Fox 3 ABS Installation by Mark Bettin

After flat spotting four healthy BFG R1 race tires and burying my car into at Hallett one Sunday morning, I decided it was a good idea to install ABS on my '89 coupe. A couple of friends had done it before me, so the learning curve was fairly short. This article will explain what is involved in the install, and I have included pictures, a wiring diagram (at bottom of article), and a parts list (at bottom of article) with Ford part numbers. In addition, I have included instructions on how to run the built-in ABS diagnostics to test the system after it is installed.
I was able to source the big stuff (ABS controller, main connectors, and sensors) from a salvage yard for fairly cheap, about $300. Your cost could vary greatly depending on how much your local salvage guy wants to make on it, I got a wide range of quotes when I was looking around. Most of the small stuff was sourced from the Ford dealer or a local auto parts store.

Special tools:

You *will* have to do some flaring of brake lines to complete the install. You will need a brake line flaring tool. I was able to complete the install making just inverted-flare connections (the flare looks like a "V" if you were to cut it down the middle), since I bought brake line that was already bubble-flared (the flare looks like a football laying on its side if you were to cut it down the middle), required by the ABS unit connections.

Requirements:

You need to have either the M-2300K Cobra brake kit or a '94-'95 GT brake system for the car in order to easily install the '94-'95 ABS system. Without either of those two brake systems, you really have no way to mount the exciter rings on the hubs/axles, and mounting the sensors would be very difficult. I've seen some M-2300K brake kits come with exciter rings mounted on the hubs/axles, and some without. Mine didn't have them, so I bought a set of front hubs from the Ford dealer (cheaper than you think) that had the rings, and for the rear axles I got a set with exciter rings in a parts swap. I later learned that I could have simply bought the rear exciter rings from Ford and pressed them on the axle with a shop press. So if you don't have rings on your brake setup, buy a new set of front hubs (rings can't be added to the hubs, and the old hubs make great backups), and get just the rear rings from the dealer, and have them pressed on the axles.

Front Hubs:

Rear Exciter Rings:

Parts you'll need:

I got what I could from a big car parts salvage place called Mid-America Auto Parts, via mail-order. This was sort of risky but a friend of mine bought an entire Cobra driveline/suspension/ABS from them, so I called and had them send me a complete setup. Well, the ABS unit apparently came out of a crashed car, one that got hit *on that corner.* The unit was damaged, so I had to send it back, and they didn't send complete rear sensors (missing most of the wire), blah blah blah, so I ended up getting a lot of the stuff from the dealer since I was running out of time. It's best to just go yourself and strip the stuff off, but apparently the ABS systems are in big demand, and they don't last long when cars come in the salvage yard.

Parts from Salvage Yard:

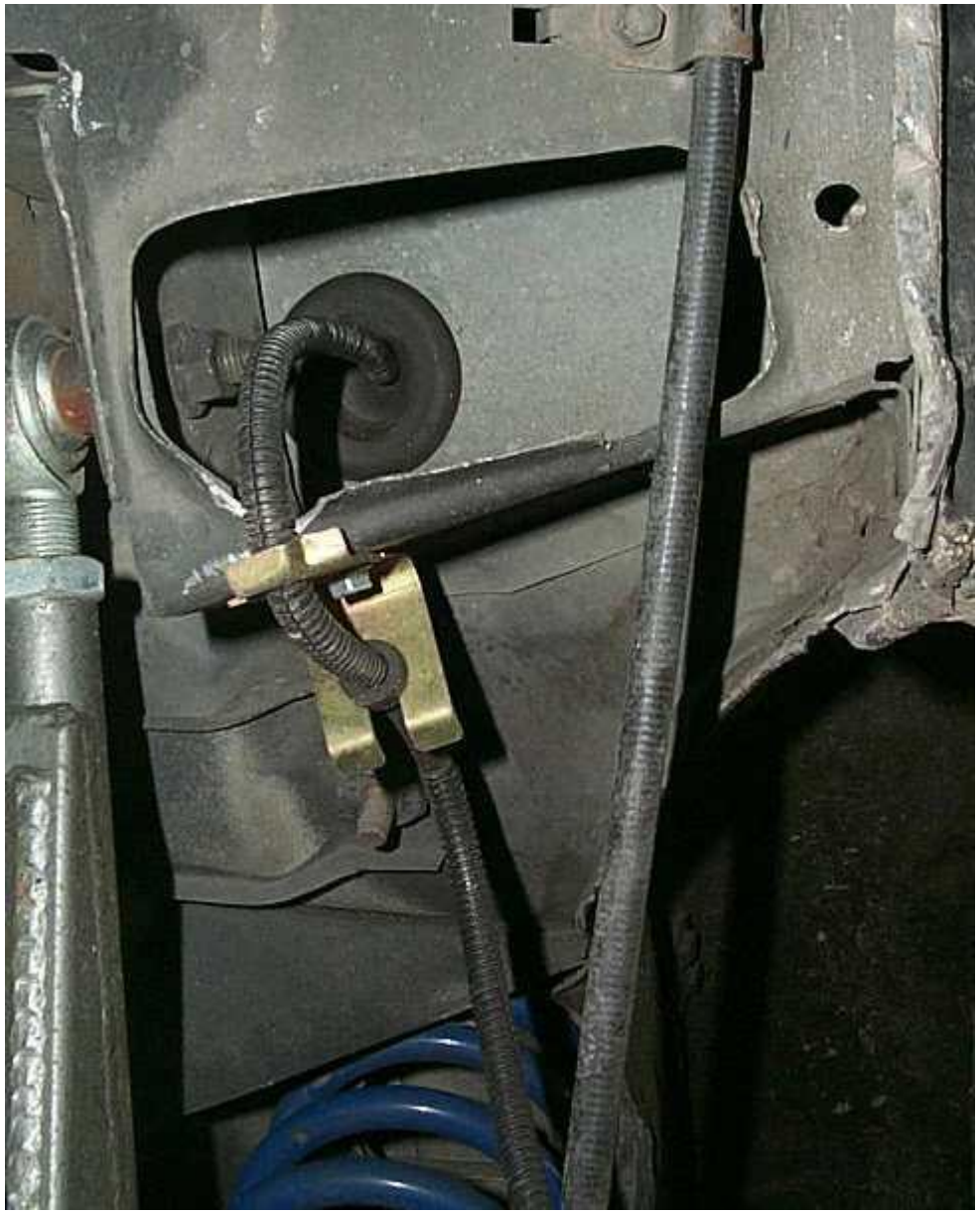
So, what you want to get off the salvage car is:

- The ABS hydraulic unit (which is the big aluminum/black thing), the black steel mounting bracket that the unit cradles in, and the three shock mounts that mount the unit to the bracket. There is also a short black ground wire hanging off the pump motor, with the other end attached to the frame rail. Get that ground wire, too, since the pump won't work without being grounded.

- There are two cable assemblies (each about 1 foot long) that go with the unit, one is more-or-less permanently attached, and the other connects to it via a large rectangular connector. Make sure you get these cables and the two mating connectors (two connectors shown by yellow arrows on the picture to the right) that are part of the car's wiring harness. Leave at least 6 inches of pigtail wire on the mating connectors when you cut them off the salvage car's wiring harness.
- There are five brake lines attached to the ABS unit. These brake lines run over to the master cylinder/stock prop valve. If you plan on mounting the ABS unit in your car in the same location it's mounted in the SN95s (between the radiator and smog pump, it's a squeeze), you would like to remove this set of five brake lines from the salvage car (including the various mounting clips/screws), since they can be used in a fox car with some tweaking. If you plan on mounting the ABS unit in the stock battery location (like I did), then you don't need these brake lines, *but you will need to get* the five bubble-flare nuts that screw into the ABS unit off the ends of the brake lines. Just cut the brake line or bend it until it breaks. This will save you the hassle of trying to find these nuts at a parts store.
- Sensor/cable assemblies. At each wheel hub is there is an ABS sensor attached to the spindle/flange with a single bolt. The bolt has a strange head on it, but a 1/4" socket fits. The cable attached to the sensor is about 3 feet long, and ends with a connector. You would like to get this complete cable off the salvage car and the mating connector (see below) that is part of the car's wiring harness. Leave at least 6 inches of pigtail wire on the mating connectors when you cut them off the salvage car's wiring harness. Holding the sensor cable assembly to the car are a couple of brackets w/ screws on each cable, be sure to get these too. For the fronts you will probably have to either remove or cut out part of the black plastic fender liner to get to the complete cable. The fender liner cuts fairly easily with a razor knife. Just don't cut the cable. In the rear the cable goes up into the body by the torque boxes (see below) and the end of the cable (the connector end) is under the back seat. Once you disconnect the connector, the cable assembly comes out from the bottom of the car, big black body plug included.

Mating Connector:

Rear Cable Going up into the Body by the Torque Boxes:



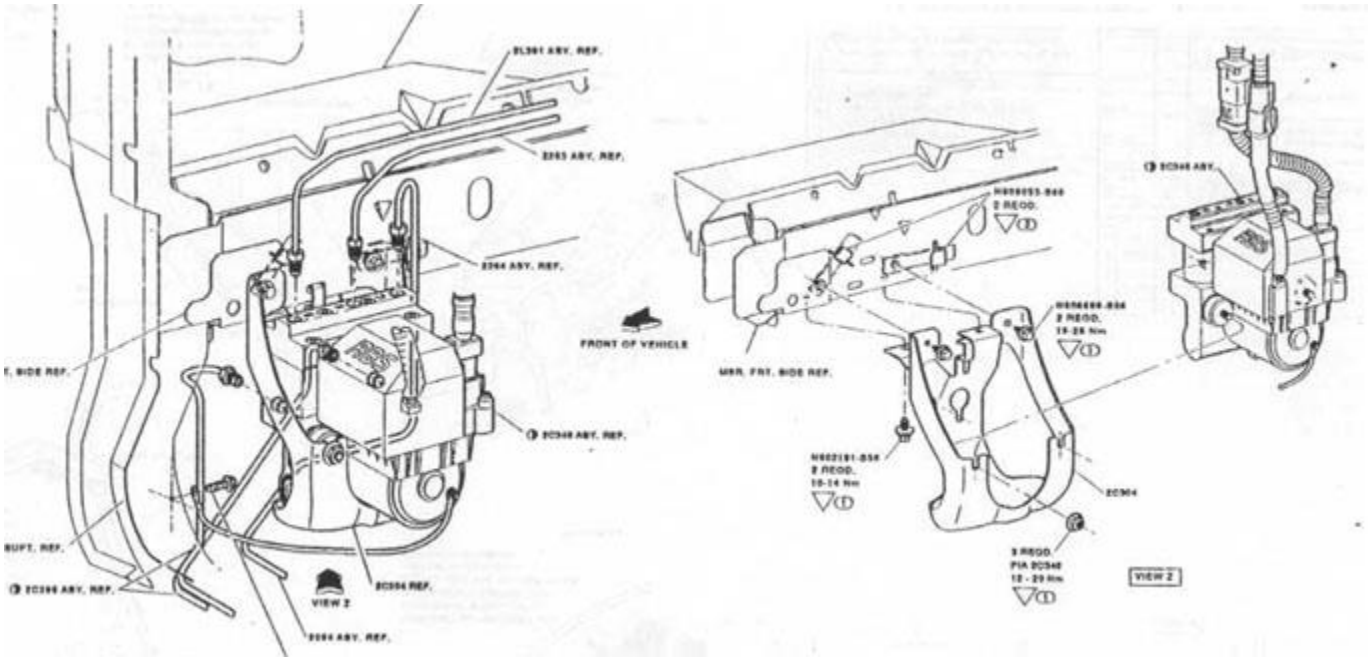
- The ABS diagnostic connector. This is plugged into a red plastic cover and attached to the fuse box near the battery of the salvage car. I didn't use the diagnostic connector since I added a diagnostic switch/light to my dashboard so I could runs diagnostics from inside the car.

- If you don't have front hubs or rear axles with the exciter rings, and the salvage car has them in good condition, you might want to pull them, too. But that's a bit more work.

Additional parts you will need from various stores:

- Wire to connect the four sensors to the ABS unit. I used 16 gauge (AWG), 2-conductor, twisted-pair. I got like 50 feet.
- A 60-amp fuse & holder for the ABS unit main power. Got mine from a car stereo supply store.
- Instead of making my own bubble-flare brake line ends to connect to the ABS unit, I just got five 5-foot sections of 3/16" brake line from an auto supply store that was already bubble-flared on the ends. It doesn't matter what size nuts are on the lines, you will gut one end of the line off, slide off the nuts that are on there, and slide on the nuts that you got with the ABS unit.
- You will need assorted inverted-flare nuts and unions to mate up the new brake line to the existing brake lines on your car. I don't have exact parts listed since this will vary depending on the car. I'll try to include more detail later, but this ends up being the tedious part of the install.

Mounting the ABS unit:

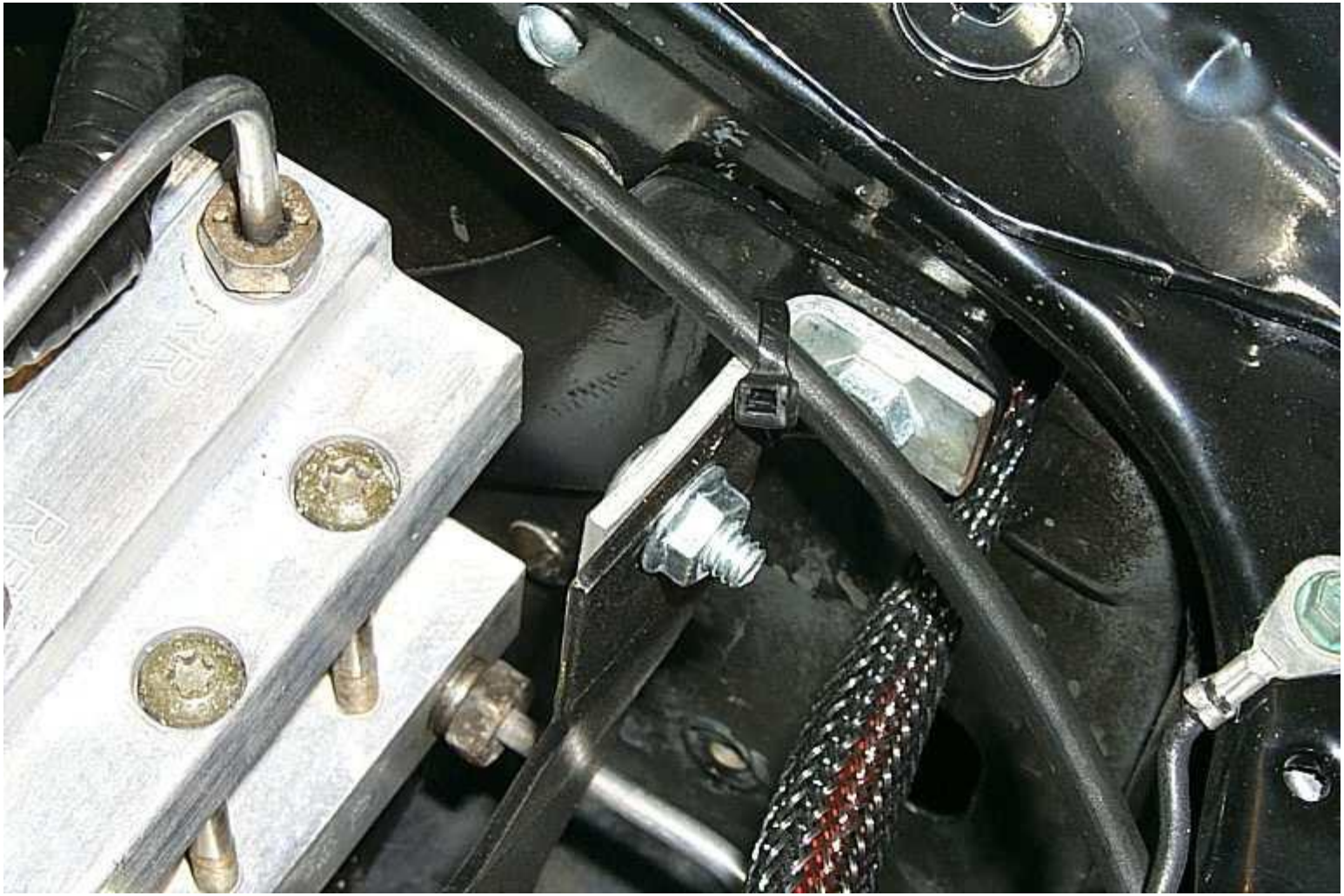


There are two main locations you can place the ABS unit. The first is in the stock location (shown in the above image) hanging off the frame rail between the radiator and smog pump. You would probably choose to put it here if your battery is in the stock location and you don't want to move it. It is a bit of a squeeze if you have a thicker-than-stock radiator, but it does fit. Having the stock brake lines that run from the ABS unit to the master cylinder area will save you a bunch of tube-bending.

The other location is where the stock battery sits. I put mine here since my battery is in the trunk, and it makes the five brake line runs a lot easier to bend and install. My Crane ignition used to sit here, I relocated it to the inside of the fender. I chose the orientation in the picture because I screwed up when I modified the cradle bracket. I cut off the wrong side of the bracket. It would be a bit easier to have the pump oriented 180 degrees from where I have it, so the brake line ports face the rear.

Stock Battery Location Installation:

To mount the pump to the body of the car, I simply bolted the bottom of the black cradle bracket to the frame rail area, being careful to keep the bolt heads from hitting the ABS unit once it's installed in the bracket. I then bent the bracket "ear" flat against the inner fender, bent the other "ear up, and used a small L-bracket to bolt both ears to the inner fender like this:



On the other side of the bracket I cut off the two ears that were just sticking up in the air. I made the mistake of cutting off the wrong side, so I was stuck with the ABS unit orientation shown two pictures up.

Connecting the brake lines:

My car has the M-2300K Cobra brake kit. The proportioning valve that comes with that kit was gutted as per the kit instructions.

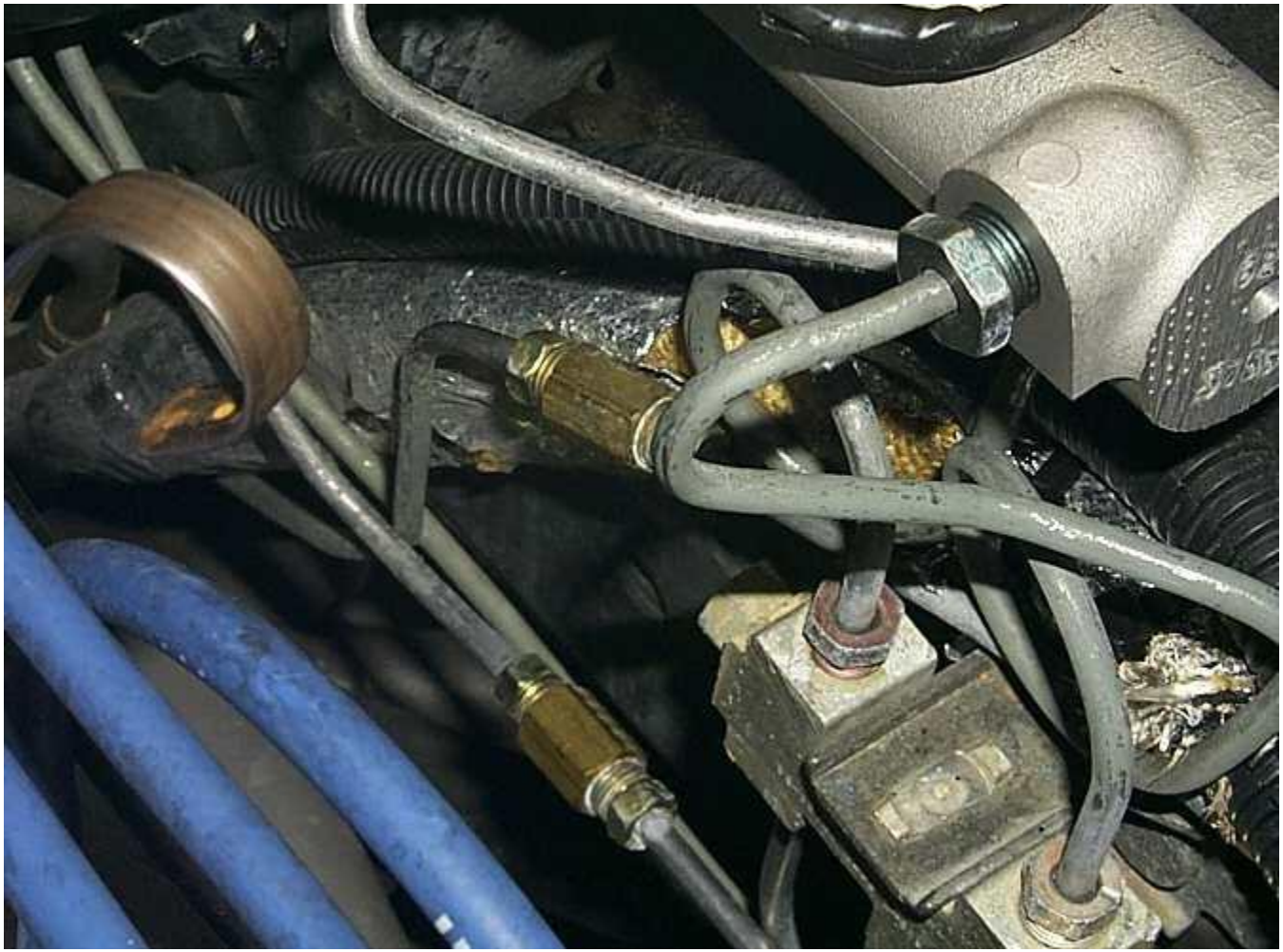
In order to make brake line connection to the ABS unit use the 5-foot lengths of bubble-flare tubing you bought. Cut one end of the tubing off, remove any nuts that came with the tubing, and slide on the appropriate-sized nut for the ABS unit connection you want to make. Bend the tubing (using a brake-line tubing bender!) in the appropriate shape to get it from the ABS port to the prop valve port. Depending on your prop valve, you may have to use an adapter if the prop valve port doesn't accept nuts for 3/16" brake line tubing. Top view of what this looks like in my install:

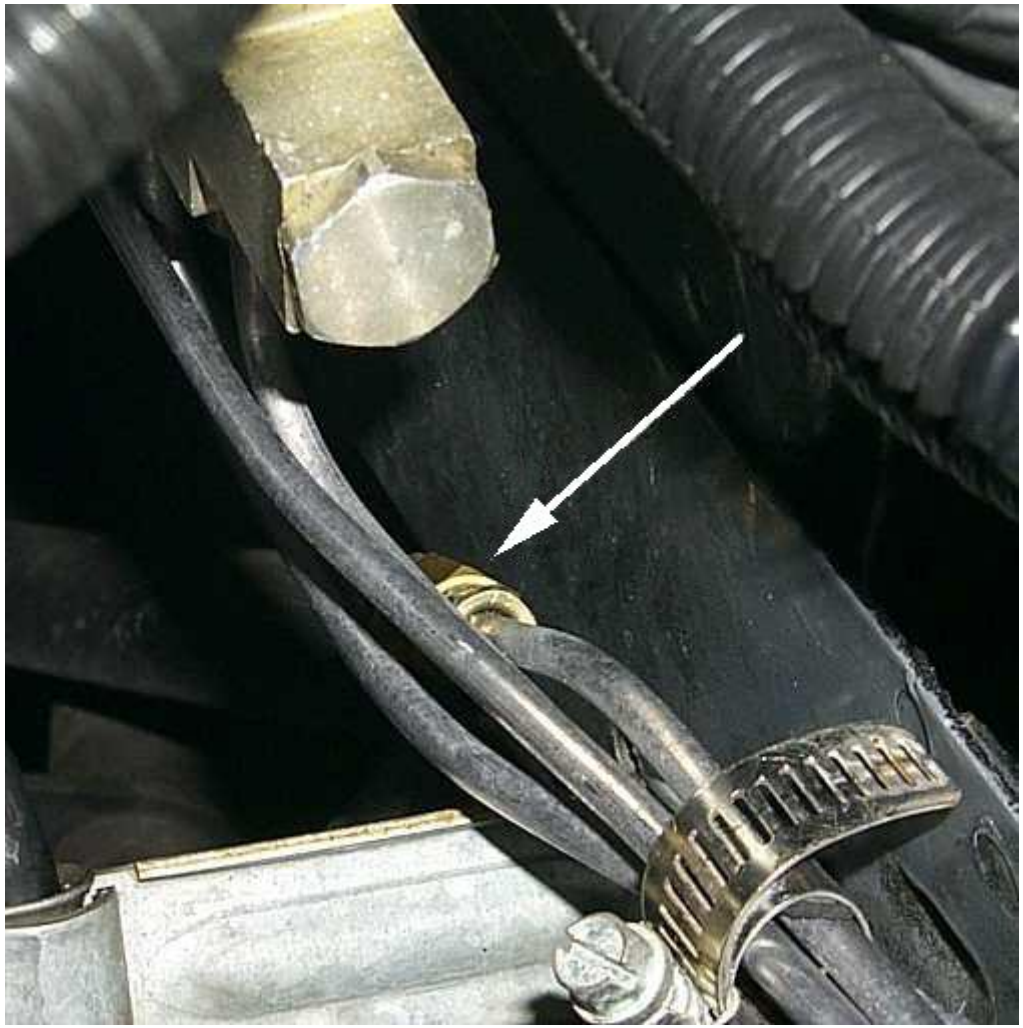
For the connections from the master cylinder to the prop valve, you should be able to re-use the short brake lines that were on there. Here is how things are routed on my car:

- The front port on the master cylinder (rear brakes) is connected to the top-front port on the prop valve.
- The rear port on the master cylinder (front brakes) is connected to the top-rear port on the prop valve.
- The front and rear end ports of the prop valve are capped off.
- The bottom-front port of the prop valve (rear brakes) is connected to the rear brake line input port on the ABS unit.

- The bottom-rear port of the prop valve (front brakes) is connected to the front brake line input port on the ABS unit.

Now all that's left is to connect the three ABS unit brake line outputs to the three stock brake lines dangling free under the prop valve. You will need to take the remaining three bubble-flare brake lines and route them to the open ends of the stock brake lines, and use the appropriate nuts and unions to make the connections. I don't remember the sizes I used to do this, I'll try to add this info if I can figure it out a bit later. Another picture of the install on my car:

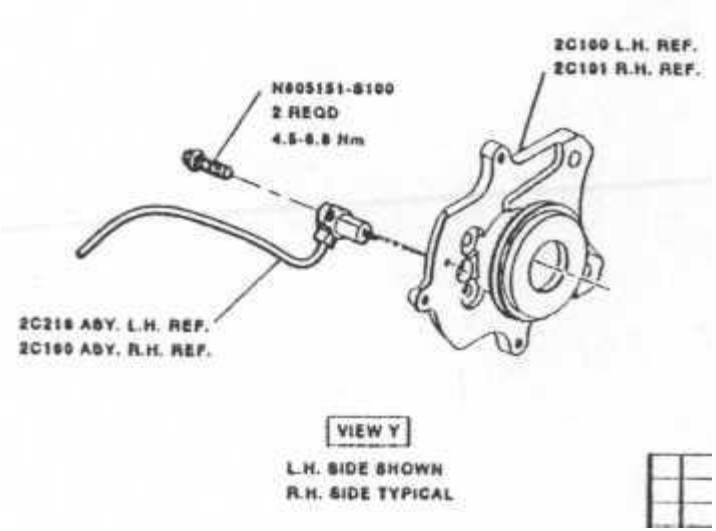




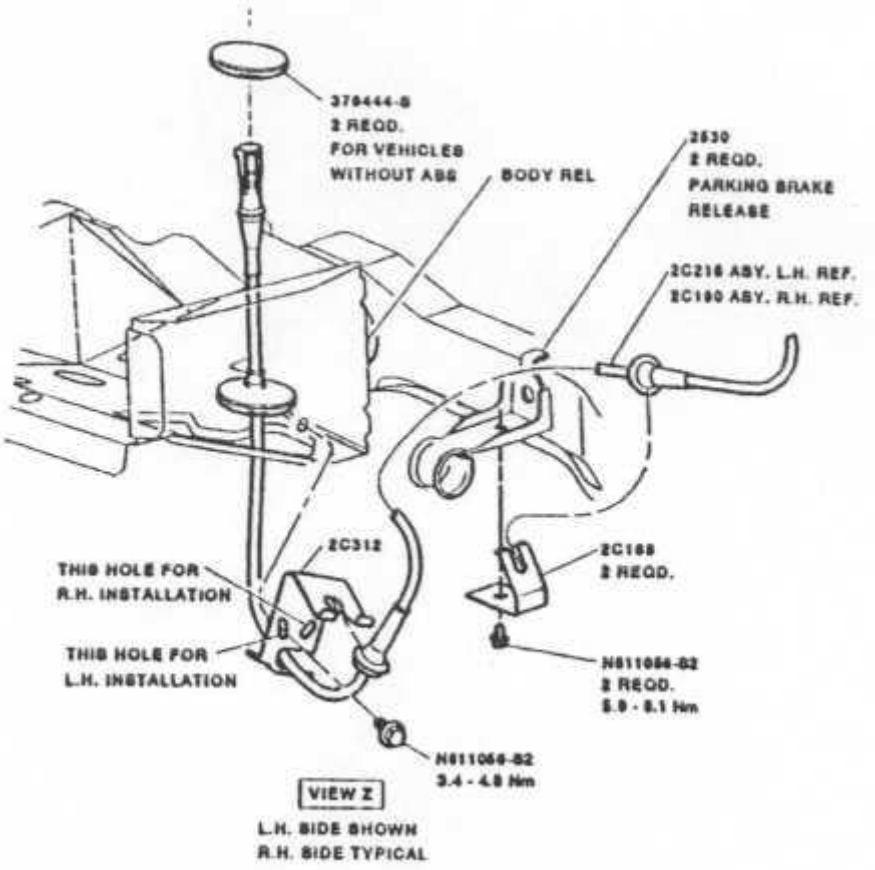
Don't forget to bleed the crap out of the brake system and check for leaks. I use Russel or Earl's speed bleeders, they work awesome and bleeding goes a lot, lot faster. You can get them from Summit or Jegs.

Mounting the sensors:

The sensors and their associated brackets are easy to mount. The only gotcha is in the rear you will have to clearance (grind away) some of the axle flange so that the sensor can slide into the hole on the caliper mount. Obviously you would want to do this before you install the rear brakes if you are doing that at the same time. One important note: you will have to remove the bolt that holds the rear sensors in place and back the sensors out a bit when you push in the axles to remove the C-clips. There is not enough clearance to do that with the sensors in place.



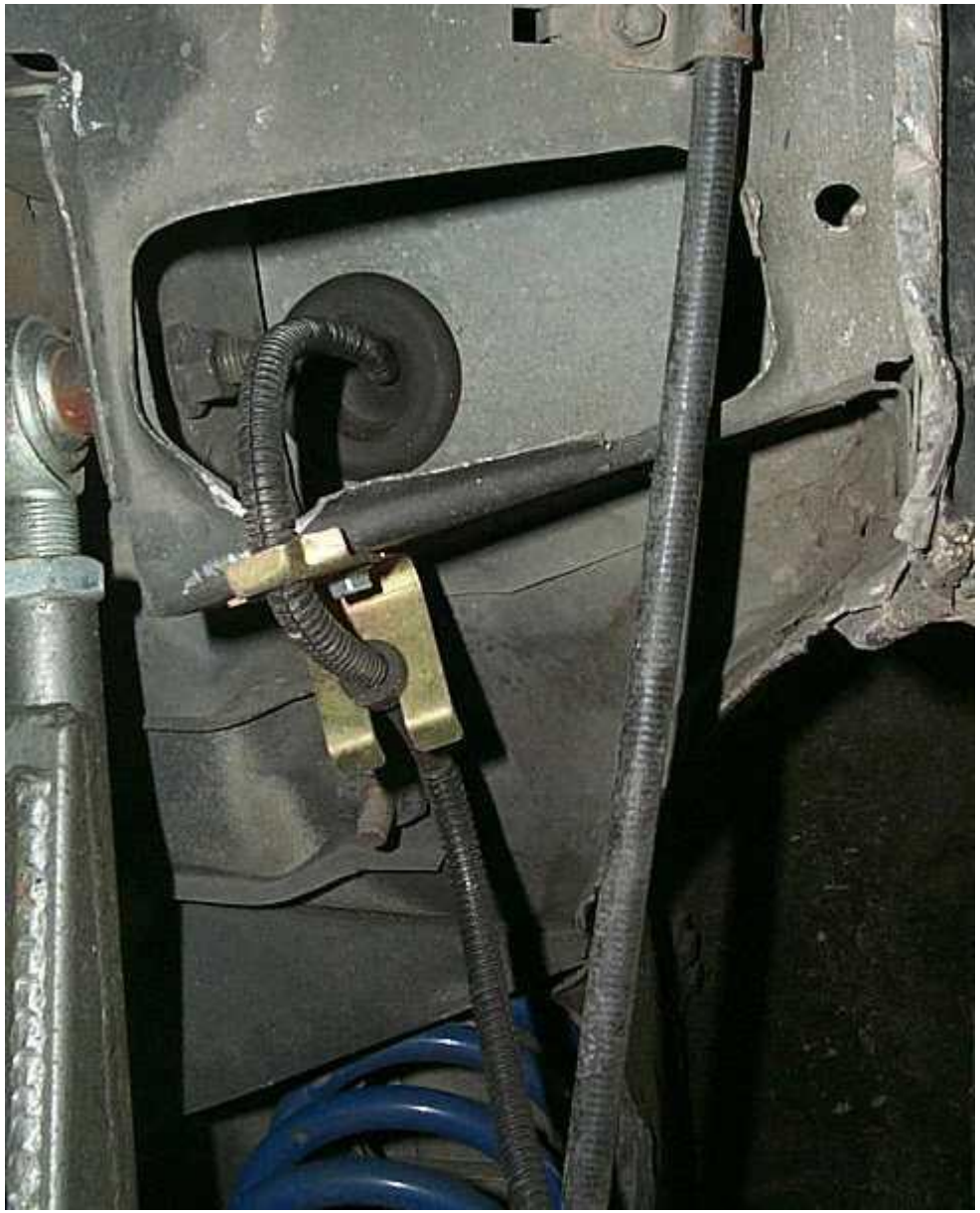
Once the rear sensor is bolted in place, you run the cable over to the body like this:



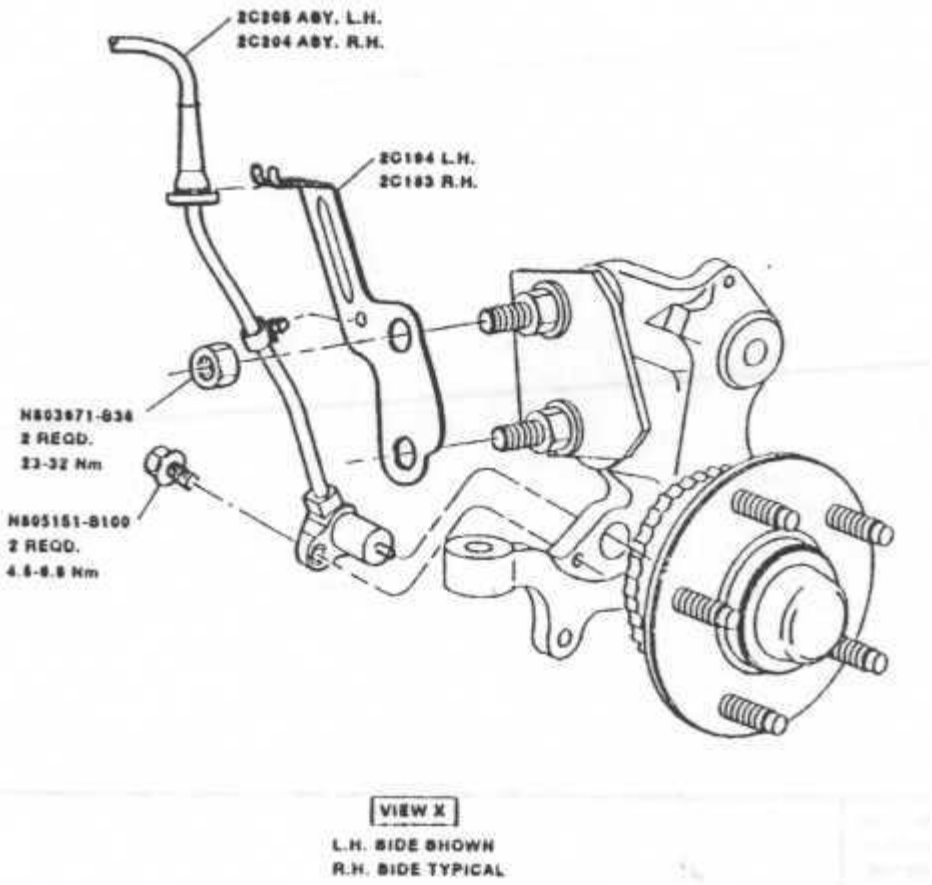
Since I have R wheels that are offset in, I use the stock e-brake cable spring to hold the e-cable (with the sensor cable ty-wrapped to it) close to the control arm. Notice I use some black plastic spiral-wrap (from Radio Shack) to protect the sensor cable where it doesn't already have wire loom around it.

You could use the e-brake cable brackets if you have enough wheel clearance.

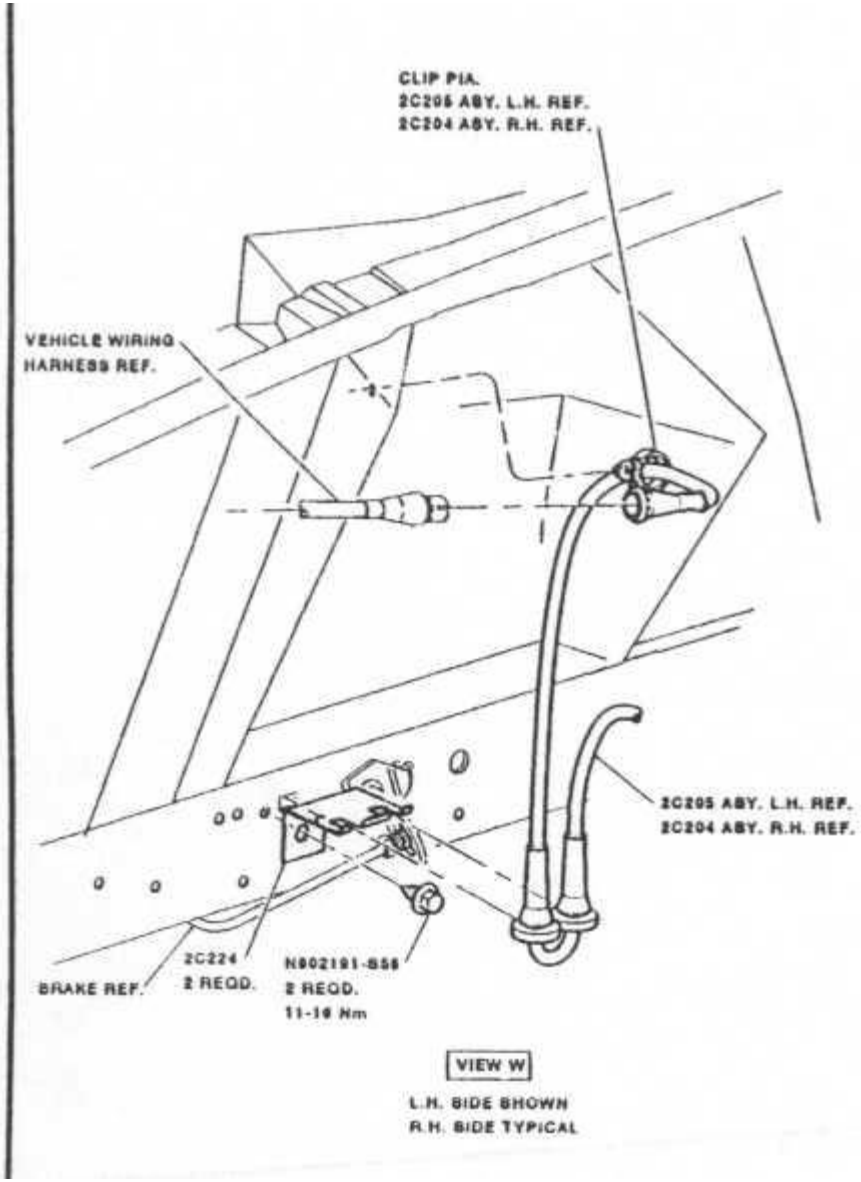
The cable (with the molded-on body plug) then goes through the body under the rear seat. You may have to grind away some of the sharp edges of the body where the body bracket holds the cable close to the body, as shown in the picture.



The front sensors are straightforward. Bolt the sensor to the spindle and run the cable through the bracket at the bottom of the strut (I used an old strut nut to hold the bracket to the strut bolts) like this:



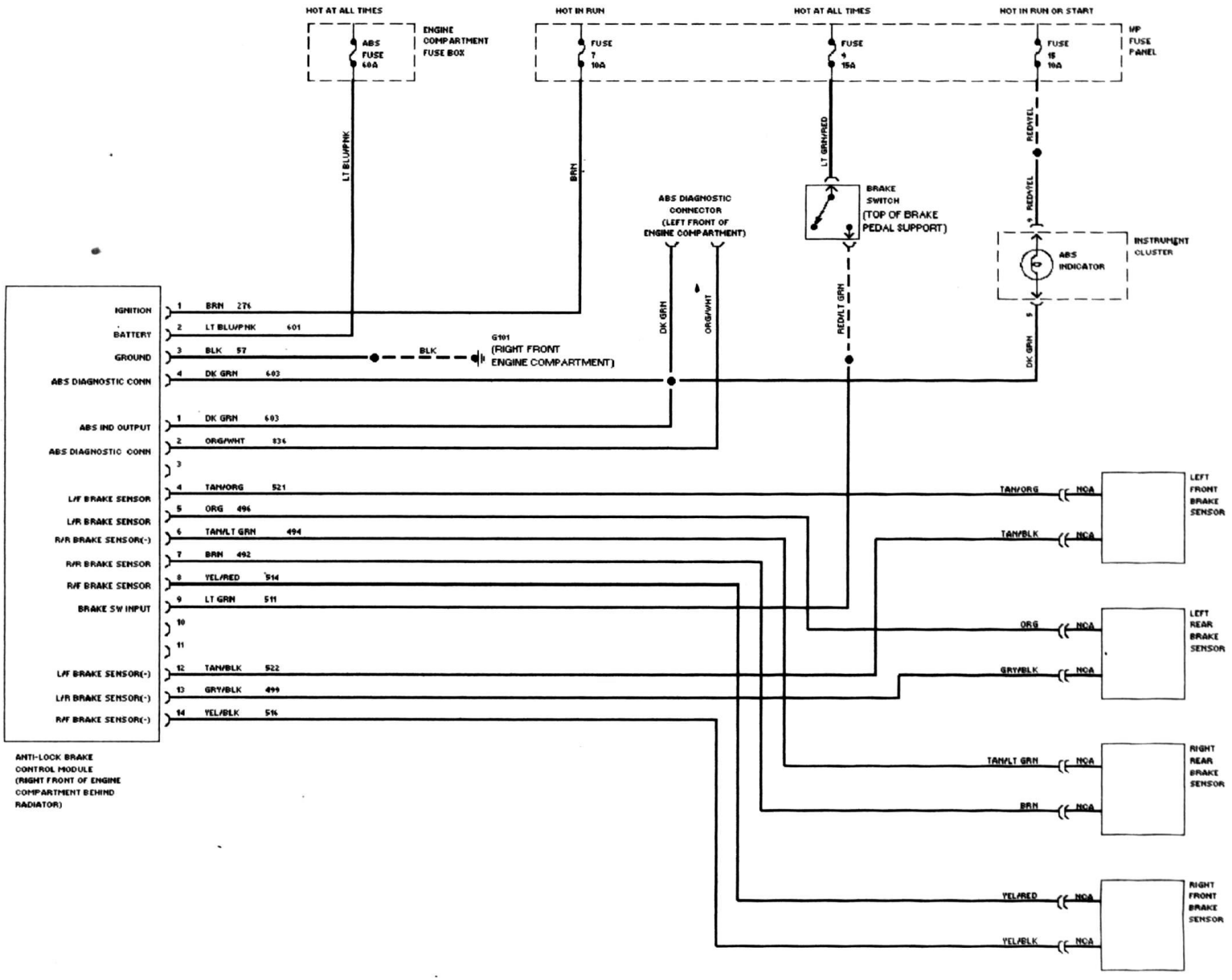
Then run the cable through the bracket attached to the frame rail.



At that point the cable is supposed to go under the plastic fender liner and through a hole in the inner fender, so you may have to remove the fender liner to do that. I somehow lost the pictures of the completed front sensor install, I'll add it a bit later.

Wiring the sensors:

Connect the sensors to the ABS wiring harness as shown in the wiring diagram below using the 16-ga twisted-pair wire as needed, matching up the right color wires for each sensor.



Wiring up the ABS unit:

Connect the ABS wiring harness to Ignition, Battery, and Ground as shown in the wiring diagram. I used 10 gauge wire for Battery and Ground (don't forget the big in-line 60amp fuse shown below), and 18 gauge wire for Ignition.

I added a switch and green power light to the ignition wire so I could turn off the ABS if desired. This is shown in the picture below:

Connect the Brake Switch Input (otherwise known as Brake On/Off, or BOO) of the ABS wiring harness to the brake on/off switch attached to the brake pedal, as shown in the wiring diagram. I used 18 gauge wire for this.

All that's left now are the diagnostic connections, as shown in the wiring diagram. You will need to add an ABS indicator light (same function as the ABS idiot light in the SN95s) to the dashboard if you want to see the status of the ABS system. I added a bright red light to my dashboard. The diagnostics are started by turning on the ignition key while the Orange/White wire at the ABS diagnostic connector is grounded. Instead of using a jumper wire at the diagnostic connector, I added a switch to the dash near the ABS indicator light that allowed me to ground the Orange/White wire from inside, turn the ignition on, and count the flashes of the ABS indicator light to get the error codes.

Testing the ABS Unit / Wiring:

If all is ok, when you turn the ignition key to "on" the ABS indicator light will come on for a few seconds, and then go out. If it stays on, then the power-on diagnostics have detected a problem. To read the error codes out of the ABS unit, you ground the Orange/White wire at the ABS diagnostic connector (with the ignition turned off), and then turn the ignition key to "on". The

ABS indicator light will flash the number of times to indicate the first digit of the first error code, followed by a short pause, and then flash the number of times to indicate the second digit of the first error code. There will then be a longer pause, then it will repeat for the second error code, and so forth. The ABS unit holds the error codes in memory for a certain number of power-on/power-off cycles even if the problem has been corrected. This messed me up trying to hunt down problems that weren't there. So, as long as the indicator light goes out after a few seconds following ignition-on, the system is fine, even though you can still read error codes out in diagnostic mode.
Here are the error codes:

- 12 - system ok
- 19 - anti-lock control module
- 22 - right front valve
- 24 - left front valve
- 26 - rear valve
- 31 - right front ABS sensor continuity fault
- 32 - right rear ABS sensor continuity fault
- 33 - left front ABS sensor continuity fault
- 34 - left rear ABS sensor continuity fault
- 41 - right front ABS sensor
- 42 - right rear ABS sensor
- 43 - left front ABS sensor
- 44 - left rear ABS sensor
- 61 - pump motor/pump motor relay fault
- 63 - voltage supply interruption
- 69 - vehicle battery voltage less than 10VDC
- 78 - ABS sensor frequency fault

Parts List:

ABS Part Description	Brand/Model/Part #	Est. Cost	Source
ABS pump /w bracket and five bubble-flare nuts	Ford	$200.00	salvage yard
Wiring harness @ ABS pump	Ford	$20.00	salvage yard
Front hubs w/ exciter rings, pair	Ford / F6ZZ-1104-AA	$103.24	Ford dealer
Rear axles w/ exciter rings	Ford	$	parts swap
Front ABS sensor, left	Ford	$15.00	salvage yard
Front ABS sensor, right	Ford	$15.00	salvage yard
Rear ABS sensor, left	Ford / F7ZZ-2C190-DA	$43.68	Ford dealer
Rear ABS sensor, right	Ford / F4ZZ-2C190-A	$43.04	Ford dealer
Sensor mounting bolts, Qty 4	Ford / N805151-S100 (M6 x 1.00)	$2.36	Ford dealer

Front sensor bracket, left @ strut	Ford / E7SZ-2C183-A	$4.34	Ford dealer
Front sensor bracket, right @ strut	Ford / E7SZ-2C183-B	$3.29	Ford dealer
Nut to hold above brackets (1 per side)		$	leftover old strut nuts
Front sensor bracket, left side @ frame rail	Ford / F4ZZ-2C224-A	$3.88	Ford dealer
Front sensor bracket, right side @ frame rail	Ford / F4ZZ-2C395-A	$3.04	Ford dealer
Rear sensor bracket, left side @ body behind torque box	Ford / F4ZZ-2C312-A	$7.16	Ford dealer
Rear sensor bracket, right side @ body behind torque box	Ford / F4ZZ-2C312-A	$7.16	Ford dealer
Self-tapping metal screw to hold above brackets (1 per bkt)		$5.00	hardware store
Rear E-cable bracket, left	Ford / F5ZZ-2530-AA	$4.26	Ford dealer
Rear E-cable bracket, right	Ford / F5ZZ-2530-AA	$4.26	Ford dealer
Rear sensor bracket, left @ E-cable bkt	Ford /F4ZZ-2C188-A	$4.28	Ford dealer
Rear sensor bracket, right @ E-cable Bkt	Ford / F4ZZ-2C188-A	$4.28	Ford dealer
16ga-2conductor twisted-pair wire, 50 feet		$8.00	hardware store
60amp fuse and holder		$15.00	car stereo supply store
Five 5-foot sections of bubble-flare 3/16" tubing		$17.45	auto supply store
Various inverted-flare nuts and unions as required		$20.00	auto supply store