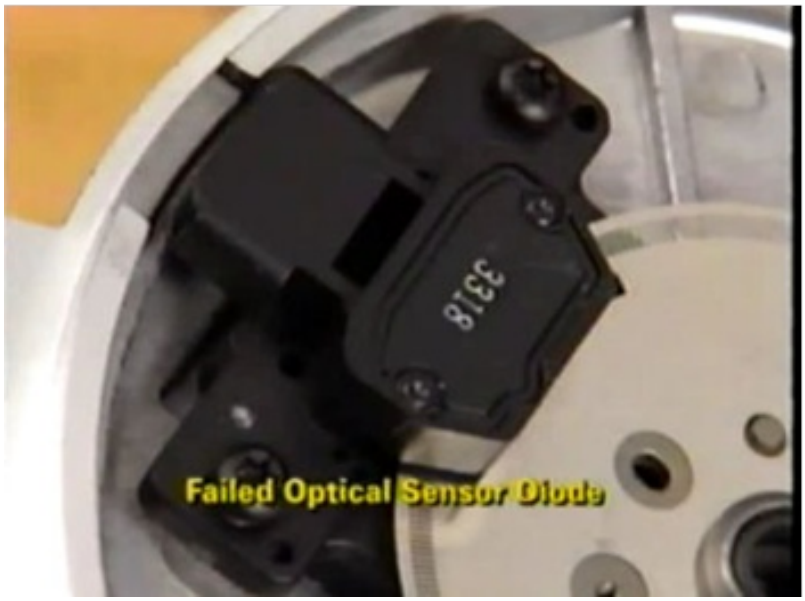
Code 36 is set if

- If PCM doesn't get Hi-resolution signal for 9 consecutive low resolution signals.

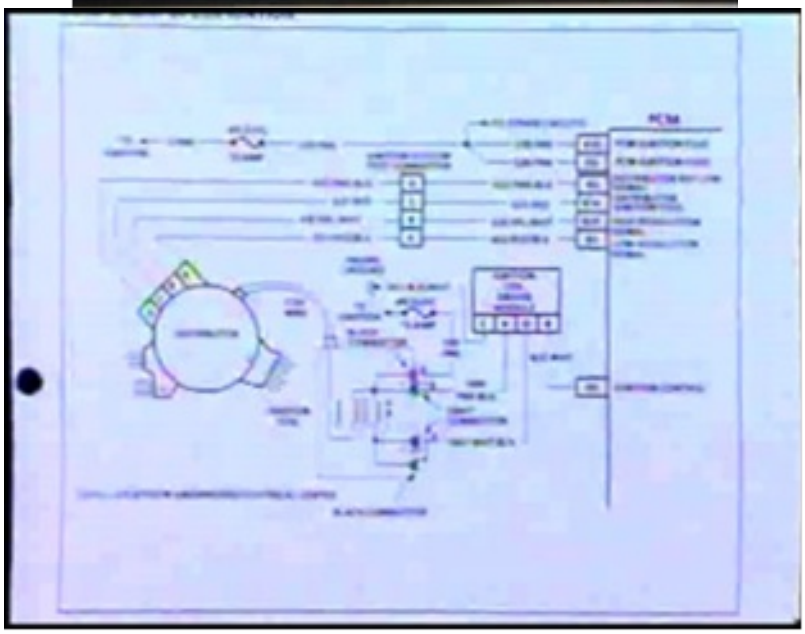
1. An open or shorted or grounded high resolution wire or open terminal.
2. A failed optical sensor diode.
3. Failed PCM

A code doesn't set when both optical diodes fail, but then the engine won't start either.




3318
Failed Optical Sensor Diode


Failed PCM

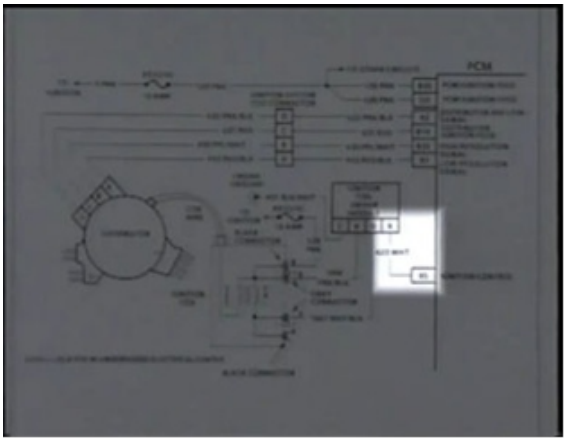


Code 41 sets

- In If an open exists in the ignition control circuit.
- The PCM looks for voltages above 4.5 volts on the ignition control line.
- When engine speed is below 1,500 RPM, a code 41 sets if there is an open in the ignition control line (or if the ignition control line is shorted to voltage that is higher than 4.5 Volts)

Code 41 also sets if there is also an open terminal in the ignition control line.

- Code 41 sets if there is an open terminal.
- Failed PCM control driver module
- Ignition system check in tech manual (Shown above)
- Failed icon control driver module.
- Failed ICM control driver module
- Failed PCM (If voltage is less than 4 volts)



A Code 42 is set

If the Ignition control line is grounded The PCM considers the control line grounded. (Less than if voltge is less than 4 volts) A code 42 is most likely caused by a grounded ignition control wire. But it could also be cause by a failed ignition driver module, or a failed PCM.

Code 41 & 42 are stored in Memory. If either are detcted the engine won't start. The PCM disbles the fuel injectors and don't rurn on the MIL.

The ignition system checking chart becomes Invaluable.

It provides an organized approach to engine diagosis

Check for voltage with an ST-125 (25K to fire this is an excellent test when checking for a misfire The ignition system may be providing enough voltage to run the engine but not enough to fire the spark plugs under heavy load). Resulting in a misfire. Since the ST-125 requiers 25,000 volts to fire it can be use used the ignition system is producing enough voltage to fire. If the system isn't producing adequate voltage Check the voltage in the primary ignition cicruit

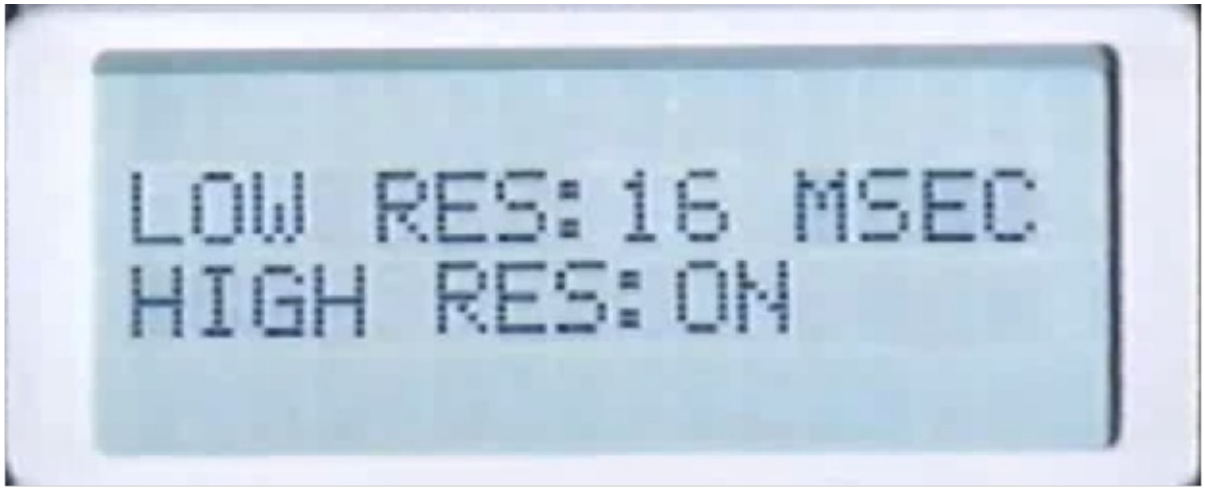
Disconnect the ignition coil driver module, and with the igniton ON check the voltage from terminals A and D to Ground

If the coil is receiving adequate voltage both terminals should be receiving (10 volts or more)

Next connect the probes to Terminal 'B' (The ignition control line) and GND. And set the DVOM to the A/C scale. Crank the engine, there should be between 1 and 4 volts.

This check is the first in determining if the PCM is providing a signal to the ignition coil driver module. If the PCM Isn't providing a signal to the ignition coil driver module, the problem exists between the distributor and the PCM.

If there wasn't 1-4 Volts the ignition system check examines more closely where the signal from the PCM is breaking down.



Using the Tech-1 see if there is a low resolution signal. If there isn't, turn the ignition off and disconnect the distributor electrical connector.

- Turn the ignition Back on
- Probe terminal C with a test light (as shown)

The light should illuminate, and if it doesn't there isn't any power going to the optical sensor.
The remaining test checks the various circuits individually. To see if the proper signals are being sent and received from both the distributor and PCM.
If the light illuminated in the last test check for continuity between distributor connector D and Ground. The circuit should have continuity.

Then using a DVOM on the DC scale

Measure voltage at distributor connector "A" (Checking the low resolution signal)

Voltage should be about 5 Volts.

Repeat the measurement at distributor connector “B”
(Checking the high resolution signal). Voltage should also be about 5 volts.

In this way the ignition system check chart thoroughly tests each component of the ignition system.
Many ignition system failures are intermittent in their early stages.
These are especially difficult to find. The best approach is to try and reproduce the conditions under which the problem occurs. Usually this means vibration, thermal stress. Raising engine coolant temperature or operating the engine in a specific RPM may bring out the failure.
Misfires are intermittent and appear only under load

Misfires are also due to a spark plug or secondary wire that is leaking voltage. If the engine misfires only under a load, mist the wires with a vegetable sprayer. Spark escaping from the secondary circuit can usually be seen under these conditions.

Part Numbers

Here is a list of part numbers some may find useful while doing routine maintenance on their LT1's. REMEMBER, these numbers are for reference, so VERIFY them before placing an order.

2503679	1 BAR MAP SENSOR
12343958	12-DISC CD CHANGER ONLY USED WITH CASSETTE PLAYER.
12344015	12-DISC CD CHANGER HARNESS ONLY USED WITH CASSETTE PLAYER.
25008308	3.5" MAF SENSOR
12486041	350 HO CRATE MOTOR (330HP)
12495515	350 RAM JET MOTOR 350HP
12497323	502 RAM JET CRATE MOTOR 502HP
22094330	91-96 B-BODY WINDSHIELD WIPER ARM CAP
3535261	91-96 B-BODY WIPER ARM MOUNTING NUT
16188051	94-95 LT1 PCM
12552898	A.I.R. CHECK VALVE
22048212	A.I.R. PUMP CHECK VALVE 95-96
14100455	A.I.R. PUMP RELAY
12569122	A.I.R. SYSTEM DISABLE HOSE PLUG
12569123	A.I.R. SYSTEM DISABLE STICKER
52455732	A/C BLOWER MOTOR RESISTOR
12088567	A/C COMPRESSOR RELAY 95-96 ONLY
10115875	A/C DELETE PULLEY 1LE
52458911	A/C VAC CHECK VALVE A/C DASHBOARD
14056648	A/C VACUUM CHECK VALVE VACUUM HOSE ON ENGINE
12524176	ABS SENSOR O-RING REAR AXLE
10242904	ACCELERATOR LINKAGE
11505169	ACCELERATOR LINKAGE BOLT
16757619	AIR BAG ASSEMBLY LIGHT GREY
10220594	AIR DEFLECTOR 9C1 - LEFT
10220593	AIR DEFLECTOR 9C1 - RIGHT
10188889	AIR DEFLECTOR BOLT FRONT AIR DAM - PK OF 10
10109530	AIR DEFLECTOR CENTER - 9C1 & SS
11514407	AIR DEFLECTOR NUT-CLAMP PACK OF 10
10161939	AIR DEFLECTOR SS - LEFT
10161938	AIR DEFLECTOR SS - RIGHT
25096932	AIR FILTER
25099478	AIR FILTER OUTLET DUCT PITCHER'S MOUND
25099945	AIR FILTER RESONATOR FRONT
25162682	AIR FILTER RESONATOR REAR
25147187	AIR INTAKE ELBOW 1LE - FOR VENTED OPTI
25147210	AIR INTAKE ELBOW 1LE - NO VENT FOR OPTI
25147186	AIR INTAKE ELBOW W/ATT 1LE
12344732	ALARM - VSS-150
12102668	ANTENNA CONNECTOR
10197140	ASHTRAY
12176639	AUX BATTERY POST
26018943	AXLE - 3.08 RELUCTOR B-BODY

26018944	AXLE - 3.23 RELUCTOR B-BODY
26029418	AXLE - 3.42 GEARS FACTORY RING & PINION
26033578	AXLE - 3.42 GEARS PINION SEAL
26018945	AXLE - 3.42 RELUCTOR B-BODY
26018946	AXLE - 3.73 RELUCTOR B-BODY
26014585	AXLE - 4.10 GEARS MOTIVE GM MOT-
26016309	AXLE - 4.10 GEARS RING & PINION
9420095	AXLE - CARRIER SIDE BEARINGS 3.42 GEARS
26066456	AXLE - DIFFERENTIAL COVER GASKET 2ND DESIGN
55028-1	AXLE - DIFFERENTIAL COVER GASKET FELPRO RDS
1052271	AXLE - DIFFERENTIAL LUBE 80W/90
14056196	AXLE - DIFFERENTIAL RETAINER PIN PACK OF 10
14091497	AXLE - FACTORY RING & PINION
1052351	AXLE - GEAR MARKING COMPOUND
1052358	AXLE - LIMITED SLIP ADDITIVE
1234726	AXLE - PINION CRUSH COLLAR 3.42 GEARS
9418356	AXLE - PINION FRONT BEARING 3.42 GEARS
1260823	AXLE - PINION NUT
9413427	AXLE - PINION REAR BEARING 3.42 GEARS
26064028	AXLE - PINION SEAL (NEW STYLE) WON'T WORK W/STOCK YOKE
554631	AXLE - SEALS
12470387	AXLE - YOKE SERVICE KIT CONT. NEW PINION FLANGE
10128489	BALANCER/DAMPER - LT1 GM 92-97
12551138	BALANCER/DAMPER 93-95
9440024	BALANCER/DAMPER BOLT
716910	BALANCER/DAMPER FLUIDAMPER 93-97
10168570	BALANCER/DAMPER HUB 93-95 B-BODY
12550097	BALANCER/DAMPER HUB 96
12550098	BALANCER/DAMPER HUB 96-97 LT1 & LT4
1981590	BATTERY SEO HEAVY DUTY
10109535	BATTERY TRAY
12550149	BELT
4040372	BELT 9C1 W/HD COOLING
4060642	BELT ACCESSORY
K060637	BELT GATES 21MM X 1635MM
12552509	BELT TENSIONER
457917	BODY BUSHING POSITION 7 - DK GREEN
457915	BODY BUSHINGS POSITION 1,2,3,4,6 - PINK
12361405	BOOST GAUGE 0-10PSI/0-30"2-5/8" W/BOWTIE
12361397	BOOST GAUGE 0-10PSI/0-30"2-5/8" W/GMPP
18021519	BRAKE - CALIPER BRACKETS 9C1 - CAD PLATED
18021945	BRAKE - CALIPER BRACKETS IMPALA - BLACK FINISH
18021517	BRAKE - CALIPER LH REAR
18021518	BRAKE - CALIPER RH REAR
18021516	BRAKE - EMERGENCY BRAKE KIT
18005606	BRAKE - FRONT CALIPER BUSHINGS ONE KIT PER CAR
18024928	BRAKE - FRONT PADS

88917169	BRAKE - FRONT PADS (CERAMIC) AC 17 D614C
18039371	BRAKE - FRONT ROTOR (L) DURASTOP HP 18A1030
18039372	BRAKE - FRONT ROTOR (R) DURASTOP HP 18A1031
18027999	BRAKE - FRONT ROTOR DURASTOP #18A399
18021344	BRAKE - FRONT ROTOR IMPALA SS ACD 177-753
18021049	BRAKE - FRONT ROTOR NON-IMPALA SS ACD 177-754
18021515	BRAKE - PADS EMERGENCY BRAKE
10223533	BRAKE - PROPORTIONING VALVE
12337902	BRAKE - REAR BRACKET CALIPER BOLT
14067559	BRAKE - REAR CALIPER BOLT GUIDE PIN
14067552	BRAKE - REAR CALIPER BOOT GUIDE PIN
18022147	BRAKE - REAR CALIPER, GUIDE PIN
18021521	BRAKE - REAR PADS
18028256	BRAKE - REAR ROTOR DURASTOP #18A656
5976306	BRAKE - UPPER LAMP ASSEMBLY
10225142	BUICK HARMONICS BRACE
10214403	BUMPER COVER FRONT
10214405	BUMPER COVER REAR
10214402	BUMPER COVER RETAINER
10249326	BUMPER MOLDING FRONT - BLACK
10267872	BUMPER MOLDING FRONT - DCM
10267871	BUMPER MOLDING FRONT - DGGM
10249329	BUMPER MOLDING REAR - BLACK LH
10249328	BUMPER MOLDING REAR - BLACK RH
10186281	BUMPER REINFORCEMENT FRONT
10161976	BUMPER REINFORCEMENT REAR
15989674	BUMPER, LOWER CONTROL ARM, FROM S10 ZQ8 SUSPENSION PACKAGE.
10185071	CAMSHAFT CAMARO ZZ3 HO 350 CAM
10243779	CAMSHAFT LT1
12370406	CARPET / MATS BLACK MAT SET FRONT
12370411	CARPET / MATS BLACK MAT SET REAR
12343624	CARPET / MATS GRAY FRONT
12343594	CARPET / MATS GRAY REAR
12528553	CARPET / MATS GREY CARPET
10253509	CARPET / MATS RETAINER LF DOOR
10222523	CARPET / MATS RETAINER LR DOOR
10253508	CARPET / MATS RETAINER RF DOOR
10222524	CARPET / MATS RETAINER RR DOOR
10249851	CAT HEAT SHIELD (1 OF 2)
10222996	CAT HEAT SHIELD (2 OF 2)
10249851 10222996,	CAT HEAT SHIELDS
12462981	CD CHANGER 12-DISC
11516141	CIGARETTE LIGHTER
11516142	CIGARETTE LIGHTER ASSEMBLY SOCKET & LIGHTER
10248599	CIGARETTE LIGHTER BEZEL RIGHT SIDE OF RADIO
20038997	CLIP - RETAINER ACC & CRUISE CABLES
12371180	CLOCK GAUGE 2-5/8" W/WHITE FACE/BOWTIE

10260084	COIN HOLDER LEFT OF STEERING WHEEL
EAG-CRS5700B3D	CONNECTING RODS - STROKER EAGLE 5.7" 650G
12495071	CONNECTING RODS GM STOCK 5.7" - SET OF 8
22555614	CONSOLE HINGE
12531192	CONSOLE LID
10282773	CONSOLE SHIFTER ASSEMBLY
10271069	CONSOLE SHIFTER PLATE TOP COVER - 96
15956547	CONTROL ARM - BUMP STOP NEW S10 ZQ8 DESIGN
88912477	CONTROL ARM - BUMP STOP W/SELF LOCKING NUT
10282171	CONTROL ARM - LOWER FRONT HEAVY DUTY 5/8" - LEFT
10282172	CONTROL ARM - LOWER FRONT HEAVY DUTY 5/8" - RIGHT
10255857	CONTROL ARM - REAR AXLE NUT 9C1
18021377	CONTROL ARM (HD) STEERING KNUCKLE LH - 5/8"
18021378	CONTROL ARM (HD) STEERING KNUCKLE RH - 5/8"
11508196	CONTROL ARM BOLT 9C1 REAR AXLE
10289786	CONTROL ARMS REAR AXLE KIT
10283878	COOLANT - DEXCOOL NOTICE STICKER
10285918	COOLANT - DEXCOOL RADIATOR CAP
10258505	COOLANT - FLOW CONT VALVE W/HOSES SEO GREEN - AC #15-5508
12135027	COOLANT - LEVEL SENS (8-WIRE)
12522853	COOLANT - RADIATOR HOSE KIT (?) SEO GREEN - 94 ONLY?
10197619	COOLANT - RADIATOR HOSE SEO LOWER
10260863	COOLANT - RADIATOR HOSE UPPER SEO GREEN
10246557	COOLANT - RADIATOR INSULATOR UPPER
12528777	COOLANT - RADIATOR OVERFLOW TANK
10219447	COOLANT - RADIATOR RECOVERY HOSE SEO GREEN
12522746	COOLANT - RADIATOR SUPPORT BRACE
12522867	COOLANT - RADIATOR TEE HEATER WATER BYPASS
10108635	COOLANT - STEAM PIPE ASSEMBLY 93-94-INCL SEALS & HOSE
12556260	COOLANT - STEAM PIPE CROSSOVER 95/96-INCL SEALS/HOSE/BOLTS
10108689	COOLANT - STEAM PIPE SEALS 93-96
12371176	COOLANT - TEMP GAUGE 140-250 2-5/8" W/WHITE FACE/BOWTIE
12361394	COOLANT - TEMP GAUGE140-240 2-5/8" W/GMPP ON FACE
12361402	COOLANT - TEMP GAUGE140-280 2-5/8" W/BOWTIE ON FACE
10096181	COOLANT - TEMP SENDING UNIT
25037332	COOLANT - TEMP SENSOR (GAUGE) AC #213-77
15326386	COOLANT - TEMP SENSOR (PCM) AC# 213-310 15326386 $ 10.95
12146312	COOLANT - TEMP SENSOR (PCM) NEW P/N 15326386
10157988	COOLANT FLOW CONTROL VALVE 8.866 (ALSO ACDELCO 15-5423)
10096163	COOLANT LEVEL SENSOR 2-WIRE 10096163 $ 23.35
12552974	COOLANT STEAM PIPE BOLTS 93-96 12552974 $ 3.07
12193604	COOLING FAN RELAY 94-96 - AC #15-8733
10208795	CORVETTE FUEL - RAIL COVER (LH)
10208794	CORVETTE FUEL - RAIL COVER (RH)
1022493692	CORVETTE FUEL - RAIL COVER (RH) STEEL VALVE COVERS
10214035	CORVETTE FUEL RAIL COVER HOSE BRAKE VACUUM BOOSTER
10476885	CRANK POSITION SENSOR SEAL 96 ONLY—OBD II

10128365	CRANKCASE VENT HOSE 93-96 - FM V/C TO T/B
14088556	CRANKSHAFT - REAR MAIN SEAL HOUSING 93-96
12556307	CRANKSHAFT LT1 - OLD P/N 12551485
12555771	CRANKSHAFT REAR MAIN HSG GASKET 93-96
10088158	CRANKSHAFT REAR MAIN SEAL 93-96
12554314	CRANKSHAFT REAR MAIN SEAL REV GM LT4 DOUBLE LIP
10128316	CRANKSHAFT SEAL - FRONT 93-96
25140611	CRUISE CONTROL MODULE
10261527	CUP HOLDER CONSOLE INSERT
12561166	CYLINDER BLOCK LS6
585927	CYLINDER HEAD DOWEL PIN 93-97
12369145	CYLINDER HEAD GASKET KIT FOR ALUMINUM HEADS
12553160	CYLINDER HEAD GASKET LT1 IRON - .029" COMP
12480092	CYLINDER HEAD HP LT1 IRON
12556463	CYLINDER HEAD HP LT4 - HOT CAM
12560801	CYLINDER HEAD LS6
12529741	CYLINDER HEAD LT1
10207643	CYLINDER HEAD LT1 ALUMINUM
12363287	CYLINDER HEAD STOCK LT4-COMPLETE
11-235-4103	CYLINDER HEAD STUDS ARP
10248200	DASH PAD (GRAY)
10268239	DASH PLATE CAPRICE SS
10250947	DASH PLATE IMPALA SS
24210915	DEEP TRANSMISSION PAN--NO DRAIN PLUG
12344998	DETAIL KIT IN A CASE WITH BOWTIE LOGO
12346290	DEXCOOL GALLONS
10474278	DISTRIBUTOR DRIVE SHAFT SEAL
16671511	DOOR COURTESY LAMP
16627914	DOOR HANDLE BLACK
10273578	DOOR HANDLE PRIMED
166300597	DOOR LOCK MODULE 6N1 - POLICE
10190343	DOOR PANEL - OUTER SHELL LR
10190342	DOOR PANEL - OUTER SHELL RR
10250953	DOOR PANEL INNER SHELL LH
10250952	DOOR PANEL INNER SHELL RH
12521582	DOOR PANEL OUTER SHELL LF
12521583	DOOR PANEL OUTER SHELL RF
15600382	DOOR PANEL RETAINERS (20)
16671421	DOOR PULL BLACK
10111989	DOOR SILL PLATE FRONT DRIVERS
10031004	DOOR SWICTH LAMP BLUE PONTIAC
16671169	DOOR TRIM - WOOD GRAIN BEZEL
20669667	DRIVING LIGHT LAMP ASSY SWITCH
10054880	EGR - BLOCK-OFF PLATE
10055726	EGR - PIPE GASK 94-96
1997223	EGR - SOLENOID VALVE
17113382	EGR - VALVE B-BODY

17113381	EGR - VALVE F-BODY
12337972	EGR & EGR BLOCK-OFF PLATE GASKET AC #219-21
12129481	ELECTRICAL RECALL PARTS BUSBAR CAVITY
12146182	ELECTRICAL RECALL PARTS BUSBARCAVITY
12146183	ELECTRICAL RECALL PARTS CENTER STUD
11516161	ELECTRICAL RECALL PARTS NUT&STUD ASSEMBLY
12161130	ELECTRICAL RECALL PARTS STUD ASSEMBLY
12344614	ELECTROCHROMIC MIRROR WITH COMPASS
10424491	EMBLEM - C PILLAR LEFT - OLD P/N 10253595
10253594	EMBLEM - C PILLAR NEW P/N 10424490
10253595	EMBLEM - C PILLAR NEW P/N 10424491
10424490	EMBLEM - C PILLAR RIGHT - OLD P/N 10253594
11516061	EVAP - BRACKET BOLT
10229207	EVAP - BRACKET FUEL TANK EVAP - CONT
17113065	EVAP - CANISTER
12553048	EVAP - CANISTER BRACKET
12551177	EVAP - CANISTER BRACKET BOLT
11514596	EVAP - CANISTER BRACKET NUT
10009923	EVAP - CANISTER BRACKET RETAINER PACK OF 10
11509509	EVAP - CANISTER BRACKET SCREW PACK OF 10
12124134	EVAP - CANISTER CHECK VALVE VACUUM
1997201	EVAP - CANISTER PURGE SOLENOID
12555984	EVAP - CANISTER PURGE SWITCH
9438315	EVAP - HOSE
10105324	EVAP - SOLENOID HOSE FROM THROTTLE BODY
12551376	EXHAUST - EXPORT EMISSIONS STICKER - 94
10243955	EXHAUST - EXPORT EMISSIONS STICKER - 95
12553939	EXHAUST - EXPORT EMISSIONS STICKER - 96
10168551	EXHAUST - EXPORT PIPE GASKET
10204015	EXHAUST - EXPORT PIPE LH
10204014	EXHAUST - EXPORT PIPE RH
10220453	EXHAUST - EXPORT PIPE STUD 10 PER PACK
12552469	EXHAUST - MANIFOLD GASKET 93-96
FEL-1406	EXHAUST - MANIFOLD GASKET FELPRO - BIG "D"-PORT
FEL-1405	EXHAUST - MANIFOLD GASKET FELPRO - BIG SQUARE
FEL-1404	EXHAUST - MANIFOLD GASKET FELPRO - REG SQUARE
10168494	EXHAUST - MANIFOLD LH
12552896	EXHAUST - MANIFOLD LH
12524289	EXHAUST - MANIFOLD RH
12556731	EXHAUST - MANIFOLD RH
10243316	EXHAUST - SYSTEM INSULATOR LARGE
10217783	EXHAUST - SYSTEM INSULATOR SMALL
GMP96B	FACTORY SERVICE MANUALS 2-VOLUME SET
12193601	FAN - BLOWER MOTOR RELAY
30531901	FAN - THERMOSTATIC SWITCH
10281083	FAN SHROUD
12501861	FENDER LEFT FRONT

12522388	FENDER LINER LEFT FRONT
12522387	FENDER LINER RIGHT FRONT
12501860	FENDER RIGHT FRONT
14088765	FLYWHEEL
25121978	FUEL - FILTER
25121293	FUEL - FILTER AC #GF578
17124248	FUEL - INJECTOR 93-96
17113544	FUEL - INJECTOR O-RING SEAL KIT AC #217-1379
12048089	FUEL - LINE RETAINERS ON SIDE OF T/B
12371178	FUEL - PPRESS GAUGE 0-15 2-5/8" W/BOWTIE
10216948	FUEL - PRESS REG VACUUM HOSE
12361404	FUEL - PSI GAUGE 0-15 2-5/8" W/BOWTIE
12361396	FUEL - PSI GAUGE 0-15 2-5/8" W/GMPP
12361398	FUEL - PSI GAUGE TUBING KIT BRADED S/S
EP381	FUEL - PUMP HIGH OUTPUT ACDELCO
12077866	FUEL - PUMP RELAY 94-96 - AC #15-5671
EP376	FUEL - PUMP STOCK ACDELCO
17113251	FUEL - RAIL 94-96 RH
10224936	FUEL - RAIL COVER CORVETT - RH SIDE
10108672	FUEL - RAIL COVER STUD VETT
17113095	FUEL - RAIL KIT PARTS FOR RETURN LINE
10191138	FUEL - TANK HEAT SHEILD (1 OF 2)
10203814	FUEL - TANK HEAT SHEILD (2 OF 2)
25028955	FUEL - TANK LEVEL SENDING UNIT
NAPA 888536	FUEL PUMP HARNESS FOR IN-TANK SENDING UNIT
ACDELCO EP381	FUEL PUMP HIGHER OUTPUT VERSION
ACDELCO EP376	FUEL PUMP OE REPLACEMENT
10191138 10203814,	FUEL TANK HEAT SHIELDS
12527729	GLOVE BOX LATCH
3848911	GM "WHITE" OIL PUMP SPRING
10269614	GRILLE BLACK
10249082	GRILLE BOWTIE CHROME
10269616	GRILLE DCM
10269615	GRILLE DGGM
22591876	GRILLE EMBLEM BLUE BOWTIE
15970086	GRILLE EMBLEM RED "SS"
22591877	GRILLE EMBLEM RED BOWTIE
FEL-1074	HEAD GASKETS (LT1 ALUMINUM HEADS) FELPRO, .039"
10168457	HEAD GASKETS (LT4 ALUMINUM HEADS), .043"
16519235	HEADLIGHT - CAPSULE LEFT
16519236	HEADLIGHT - CAPSULE RIGHT
6288471	HEADLIGHT - CONNECTOR EXPORT T84 CAPSULE
16519237	HEADLIGHT - EXPORT T84 CAPSULE LEFT
16519238	HEADLIGHT - EXPORT T84 CAPSULE RIGHT
16511961	HEADLIGHT - MOUNTING BRACKET LEFT
16511962	HEADLIGHT - MOUNTING BRACKET RIGHT
10161999	HEADLIGHT - OPENING FILLER LEFT

10161998	HEADLIGHT - OPENING FILLER RIGHT
6294068	HEADLIGHT - TERMINAL EXPORT T84 CAPSULE
10279131	HEADLINER
52469251	HEATER CORE
10256544	HEATER CORE HOSE IN/OUT ASSEMBLY SEO GREEN
10164972	HEATER DISTRIBUTOR REAR FLOOR DUCTS
10164975	HEATER OUTLET LH REAR FLOOR DUCTS
10164974	HEATER OUTLET RH REAR FLOOR DUCTS
20030401	HEATER RETAINER REAR DUCT
10248301	HOOD
10109664	HOOD HINGE
10109665	HOOD HINGE
10196123	HOOD INSULATION
20064875	HOOD INSULATOR RETAINER
10203566	HOOD LAMP - DISCONTINUED
15306195	HOOD LAMP CONNECTOR
10186229	HOOD LATCH RELEASE CABLE
1892246	HORN CADILLAC HORN C NOTE
1892162	HORN CADILLAC HORN D NOTE
10128361	HOSE CLAMP VETT PLASTIC VLV COVER
12553250	HUB, BALANCER/DAMPER 93-95 ?
5234890	HYDRAULIC LIFTER 93-95
17120735	HYDRAULIC LIFTER 96
12371042	HYDRAULIC LIFTER KIT
24501365	HYDRAULIC LIFTER, BOLTS
12550002	HYDRAULIC LIFTER, GUIDES
14101116	HYDRAULIC LIFTER, RETAINER
120386	HYDRAULIC LIFTER, WASHERS
CCA-850-16	HYDRAULIC LIFTERS CC HIGH ENERGY
10477208	IGNITION - COIL - 94-95 AC #D573
10489421	IGNITION - COIL - 96 AC #D577
12096466	IGNITION - COIL - WIRE - 93-95 AC PART # 340R
12173578	IGNITION - COIL - WIRE - 96 AC PART # 346U
1115315	IGNITION - COIL 93/AC #D535
10483131	IGNITION - CONTROL MODULE - 93 AC #D1971A
10483139	IGNITION - CONTROL MODULE - 94-95 AC #D1986A
10482803	IGNITION - CONTROL MODULE - 96 AC #579
16164576	INSTRUMENT CLUSTER LENS
10250238	INSTRUMENT CLUSTER TRIM BEZEL
12160244	INTAKE - AIR TEMP (IAT) SENSOR
20-25147187	INTAKE BELLOWS THUNDER RACING
FEL-1284	INTAKE GASKETS FELPRO
12367777	INTAKE MANIFOLD GASKET GM LT4 - RAISED PORTS
12524653	INTAKE MANIFOLD GASKET SET LT1
12552137	INTAKE MANIFOLD LT1
10231273	JACK
10239647	KEYLESS ENTRY FOB

12499735	KEYLESS ENTRY RECEIVER
15725423	KEYLESS ENTRY TRANSMITTER 94-95
16245100	KEYLESS ENTRY TRANSMITTER 96-02
16214671	KNOCK MODULE - LT1 CORVETTE
16217700	KNOCK MODULE - LT1 F-BODY OBD-I
16214661	KNOCK MODULE - LT1 F-BODY OBD-II
16214681	KNOCK MODULE - LT4 CORVETTE
16188309	KNOCK MODULE 94/95 SS
16214691	KNOCK MODULE 96 SS
10456126	KNOCK SENSOR - LT1 94-95 - AC #213-96
10456287	KNOCK SENSOR - LT1 96 - AC #213-325
88890544	LS1 ENGINE 00 VETT
89017548	LS1 ENGINE 01-04 VETT
12455109	LS1 ENGINE 97-98 VETT
88894086	LS1 ENGINE 98 F-CAR
88894386	LS1 ENGINE 98 F-CAR
88890543	LS1 ENGINE 99 VETT
88890545	LS1 ENGINE 99-00 F-CAR
25534322	LS1 ENGINE CRATE MOTOR-320HP
89017654	LS2 ENGINE - LONGBLOCK 05 VETT
88894384	LS6 ENGINE 01 VETT
89017349	LS6 ENGINE 03-04 VETT
89017653	LS6 ENGINE 05 CADDY
88894193	LT1 ENGINE - 94-95 B-BODY
88894195	LT1 ENGINE - 95 F-FODY
88894194	LT1 ENGINE - 96 B-BODY
88894197	LT1 ENGINE - 96-97 F-FODY
12527740	LT1 WATER PUMP B BODY
12527741	LT1 WATER PUMP F, Y BODY
12370835	LT1/LT4 EXTREME DUTY ROLLER TIMING SET
12555885	LT1/LT4 ROLLER TIMING SET CAM GEAR (95+ LT1) OR 94 + B-BODY
12555886	LT1/LT4 ROLLER TIMING SET CRANK GEAR (95+ LT1) OR 94 + B-BODY
12555887	LT1/LT4 ROLLER TIMING SET ROLLER CHAIN (95+ LT1) OR 94 + B-BODY
10260166	LT4 - ACCELERATOR LINKAGE COVER
12551486	LT4 - BALANCER/DAMPER F&Y-BODY LT4 ONLY
24502586	LT4 - CAMSHAFT HOT CAM
12480002	LT4 - CAMSHAFT HOT CAM KIT
12557236	LT4 - CYLINDER HEAD GASKET LT4 - .051" COMP THICK
12551488	LT4 - CYLINDER HEAD GASKET STOCK LT4 - .050" COMP
12552126	LT4 - CYLINDER HEAD STUD LT4
12551183	LT4 - ENGINE (DISCONTINUED) NEW P/N 88894198
12551313	LT4 - EXHAUST VALVE
12495499	LT4 - HEAD BOLT KIT
12555331	LT4 - INTAKE VALVE
12338092	LT4 - VALVE COVER BOLT LT4 PLASTIC COVER
14094717	LT4 - VALVE COVER WASHER
12495503	LT4 - VALVE LOCK SET OF 32

12495492	LT4 - VALVE RETAINER SET OF 16
12551483	LT4 - VALVE SPRING
12495494	LT4 - VALVE SPRING MAX .525" LIFT - SET OF 16
24503856	LT4 - VALVE STEM KEY PACK OF 10
12337955	LUG NUTS SET OF 5
12529241	MAF SENSOR - EXTENSION CABLE
16137039	MAP SENSOR NEW P/N 12569240
1635948	MAP SENSOR SEAL 94-96
12047767	METRI-PAK TERMINALS (10PK)
12371585	MIRROR - INSIDE REARVIEW WITH COMPASS
10231161	MIRROR LH OUTSIDE 93/94
10231121	MIRROR LH OUTSIDE 95/96
10231160	MIRROR RH OUTSIDE 93/94
10231120	MIRROR RH OUTSIDE 95/96
10263981	MIRROR, INSIDE AUTO DIM W/MAP LIGHTS
12482046	MOLDING - REAR SIDE
12522934	MOLDING - REAR SIDE
12522935	MOLDING - REAR SIDE
12522931	MOLDING - WHEEL WELL FRONT BLACK LH
12522930	MOLDING - WHEEL WELL FRONT BLACK RH
12524189	MOLDING - WHEEL WELL FRONT DCM LH
12524188	MOLDING - WHEEL WELL FRONT DCM RH
12524187	MOLDING - WHEEL WELL FRONT DGGM LH
12524186	MOLDING - WHEEL WELL FRONT DGGM RH
12522937	MOLDING - WHEEL WELL REAR BLACK LH
12522936	MOLDING - WHEEL WELL REAR BLACK RH
12524197	MOLDING - WHEEL WELL REAR DCM LH
12524196	MOLDING - WHEEL WELL REAR DCM RH
12524195	MOLDING - WHEEL WELL REAR DGGM LH
12524194	MOLDING - WHEEL WELL REAR DGGM RH
12516867	MOLDING KIT FRT S/D LWR (LEFT)
12482045	MOLDING REAR SIDE
22146273	MOTOR MOUNT LT1-LEFT
22146274	MOTOR MOUNT LT1-RIGHT
10279898	MUFFLER HEAT SHIELD (1 0F 2)
10279899	MUFFLER HEAT SHIELD (2 0F 2)
10279898 10279899,	MUFFLER HEAT SHIELDS
12343477	NET CARGO PACKAGE
15966491	NUT CLIP SHEET METAL
10226222	OIL - COOLER 9C1 AIR-TO-OIL COOLER
10260341	OIL - COOLER HOSE ASSEMBLY 9C1 AIR-TO-OIL COOLER
12337917	OIL - COOLER NUT
10225895	OIL - COOLER PIPE 9C1 AIR-TO-OIL COOLER
10225896	OIL - COOLER PIPE 9C1 AIR-TO-OIL COOLER
20351035	OIL - COOLER SCREW
14090908	OIL - COOLER TUBE SEAL 2 REQUIRED
23011420	OIL - DRAIN PLUG GM MAGNETIC PLUG

12554955	OIL - FILL CAP LT4 - MOBIL 1
10229162	OIL - FILL CAP STEEL VALVE COVERS
12558300	OIL - FILL CAP VALVE COVER MAGNESIUM
10108694	OIL - FILL CAP VETT PLASTIC VALVE COVER
10236268	OIL - FILL STICKER LT4 - MOBIL 1
25322836	OIL - FILTER AC #PF52 - ULTRAGUARD GOLD
12551589	OIL - FILTER ADAPTER GASKET
88893990	OIL - FILTER ADAPTER KIT INCLUDES GASKET & O-RINGS
10244495	OIL - FILTER ADAPTER O-RING
24507190	OIL - LEVEL SENSOR (LOW)
10108676	OIL - PAN GASKET
14088501	OIL - PAN RAIL LH
14088502	OIL - PAN RAIL RH
12554816	OIL - PAN WINDAGE TRAY GM
12371175	OIL - PSI GAUGE 0-100 PSI 2-1/16" WHITE FACE/BOWTIE
12361400	OIL - PSI GAUGE 0-100 PSI 2-5/8" W/BOWTIE ON FACE
12361392	OIL - PSI GAUGE 0-100 PSI 2-5/8" W/GMPP ON FACE
10201491	OIL - PSI SENDER SEO POLICE
10137636	OIL - PSI SENSOR 90 FITTING
12555884	OIL - PUMP W/O PICK-UP
12361401	OIL - TEMP GAUGE 140-280 2-5/8" W/BOWTIE ON FACE
12361393	OIL - TEMP GAUGE 140-280 2-5/8" W/GMPP ON FACE
10096181	OIL - TEMP SENDING UNIT
12102748	OIL - TEMP SENDSOR CONNECTOR
25325403	OIL FILTER AC PF52(DURAGUARD SILVER)
25171377	OIL FILTER AC PF52(DURAGUARD)
134-7901	OIL PUMP DRIVESHAFT, ARP
IS-55E	OIL PUMP DRIVESHAFT, MELLING
12106559	OPTI-SPARK - ELECT HARNESS 93-94 - NON-VENTED
12130319	OPTI-SPARK - ELECTRICAL HARNESS 95-96 - VENTED
14082470	OPTI-SPARK - FITTING GM VAC
10457702	OPTI-SPARK - NON-VENTED 93-94
10128317	OPTI-SPARK - SHAFT SEAL 93-94
12552428	OPTI-SPARK - SHAFT SEAL 95-96
12555323	OPTI-SPARK - VENT & VAC HARNESS 95-1997
1104032	OPTI-SPARK - VENTED 95-1997
10457293	OPTI-SPARK CAP & ROTOR KIT (INC BOLTS/COVER/O-RINGS) - AC #D8301
25312184	OXYGEN SENSOR AC #AFS75
88961150	PCM 94-95 SS
16214399	PCM 96 SS
9416200341	PCM CALIBRATION - 94 INITIAL
9416232021	PCM CALIBRATION - 94 UPDATE FIX FOR CHUGGLE AND SURGE
9416207221	PCM CALIBRATION - 94 UPDATE FIX SHIFT CLUNK/COLD SURGE
9416202491	PCM CALIBRATION - 94 UPDATE IMPROVE AIR PERFORMANCE
9516206641	PCM CALIBRATION - 95 INITIAL
9516232011	PCM CALIBRATION - 95 UPDATE CORRECT CHUGGLE & SURGE
9516209351	PCM CALIBRATION - 95 UPDATE IMPROVE DRIVEABILITY

9616229981	PCM CALIBRATION - 96 INITIAL
12084913	PCM CONNECTORS (5PK)
10240678	PCV GROMMET - INTAKE MANIFOLD VETT PLASTIC VALVE COVER
12556257	PCV PIPE
25095452	PCV VALVE 93-96/AC #CV895C
12551389	PCV VALVE ELBOW
R-9401 35	PISTON RING SPEEDPRO 4.030
139628	PISTON SRP-4.030, 16CC, 5.7" ROD
24213991	PLUG--HEX HEAD, FOR DEEP PAN PLUG
8891017	POWER ANTENNA
22535475	POWER ANTENNA RELAY
10099012	POWER SEAT SWITCH 6-WAY
26055706	POWER STEERING NEW PUMP FOR 94-96 CHEVY B W/N40 STEERING
88985220	POWER STEERING REMAN PUMP ACDELCO 36-516309
10188907	POWER WINDOW SWITCH REAR
17113086	PRESSURE REGULATOR SEAL KIT
12371041	PUSHROD KIT CONTAINS 16
CC-7940-16	PUSHRODS CC HARDENED
10041121	RACKS & CARRIERS
15757172	RADIO CASSETTE PLAYER
15071233	RADIO CD PLAYER
12555714	REAR MAIN SEAL HOUSING GASKET
1052369	REARVIEW MIRROR ADHESIVE
CCA-1305-16	ROCKER ARMS CC PRO MAG 1.6 W/ 7/16" STUD
12495490	ROCKER ARMS STAMPED STEEL 1.5
12370839	ROLLER ROCKERS 1.6 RATIO GM SPEC CRANE R/R
16726726	SEAT
16731968	SEAT
12513339	SEAT BELT KIT FRONT LH
12513338	SEAT BELT KIT FRONT RH
16780068	SEAT COVER FRONT LOWER CUSHION
22003254	SHOCK - AIR
22064600	SHOCK ABSORBERS FRONT
22064499	SHOCK ABSORBERS REAR
10267037	SIDE SCRIPT CAPRICE SS - BLACK
10267039	SIDE SCRIPT CAPRICE SS - DCM
10267038	SIDE SCRIPT CAPRICE SS - DGGM
10248742	SIDE SCRIPT IMPALA SS BLACK
10262809	SIDE SCRIPT IMPALA SS DCM
10262808	SIDE SCRIPT IMPALA SS DGGM
25166821	SPARK PLUG
12096437	SPARK PLUG WIRE SET
12173568	SPARK PLUG WIRE SET
12524697	SPOILER
12337977	SPOILER - BOLTS
22076523	SPRINGS 1994-96 7B3 SUSPENSION - 9C1
22076517	SPRINGS 1995 REAR - 18.0 N/MM RC

22076526	SPRINGS 1995 REAR - 27.0 N/MM RX
22132375	SPRINGS 1995 REAR - STOCK
22078017	SPRINGS HIGHEST LOAD RATE-95 FRONT
10465143	STARTER
10465293	STARTER
10455709	STARTER--GEAR REDUCTION, LIGHTWEIGHT, FROM 92-96 LT1 CORVETTE
26001594	STEERING - CONNECTION SEAL PACK OF 10
11509363	STEERING - COOLER BOLT
2091638	STEERING - COOLER CLAMP
11518121	STEERING - COOLER NUT
26036034	STEERING - COOLER PIPE
454947	STEERING - DAMPER BOLT
10245794	STEERING - DAMPER BRACKET
4993536	STEERING - DAMPER BUICK STYLE
9442937	STEERING - DAMPER NUT SOLD IN PACK OF 10
26059109	STEERING - DAMPER ROD KIT
1050017	STEERING - FLUID SOLD IN PACK OF 12
26048653	STEERING - GEAR BOX
88911336	STEERING - IDLER ARM (DANA-SPICER) W/BONDED BLUE POLY SEALS
26041013	STEERING - IDLER ARM (STOCK)
6055706	STEERING - PUMP (NEW STYLE) 94-96 W/N40 STEERING 2
36-516309	STEERING - PUMP (REMAN) AC
26014085	STEERING - SHAFT ASSEMBLY
10225365	STEERING - STOP LARGER THAN STOCK - LH
10225366	STEERING - STOP LARGER THAN STOCK - RH
16757633	STEERING - WHEEL GREY W/AIR BAG
MOR-86015	SWAYBAR - (HA) FRONT
MOR-86516	SWAYBAR - (HA) REAR
26039956	SWAYBAR - BUSHINGS 32MM FOR HA SWAYBAR
14094388	SWAYBAR - BUSHINGS 34MM FOR HA SWAYBAR
10221779	SWAYBAR – END LINKS F-BODY STYLE
457923	SWAYBAR – FRONT
88912162	SWAYBAR - FRONT END LINK KIT
88912214	SWAYBAR - LINK KIT SIMILAR TO P/N 10221779
10207649	SWAYBAR - REAR
10225157	SWITCH - SEO 6H6 RH 1-BUTTON/LIGHTS OFF
10225158	SWITCH - SEO 6H6 RH 2-BUTTON SWITCH
10188966	SWITCH - SEO 6H6 RH SEO 6H6 1-BUTTON/TRUNK
10203772	SWITCH - WAGON RIGHT SIDE OF RADIO
5977447	TAILLIGHT - ASSEMBLY LEFT - COMPLETE
5977448	TAILLIGHT - ASSEMBLY RIGHT - COMPLETE
16521719	TAILLIGHT - LENS ONLY CAPRICE - LEFT
16521720	TAILLIGHT - LENS ONLY CAPRICE - RIGHT
16522451	TAILLIGHT - LENS ONLY SS - LEFT
16522452	TAILLIGHT - LENS ONLY SS - RIGHT
12555290	THERMOSTAT
12553106	THERMOSTAT HOUSING GASKET

10105379	THROTTLE BODY - GASKET 48MM
17113178	THROTTLE BODY - GASKET KIT COMPLETE
17113074	THROTTLE BODY - GASKETS TOP & BOT - AC #40-743
17113099	THROTTLE BODY - IAC VALVE 94-95 - AC #217-429
17113188	THROTTLE BODY - IAC VALVE 96 - AC #217-433
17106682	THROTTLE BODY - TPS SENSOR 93 W/SCREWS
17106680	THROTTLE BODY - TPS SENSOR 94-96 W/SCREWS
112-504	THROTTLE BODY HOLLEY 58MM
10128349	TIMING CHAIN - CAM GEAR 94-96 LT1
10206039	TIMING CHAIN - CAM SPROCKET 95-96
12551636	TIMING CHAIN - COVER 93-94 - INCL ROUND SEALS
12552426	TIMING CHAIN - COVER 95 - INCL ROUND SEALS
12552427	TIMING CHAIN - COVER 96 - INCL ROUND SEALS
12554553	TIMING CHAIN - COVER DOWEL PIN 93-97
10128293	TIMING CHAIN - COVER GASKET 93-96
10128346	TIMING CHAIN - CRANK GEAR 94-96 LT1
10128303	TIMING CHAIN - CRANK SPROCKET KEY 92-95 ENGINES ONLY
10128485	TIMING CHAIN 93-96
TCS45956	TIMING CHAIN FELPRO
10269710	TRANS - COOLER PIPE AIR-TO-TRANS HOSE ASSY
10269707	TRANS - COOLER PIPE RADIATOR-TO-COOLER
8679994	TRANS - DEEP PAN
4215535	TRANS - DEEP PAN - TRUCK STYLE MUST USE FILTER KIT 24208576 2
8633208	TRANS - DEEP PAN FILTER BOLT
24208576	TRANS - DEEP PAN FILTER KIT INCLUDES SEAL & GASKET
8629523	TRANS - DEEP PAN FILTER SPACER
24209295	TRANS - DEEP PAN NO DRAIN PLUG
8629526	TRANS - DEEP PAN OIL - INTAKE PIPE
12338119	TRANS - DOWL PIN REAR OF BLOCK
12337210	TRANS - FILTER KIT EXTRA DEP PAN
24200796	TRANS - FILTER KIT INCL SEAL & GASKET
24215535	TRANS - PAN PLUG HEX HEAD,
8667545	TRANS - PAN STOCK
24201203	TRANS - TORQUE CONVERTER 86 VETT
24202310	TRANS - TORQUE CONVERTER 95 S10-140K FACTOR
24204670	TRANS - TORQUE CONVERTER 96 S10-135K FACTOR
1261968	TRANS - TORQUE CONVERTER BOLT 85/86 VETT
12497318	TRANSMISSION 4L60E GMPP TAHOE MOD/370LB-FT
12523079	TRUNK EMBLEM BLACK
12524203	TRUNK EMBLEM DCM
12524202	TRUNK EMBLEM DGGM
10268235	TRUNK LAMP ASSEMBLY 2ND DESIGN LATE 95
10211580	TRUNK MAT SEO B48 - B42?
5976555	TURN SIGNAL LEFT FRONT
5976557	TURN SIGNAL LEFT FRONT
25140743	TURN SIGNAL LEVER W/CRUISE CONTROL
5976556	TURN SIGNAL RIGHT FRONT

5976558	TURN SIGNAL RIGHT FRONT
10220597	USE OVERDRIVE DURING… STICKER
12564852	VALVE - EXHAUST SEAL LT4
10212810	VALVE - INTAKE SEAL LT4
460483	VALVE - OIL SEAL LT1 INTAKE & EXHAUST
10212808	VALVE - SPRING CAP LT4
10212809	VALVE - SPRING SHIM LT4 - PACK OF 10
274288	VALVE - STEM TIRE - SOLD IN SETS OF 5
14088793	VALVE COVER - BOLT GASKETS BAG OF 10 - MAGNESIUM V/C
12356818	VALVE COVER - BOLTS - CHROME
10088165	VALVE COVER - BOLTS MAGNESIUM V/C
12355350	VALVE COVER - CHROME W/RED BOWTIE - SET
12552321	VALVE COVER – CORVETTE
12552322	VALVE COVER - CORVETTE
14088564	VALVE COVER - GASKET NEOPRENE - MAGNESIUM V/C
10108625	VALVE COVER - GASKET VETT PLASTIC
10046089	VALVE COVER - GASKETS IRON CYLINDER HEAD
10055781	VALVE COVER - MAGNESIUM LH
10055782	VALVE COVER - MAGNESIUM RH
10108675	VALVE COVER - NUT (PACK OF 10) FOR COMPOSITE V/C
10108674	VALVE COVER - STUD FOR COMPOSITE V/C
15552872	VEHICLE SPEED SENS (VSS) O-RING AUTO TRANS
12361406	VOLT GAUGE 8-18 VOLTS 2-5/8" W/BOWTIE ON FACE
123701176	VOLT GAUGE 8-18 VOLTS 2-5/8" W/WHITE FACE/BOWTIE
10261164	WARRANTY & OWNER'S BOOKLET
10128487	WATER PUMP - DOWEL PIN 93-96
12553792	WATER PUMP - DRIVE O-RING 93-96
10219554	WATER PUMP - DRIVE SHAFT 93-96
10128343	WATER PUMP - GASKET 93-96
10217886	WATER PUMP - SHAFT SEAL TIMING CHAIN COVER
12360496	WHEEL - 17" X 8.5" EACH
12495438	WHEEL - 17X8.5 (SET OF 4) EST $125 SHIPPING
15988450	WHEEL - HUB CAP RED BOWTIE
9592426	WHEEL - HUB CAPS BLACK BOWTIE
9592229	WHEEL - HUB CAPS STOCK IMPALA
9591766	WHEEL - SPARE TIRE WHEEL 16X4 - DOESN'T INCLUDE TIRE
16631405	WINDOW - REGULATOR MOTOR?
9442468	WINDOW ROLLER FIX RIVETS PACK OF 5
9666748	WINDOW ROLLERS PACK OF 5
22144138	WINDSHIELD WASHER CONTAINER
22127653	WINDSHIELD WASHER PUMP 96
10283602	WINDSHIELD WIPER ARM 9C1
102836022	WINDSHIELD WIPER BLADE 9C1
10161510	WOOD GRAIN BEZEL TRIM FASTENERS PACK OF 20
10242034	WOOD GRAIN DOOR BEZEL INSERT (LF)
10242040	WOOD GRAIN DOOR BEZEL INSERT (LR)
10242035	WOOD GRAIN DOOR BEZEL INSERT (RF)

10242039	WOOD GRAIN DOOR BEZEL INSERT (RR)
10256065	WOOD GRAIN LOWER DASH PLATE
10240921	WOOD GRAIN SWITCH PANEL (DRIVER)
10240920	WOOD GRAIN SWITCH PANEL (PASS)
10237292	ZZ502 BLOCK (4-BOLT MBC)
12371171	ZZ502 CRATE MOTOR - UNASSEMBLED 502HP
12371204	ZZ502 ENGINE LONG BLOCK KIT
12496962	ZZ502 MOTOR-COMPLETE 502HP
12496963	ZZ502 MOTOR-LESS INTAKE 502HP

Specifications & Dimensions

Exterior Dimensions	Sedan	Wagon	Impala SS
Wheelbase	115.9	115.9	115.9
Length (overall)	214.1	217.3	214.1
Width (overall)	77.5	79.6	77.5
Height (overall)	55.7	60.9	54.7
Tread - Front	61.8	62.1	62.3
Tread - Rear	62.3	64.1	62.7
Minimum running ground clearance	7.0	5.5	7.0
Front overhang	41.7	41.7	41.7
Rear Overhang	56.5	59.6	56.5

Interior Front Dimensions	Sedan	Wagon	Impala SS
Head Room	39.2	39.6	39.2
Leg Room	42.2	42.2	42.2
Shoulder Room	63.4	63.4	63.4
Hip Room	57.0	56.9	57.0

Interior Rear Dimensions	Sedan	Wagon	Impala SS
Head Room	37.9	39.4/36.6 2nd seat	37.9
Leg Room	39.5	38.0/30.5 2nd seat	39.5
Shoulder Room	63.4	63.5/48.6 2nd seat	63.4
Hip Room	56.9	57.1/43.7 2nd seat	56.9

Capacities	Sedan	Wagon	Impala SS
Passenger capacity	6	8	5
Passenger index (cu. ft.)	114.2	115.4	114.2
Cargo index (cu. ft.)	20.4	54.7	20.4
Fuel tank capacity (gal.)	23.0	22.0	23.0
EPA interior index (cu. ft.)	134.6	170.1	134.6
Curb weight (lbs., est.)	4061	4473	4036

Torque Specifications

Fastener Application	Torque Value	Wrench Size	Thread/Pitch/Length (if appl.)
Accelerator Cable Bracket Bolt	106 lb. in.	10mm	M6 x 1 x 12
Camshaft Retainer Bolt	105 lb. in.	T30 Torx	1/4"-20 x 1/2"
Camshaft Sprocket Bolt	18 lb. ft.	1/2"	5/16"-18 x 3/4"
Crank Pulley Bolts	63 lb. ft.	5/8"	7/16"-14 x .88"
Crank Hub Bolt	74 lb. ft.	5/8"	7/16"-20 x 2¼"
Crank Main Bearing Cap Bolt	77 lb. ft.	5/8"	7/16"-14 x 3.34"
Optispark Mounting Bolt	106 lb. in.	3/8"	1/4"-20 x 2"
EGR Solenoid Mounting Nut	18 lb. ft.	9/16"	3/8"-16
EGR Valve and Pipe Nuts	18 lb. ft.	1/2"	5/16"-18
Front Cover Bolt	100 lb. in.	3/8"	1/4"-20 x 1-3/8"
EVAP Solenoid Bolt	53 lb. in.	8mm	M5 x .8 x 10
Fuel Rail Bolts	90 lb. in.	10mm	M8 x 1 x 35 (93) M6 x 1 x 35 (94-97)
Generator to Accy Bracket bolts	37 lb. ft.	13mm	M10 x 1.5 x 45 / M10 x 1.5 x 85
Generator upper,rear bracket bolt	37 lb. ft.	13mm	M10 x 1.5 x 20
Generator lower, rear bracket bolt	18 lb. ft.	13mm	M10 x 1.5 x 20
Generator upper brace manifold nut	24 lb. ft.	9/16"	3/8"-16
Ignition Coil Bolts/Nuts	30 lb. ft.	9/16"	3/8"-16
Intake Manifold Bolts/Studs (1st Pass)	71 lb. in.	9/16"	3/8"-16 x 1.38"
Intake Manifold Bolts/Studs (2nd Pass)	35 lb. ft.		
Oil pump drive	13 lb. ft.	1/2"	5/16"-18 x 3/4"
Oil Pump	66 lb. ft.	5/8"	7/16"-14 x 2-3/4"
Oil Pan Corner Bolts/Studs	15 lb. ft.	1/2"	5/16"-18
Oil Pan Side Rail Bolts	106 lb. in.	3/8"	1/4"-20 x .62"
AIR Pump Bracket Bolt	30 lb. ft.	9/16"	3/8"-16 x 1.12"
AIR Pump Mounting Bolt	50 lb. in.	10mm	M6 x 1 x 30
Throttle Body Mounting Bolt	18 lb. ft.	10mm	M8 x 1.25 x 65
Lifter Guide Retainer (Spider) Bolts	18 lb. ft.	1/2"	5/16"-18 x 5/8"
Rocker Arm Cover Bolt	106 lb. in.	3/8"	1/4 - 20 x 3¼"
Rocker Arm Stud, Stock (3/8")	50 lb. ft.	5/8"	3/8"-16
Rocker Arm Stud, (7/16")		11/16"	7/16"-14
Water Pump Mounting Bolt	30 lb. ft.	9/16"	2 bolts 3/8"-16 x 2" 4 bolts 3/8"-16 x 4"