# HEI for your 1937-1962 GM Six

Welcome everyone to one of the first projects in The Think Tank. What is The Think Tank? It is a collaboration of people with similar interests who have an inventive, can-do spirit. It is designed to overcome obstacles contained in the various automotive systems for our vintage GM/Chevy vehicles.

How it works is, a topic is chosen, the group decides what guidelines to follow, and we find a way to overcome all challenges. In the end, as close as humanly possible to a perfect solution is born. We then compose a document such as this one to share this new technology with everyone interested. The most important quality of our contributors is their ability to stick to mathematics and science to prove their contributions. This eliminates conjecture but also takes time to research and 'Think Tank' our way to a successful outcome. Wish us luck! If you wish to participate in our little experiment, contact Deve@speedprint.com.

In this particular discussion, we will learn together how to use our stock 216/235/261 distributors in an effort to modify them for High Energy Ignition (HEI).

What are the advantages of HEI? A few of them are more consistent firing, no points to adjust, fewer moving parts. Since the spark is much hotter, wider plug gaps, thicker spark means a more complete burn of leaner fuel mixtures. This will improve engine performance and reliability. As one of the instructors at one of the countries foremost automotive colleges put it: "the HEI as built from GM could very well be the best overall ignition system out there ever. It has a varying dwell based on RPM and a ramp and fire circuit using 3.6 ms and 5.5 amps output with current control."

We will let you determine if you need it, but for this project we will adhere to the following **Solution Criteria**:

- **We will use the Stock Distributor you already own!**
- **We will NOT permanently modify any part of the Distributor.** This is because vintage parts are increasingly harder to find and we must keep as many of them in 100% serviceable condition as possible. If you want to move back to a points system, you can.
- **We will try to make this modification as stock looking as possible.**
- **Due to some pretty insurmountable difficulties, we will only offer this for 12 volt systems at this time.**

A really nice, well done project along these same lines can be found here:

http://www.greasygringo.com/2012/06/59-chevy-hei-conversion/

Jason did this already. We can't thank him enough for his pioneering efforts. But just because one person did it, does that mean you should too? So, later in my research I got an email out of the blue from another friend, Jim Linder. He runs Bubba's Hot Rod Shop. He has been an Ignition Technology Instructor for the past 30 years and he has been very helpful in answering my questions. He offers the service of modifying your distributor similar to how Jason did it. If this How-To is a bit over your head, I am sure Jim would love to do it for you.

http://www.lindertech.com/bhrs/

What we want to do is expand on this idea, explore ways to make it better and do it all using the aforementioned guidelines.

After doing a little research on parts, the parts Jim and Jason used seem to be the most available and the easiest to fit into this very tight space. To be more specific, the reluctor and reluctor pickup units are out of 1972-1985 slant 6 Mopar. The brains (HEI Module) for all this is a GM design.

**The Parts List** is as follows:

1) Standard Motor Products, LX-105, Ignition Reluctor

2) Standard Motor Products, LX-103, Ignition Reluctor Pickup

3) Speedway Motors, 91012338, Stock HEI Replacement Module

4) AC Delco, 10474610, HEI Module Heat Sink

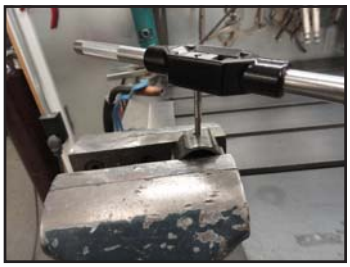
The cost for everything is about $60 and available at Amazon, Ebay, Summit Racing, or your favorite supplier except for the HEI Module which is available at Speedway Motors. The only reason we are using the Speedway Motors unit and not the original GM unit is the price difference.

**Tools** for this Project: DeWalt Portaband w/Swag Offroad Table, Dremel Model 220 Drill Press Attachment for Dremel 4000 rotary tool, 1/8" straight rasp for the Dremel, Metal Ruler/Straight Edge, Makita 4 inch Grinder with both grinding wheel and Flap Disc, Allen Wrenches, Screwdrivers, Hammer and Punch for locating hole placement, Multimeter, Tap and Die set for 6-32 and 8-32, Both Fractional and Numbered Drill Bits.

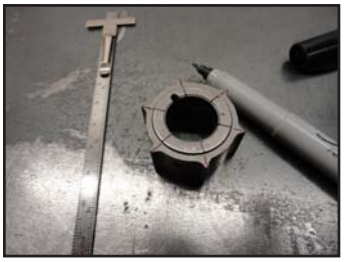
## Step One: The Reluctor

After a bit of research on reluctor technology, the one we chose comes out of a 1972-1985 slant 6 mopar. It fits our distributors like it belongs there. We did search HARD for a GM reluctor that would be appropriate but nope, this is the perfect one for our application.

Drill the Reluctor for two 8-32 (3/16 long) set screws. Use a #29 drill bit. My set screws required a 5/64 Allen Wrench. Back them out or remove them entirely for the next operation which is the lobe grinding process. Remember, no modifications to the Distributor itself. The actual lobes on the distributor happen to be 5/8" hexagon. You can turn your dizzy all day long with a 1/2 drive 5/8" long socket. Drill these set screws on the thick part of the reluctor as shown. I just drilled both at the same time to get them across from each other perfectly. If you set the reluctor flat like I did in the vise, the holes come out really nice. Use a standard clean and sharp 8-32 tap to finish this part.

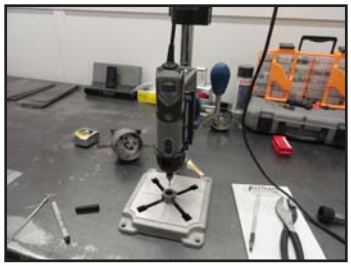


Using the Dremel Model 220 Drill Press attachment, with a fine straight shanked rasp with the 1/8" diameter made pretty easy work out of cutting the hexagon shape out of the center. Remember not to take off very much material. The reluctor is already 5/8" round diameter inside, and we are making it 5/8" hexagon. This took about 45 minutes to do because there is lots of fitting and refitting involved. See template on page 4.



Don't have a Dremel Model 220 Drill Press attachment? Use your drill press and get the same bit I used, and it should work as well. Be sure to use the highest RPM you can get your machine to muster!

Start by marking across the reluctor as shown. Then, keeping the reluctor so that the lobe you are attacking is directly across from the line in front of you, push the reluctor gently into the rasp and move the Dremel's lever up and down to make a groove top to bottom, as shown. Especially notice the placement of the reluctor on the tool. You want to make 6 equal such grooves. I



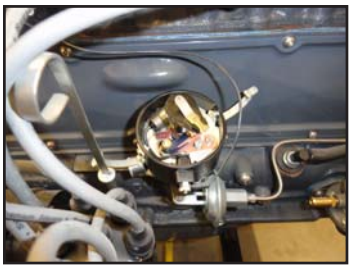
can't express the importance enough of taking this S-L-O-W. Remember its a 5/8" hole already. There isn't much to take off and still have it fit tightly. And, it needs to fit 100% tight otherwise you will have trouble with the .007 clearance on all 6 lobes between the reluctor and pickup. Do all 6 lobes with equal pressure and depth then dry fit on the distributor, over and over.

Once all lobes have a distinctive 6 sided shape, carefully move the reluctor on the tool side to side to square the sides with the grooves. Do all of this very slowly! When you are done, it should fit tight without the set screws. Not like you have to hammer it in, but snug push in, pull out by hand.

Once you have your tight and consistent fit, tighten down the set screws and test to see if it's wobbling or hitting anything. Mine came out very nice the first time. (Truth be told, if I can do it, anyone can). No sense in letting the reluctor scrape the bottom plate. Pull it up a little so it turns smoothly and doesn't bottom out.

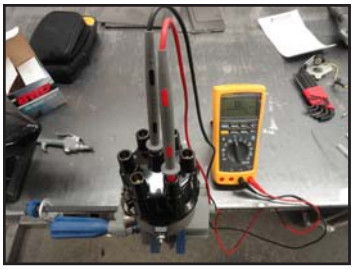
If you did it right, your rotor will sit on top like it always does and even if 'just barely' your reluctor isn't hitting anything.

## Step Two: Setting up the Phasing



Before doing the tricky part, we need to know EXACTLY where number one spark plug is on the distributor cap. The preferred location is at about 5:00 with the black wire terminal facing away from the engine as shown.

Thing is, we are talking about electronic phasing here so we need to be very precise and without cutting a hole in your distributor cap so you can see. We will accomplish this with a multimeter set to ohms in scream mode. (So it beeps at us when it hits the sweet spot).



Remove your distributor, points and condenser if you haven't already and put it firmly in a vise so that it's allowed to turn through all 360 degrees. Install the rotor in the proper place and install the distributor cap. It only goes on properly one way because the cap is keyed. Put one lead on the center hole on top of the distributor (coil input) and the other lead on the 5:00 hole as shown.

Since the cap wasn't designed for residual voltage, you will need to push up on the distributor shaft to get your reading. It will only beep at you in one position through the entire 360 degrees and it's a very narrow band, probably one degree. This puts the rotor at exactly #1 firing position. VERY carefully remove the cap making sure not to disturb exactly where the rotor is located. Critical issue that you don't bump the distributor or move that rotor in any way.

Notice when removing the cap that the rotor and the reluctor lobes do not exactly line up. Using a straight edge, mark each lobe on the top rim of the distributor with a Sharpie so it doesn't go away easily. I just used a straight edge to transfer the lines over as shown. Fact is, we really don't care where #1 is located but that all the lobes are located for firing. The distributor will only fire when the rotor is under the caps plug wires.

Remember the more precise you do this, the more likely your phasing is set correctly the first time. This procedure puts the lobes within a few degrees so our reluctor pickup can adjust that far. We are shooting for approx. 5 degrees of adjustment for the next step. (2.5 one side of center, 2.5 on the other).

## Step Three: The Pickup Adapter Plate

The Reluctor Pickup assembly for this is made to drop into a 72'-85' mopar slant 6 so we can't use the plate that it came with. I found nothing redeeming about this plate so I removed it and started designing a plate for our Delco Distributor. Do not just willy nilly remove the plate! Follow the procedures coming to do that. Set the assembly aside for now.

All we have to do now is re-design the pickup plate so that the pickup sensor is directly across from any of the lobes. Since we designed this thing to fit directionally so that each lobe also corresponds to each reluctor bump we will just refer to them as lobes from now on.

Now we will need about a 12 gauge metal plate that very cleanly accomplishes the following:

1) Ability to rotate within the distributor 5 degrees left to right for proper phase adjustment.

2) Allow the pickup assembly to move in or out to adjust for the .007 gap that is recommended.

3) Not interfere with what's there, but not needed, like the points pin and cam screw.

4) Make the adjustments stable so that one adjustment doesn't interfere with the other.

Of course in keeping with the philosophy of NO modifications to the vintage parts, we have to figure out how to use the condenser hold-down screw and the points hold-down screw for our plate hold-down since those are the only two tapped holes on the surface of our vintage distributor.

I experimented with three designs before I felt I got it right. The first was the one on the the left. The crescent shape proved to be too unstable for me. We are talking about two adjustments here and to do it cleanly you need nice smooth circular rotation, Although that concept would work, it's not any fun to adjust when the phase adjustment is interfering with the gap adjustment.

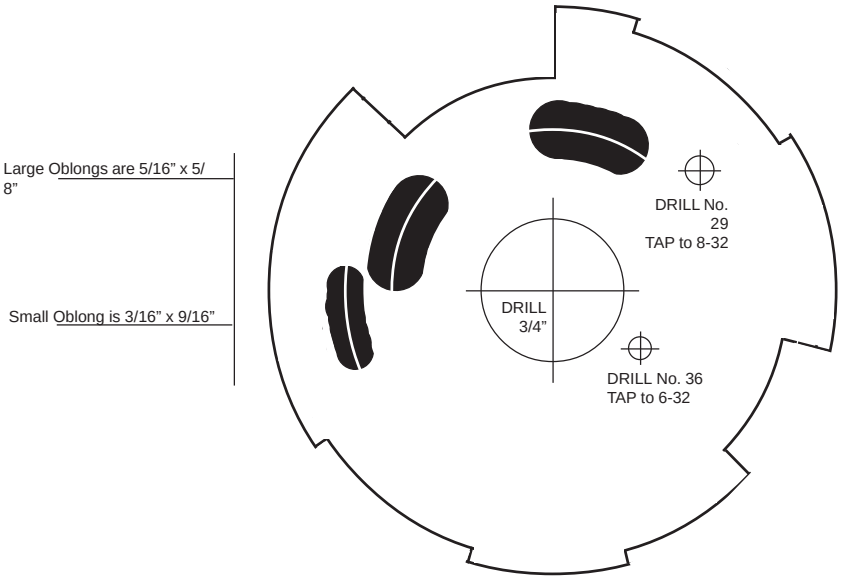
Altho the one on the right is much more work, in the end it proved to be much smoother. After a great deal of playing around with this, the final design looks like the one to the right.

I won't go into step by step on how to make that because in this case pictures and the template on the following page will give you everything you need. Be sure to print at 100%. Most printers do not by default. Yours will come out better than the ones shown since I had to figure out all the geometry myself which for me required adding weld, taking it away, etc, etc. Funny thing, turns out a roll of blue 3M brand masking tape has the exact same inside diameter as the distributor!

When you are through, the 12 gauge metal plate should fit perfectly inside the distributor with no slop whatsoever. If there is enough interest, I would like to get a bunch of these templates laser cut out of stainless steel so they are all perfect.

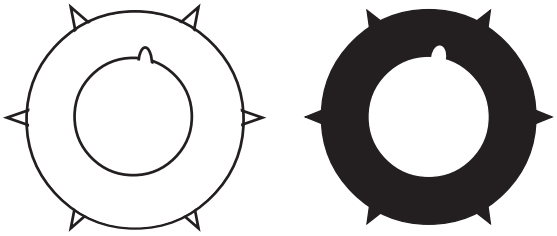
## HEI Adapter Template for Delco-Remy Chevy Distributor 1937-1962

Full size Template, Be sure you are printing at 100%! That is not the default of most printers, so be careful! The largest diameter of the radius should be 2-15/16".

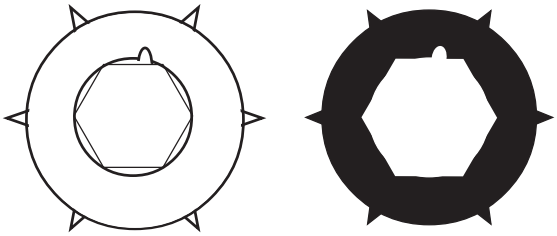



## HEI Reluctor Standard LX-105

5/8" Round



Machine to 5/8" Hex



### Step Four: Putting it all Together

Next we need to mount the pickup assembly on the new plate. To remove the pickup assembly from its original plate, drill out the rivet using a #36 drill bit. Do not make this hole larger than #36! We will be tapping this hole and the new plate corresponding to this hole for a 6-32 screw. This method will take the place of the rivet quite nicely. We will Loc-Tite it in place later. Remove the hold down screw on the old plate and you should have just the pickup assembly free. We will re-use the hold-down screw because it is short enough to be flush with the bottom of the plate when it's mounted. The 6-32 rivet screw will need to be shortened to be flush with the bottom of the plate as well.

There is ZERO room for error in making this adapter plate because of the space we are trying to use. As it stands, using this new plate, I still had to grind a small ridge off of the Distributor Cap to get enough room. It's probably about .020 deep! Almost

nothing, but it had to be done. It will have no adverse affect in any circumstance, so I didn't feel TOO bad about it.

Once you have the adapter plate in place with the pickup assembly, install it and make sure the magnetic pickup is lined up exactly with the marks you made on the top rim of the distributor. If you rotate the plate, you have 2.5 degrees on one side of the mark, and 2.5 on the other side. Install the reluctor and set the gap to .007. Now you see how tight it is! Rotate the reluctor through all six lobes to make sure it maintains .007 or so through all of them. If you need a little adjustment, very little, you can loosen the set screws on the reluctor and wiggle it a bit for ultra fine tuning. Rotate the distributor and make sure there is no noise coming from any of this. Your reluctor may be bottomed out scraping on the new plate. No problem, just loosen the set screws and pull it up a bit. Plenty of room for the rotor to sit properly.

## Step Five: Wiring and Details!

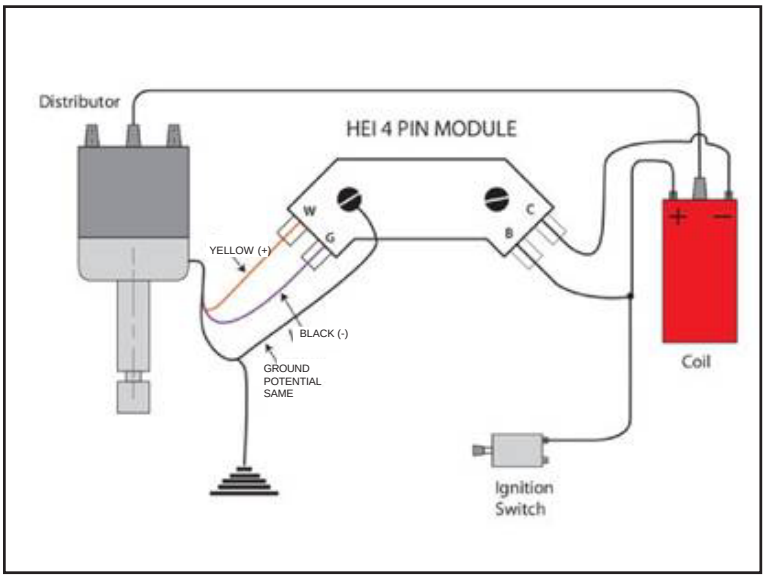
So we have established the Distributor cap and rotor fit nicely and the distributor turns quietly. The gap is set to .007 and the lobes are indexed to the pickup assembly. It ***should*** work right? I don't know yet because there are still a few loose ends.

One of the conundrums in dealing with this project is trying to keep it looking stock. But what to do with the two wires coming out of the distributor? That black plastic that sticks out with the single wire attached helped give the stock look, the stock look! And, worse, it's right where you can see it when it's mounted.

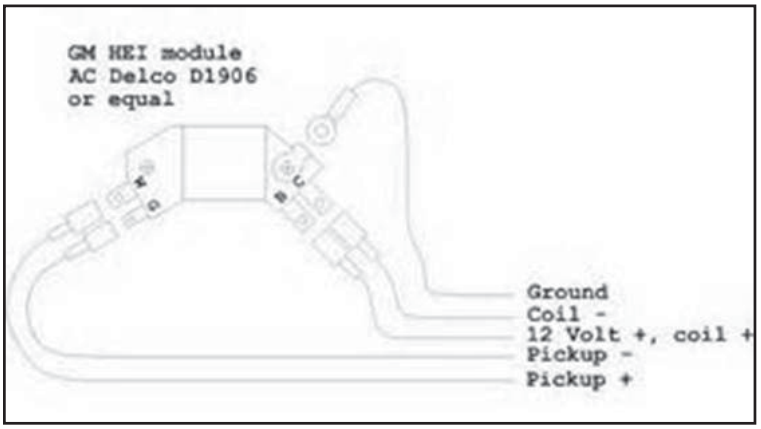
The best I can come up with on short notice is, we JB Weld the black plastic pieces back in the hole and to each other. The distributor works as advertised for points if you keep the screw assembly part in your toolbox, and we CAN get two wires out to the outside this way. If the JB Weld ever came loose, you can't lose your parts because there are wires through them. I did some further research and if you were to use a long piece of black shrink tubing around the two wires, you would have a hard time noticing at all.

I was able to obtain a few schematics of the system. This really makes it clearer and should help in understanding the whole system.

Schematic One is a generic 4 Pin HEI module setup, just like what we are doing.




Schematic Two is the actual GM HEI module which is the same as ours and confirms what Schematic One gives us. I always feel better when I have two independent sources especially when wiring is concerned.




Our Reluctor Pickup system uses a Yellow wire and a Black wire. So Pickup (+) would be yellow and Pickup (-) would be black. It matters which is which as doing it backwards can change the phase as much as 30 degrees!

**Note:** The Speedway Motors HEI module comes with a big connector with a capacitor on it. I am told this is for electrical engine noise suppression.

## Choosing the correct Coil for HEI

The stock GM coil from 1955-1959 was a 6 volt coil. If you ohm across the two terminals of the coil it is approx. 1.5 ohms. If you ohm from the other side of the ignition resistor on the firewall to the -minus terminal on the coil, you should get about 3.5 ohms.

In other words, GM ignition resistors are 2 ohms. If you have a Resistor Coil and no ignition resistor on your firewall, measuring across the two terminals will get you about 4 ohms. The breakdown for the stock system is about as follows: With charging system running about 13.8 volts, and the current in the circuit at about 3.94 amps, once the charge hits the ignition resistor on the firewall, the voltage is cut down to 7 volts. Once it has gone through the coil, there is 5.94 volts at the points. If you have the resistor coil it's less. Very balanced system, but not what we are looking for with an HEI system.

We care because the ignition resistor and 1.5 ohm Coil keeps the current limited to make our stock parts last longer. But now we have a more modern system with its own current limiting circuit. Our HEI system limits the current to between 5.5 and 5.8 amps. Also, our HEI system likes to run at as close to 12 volts as possible. These two facts make the old coil obsolete.

It also means the idea of bypassing the ignition resistor during cranking, and all that was sacred for the points system is now a detriment. Your new HEI system will not require the firewall ignition resistor. This can be bypassed with a nice new piece of 14 gauge wire jumpered across the resistor when installation time comes.

Our new HEI technology craves 12 full volts during regular operation. The HEI module has its own current limiting (5.5-5.8 amps), so we aren't concerned with excessive current. We want full voltage, so the coil you want is the one with the least PRIMARY ohm value. But the problem with using an ohm value too low is that your HEI module is dissipating more current thus gets hotter. Lets explore what's happening..

Not including normal voltage/current loss thru wires which is expressed as resistance:

1) 1.5 ohm stock coil with 2 ohm Ballast Resistor - 4 amps

2) 4 ohm replacement resistor coil - 3 amps

Those are the choices usually associated with a stock points system. Now let's look at lower ohm values that work best for HEI. (Based on 12 volts input.)

4) .7 ohm(R) coil - 17.14 amps (I)

$$I = \frac{V}{R} \qquad R = \frac{V}{I}$$

5) .6 ohm(R) coil - 20 amps (I)

$$V = I \times R$$

6) .35 ohm(R) coil - 34.28 amps (I)

As you can see, there is a point where it gets pretty scarey! Since the HEI module we are using for this limits the current to between 5.5 and 5.8 amps, we are not concerned about amperage to a point. Since the .35 ohm coil would obviously be the closest to our goal, you might think that's a good choice. The reason it is not, has to do with the HEI modules heat sink dissipation rate. It would just get too hot and fail prematurely. In the end, the sweet spot from a mathematical perspective appears to be a 12 volt coil between .6 and .7 ohms. One of the main reasons we are doing this upgrade is to get a much hotter, wider spark that allows us to run .045 point gaps so that we can ignite leaner mixtures and greatly improve engine performance. The new coil and balanced wiring system will make a big difference.

This link provides an example of a suitable coil for our project. There are many more choices including square coils but most people like the round can style for this vintage.

http://www.summitracing.com/parts/msd-8202/overview/

## Evaluating your vehicles wiring.

The gauge of wiring in your vehicle was fine for the 9 volts and 4 amps or so that it was designed for. But now, we want to run 6 amps through those wires. This is why GM beefed up the ignition wires on HEI systems. You want to prepare for more current than your system is used to. New wiring is probably okay, but old wiring could cause a fire, so please look hard at your wiring. My recommendation is to go with 14 gauge wire clear through the ignition system just to be safe.

If your plan is to keep a points distributor as a backup, just keep the ignition resistor on your firewall and keep the stock coil then remove the jumper from the ballast resistor.

Hooking it up seems pretty straightforward other than that, so let's also discuss options for hiding this module somewhere. If you have a 12v system with Alternator, maybe it could be hidden inside the regulator box? Bolted to the backside of the valve cover between the firewall? All ideas are surely welcome. Once you have determined where your module is going to be placed, its time to look at putting this all together.

This is as far as I have gotten so far on this project and I am hoping for input from people more knowledgeable than me on this issue. I didn't know anything at all about HEI until a few months ago!

In the end, the plan is to see if we can get those adapter plates laser cut in stainless and make this upgrade more available. We could really use machine shop expertise, electronic guru's etc to complete this project. Stay tuned!