1993-1995 FX7 Automatic to Manual Conversion

FX JDM

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Release 6.0.3

1 Contents

2 Revision History

4.2 – Published to forum as release 4.0

4.3 – Add note to fill oil with 4.5 US quarts, add note to grease clutch pedal rod, rod pin, shoulder on bolt that pedal attaches with

4.4 – Change heading text to reinstall PPF before Driveshaft (steps were correct, heading was wrong)

4.5 – Removed "Step 3.1, Step 3.2, etc."

5.1 – Updated version to match engine removal, strip to short block, rebuild rats nest books published at https://fxjdm.com/rx7-fd-documentation

5.1.1 –Thrust Bearing added with grease 3 points.

5.2 – 2/25/2024 – Wiring section 6 rewritten with much clearer instructions. No changes to the actual wiring connections.

Version 6.0.2 – Sync'd book version numbers and published to the FX JDM website 6/19/2024.

3 Overview

This document was written while FX JDM (on Instagram) did our second automatic to manual conversion June 2022 and then the document was tested and improved while we did our third automatic to manual conversion July 2022 from it. Some of the steps can also be done out of order to optimize time where the car is up in the air or down on the ground especially when a lift is not available such as not necessarily doing all of the fluids near the end. The first time I converted an RX7 my garage / warehouse wasn't built yet and I did this in my home garage on jack stands. The next two were done in our facility which has 2 post lifts and of course it was more comfortable, but the job can be done on jack stands just fine.

3.1 Wiring

The cleanest and easiest solution for the auto to manual wiring is to keep the automatic wiring harnesses in the car and simply modify them. The automatic already has every wire that you need and we can re-purpose a few of them to make the fewest number of cuts and jumpers. If you go the other route and replace the emissions harness (engine harness) with one from a Manual transmission car, the big blue connector that meets the auto main wiring harness won't fit. If you change the main harness to a MT one, then the auto dashboard harness won't connect to the MT main either. You basically would have to swap out 3 major harnesses. They would be very expensive and very time consuming to swap.

What we do instead is keep the speed sensor connector from the automatic exactly as it is. We locate the two wires for the reverse sensor and add a reverse sensor pigtail. We re-purpose 4 other wires for the neutral switch, 1st gear, and send gear sensor, and ground for the neutral, 1st, 2ndand add a pigtail for neutral and a pigtail for 1st/2nd gear. We also add a signal wire and ground for the

clutch pedal sensor and we wire the clutch safety switch through the H302 relay so the car can only be started with the clutch pedal pressed in. This method takes a few hours of wiring changes (unwrapping old wires, taping them back up) and there are around 10 cuts and connections made. Corsa Technic offers all of the necessary connectors and the part #s are listed in the "Full list of parts" section of this document.

3.2 Time to Complete this Task

It will take a minimum of 40 hours to complete this job even with a lift assuming you follow the instructions and replace all the fluids on the car, swap the differential, adjust the speedometer, replace the tachometer, do the proper wiring mods (neutral switch, clutch position switch, clutch safety switch, 1st/2nd gear). Ideally you can get a couple of hours of helper / friend time for the portions of the job that are easier with 2 people like removing the very heavy automatic transmission, installing the 5 speed transmission, raising and lowering the factory exhaust. There are a ton of steps to this process, but it's well worth it as the car will drive completely differently as a 5 speed compared to the original 4 speed automatic (3 power gears and one overdrive gear). First timers will like

ly take more than 40 hours.

It's suggested to read through the document ahead of time and then adjust the step order to your liking and see which options you want to do or not do. For example are you swapping the rear differential or just swapping the automatic diff flange for the MT diff flange. Are you going to swap the tachometer, swap the faceplate only, or leave the automatic 7,000 RPM tachometer that displays PRNDL?

3.3 Special Tools:

3.3.1 54mm socket for flywheel nut (Atkins Rotary ARE903)

3.3.2 Auto counterweight removal tool from Racing Beat

3.3.3 Flywheel Locking tool (Mazdatrix)

3.3.4 Pilot bearing removal tool (in case pilot bearing starts going in crooked)

Mazdatrix sells a pilot bearing removal tool slide hammer with a special end piece. I've also used an OTC 4420 puller on a slide hammer successfully shown below. I recommend having this tool as it's easy to get the pilot bearing crooked when putting it in and you'll need the tool to get it out and try again.

3.3.5 Clutch alignment tool that comes with clutch kit

The clutch alignment tool that comes with the Exedy clutch kit is too long and I have to cut about half of it leaving 22-23mm. Otherwise the spline part of the tool won't engage with the friction disc. Picture above shows the original tool and the cut down tool.

3.4 Parts List and Parts Considerations

Some choices need to be made about the differential and tachometer as you hunt for parts.

3.4.1 Differential Gearing

The original 5 speed cars were equipped with a 4.1 rear end gear ratio, and the automatics were equipped with a 3.9 gear ratio (Mathematically a 5.12% difference where the auto diff is 5.12% taller gearing). When you swap in the Mazda 5 speed transmission, you must use the 5 speed driveshaft since the automatic drive shaft will not fit into the 5 speed (spline shaft is different). The 5 speed drive shaft has a different rear end bolt pattern and is shorter, so something must be done to the differential to work with it. Options are to either swap a 5 speed 4.1 ratio differential OR just swap the 5 speed diff flange (still available from Mazda in 2022). I've done it both ways and each way the car drives very well.

Another consideration is that since 1993, highway speeds have increased from 55mph speed limit to 75 mph in the US and I've noticed on my 5 speed geared cars that at 80 mph I'm cruising at 3500 RPM, so if anything the auto diff helps a bit in that regard and I can cruise at 3325 RPM instead.

3.4.2 Tachometer

The automatic tach shows PRNDL and also has a 7,000 RPM redline compared to the 5 speed 7,500 RPM redline. I like to change this out and usually buy a used 5 speed tachometer or a new one if it's available. For a used one that might have unknown electrical issues, I usually swap the faceplate out which just requires lifting the needle off and then removing 4 plastic clips and gently prying around the needle motor at the top and bottom.

3.4.3 ECU

According to an early 2001 post by one of the pioneers in the auto to manual conversion for a 3rd gen RX7: "**You dont have to use a 5speed ECU, but I would recommend it because the car idled like it had a heavy streetport with the auto ECU still in**"

You will definitely notice idle hunting if you leave the auto ECU in the car after the conversion. Below is a partial list of part numbers to help you find the correct ECU for the conversion.

1st Digit: Engine Family, N=Non-Piston Engine (Rotary)
2nd Digit: Last number of displacement in Liters, 2=12A, 3=13B, F=20B
3rd Digit: Version & Options, A= S6 USA/JP, B=S6 Euro, C=Revised S6 USA, etc
4th Digit: Region & Transmission, 1=USA MT, 2=USA AT, 3=California MT, 4= Cali AT
and so on (7 is JDM)

1993 Versions

Federal M/T - N3A1-18-881B (3rd digit A is Series 6 USA, 4th digital 1 is USA MT)

Federal A/T - N3A2-18-881A (3rd digit A is Series 6 USA, 4th digital 2 is USA AT)

N3A3 is likely 93 California MT

N3A4 is likely 93 California AT

1994 Versions

Federal M/T - N3C1-18-881A (3rd digit C is revised S6 USA, 4th digital 1 is MT)

Federal A/T - N3C2-18-881A (3rd digit C is revised S6 USA, 4th digital 2 is AT)

California M/T - N3A3-18-881B (3rd digit A is Series 6 USA, 4th digital 3 is Cali MT)

California A/T - N3A4-18-881C (3rd digit A is Series 6 USA, 4th digital 4 is Cali AT)

California cars have a wire on the EGR to verify the EGR is present and will generate a CEL if used on a non-CA car since the wiring harness(es) and EGR are missing this wire. Don't put a CA ECU on a non-CA car.

3.5 Full List of Parts

Here's a complete list of every single part you need for the conversion aside from a few misc. M6 nuts and bolts which you may have lying around and an M8x1.25 nut with a large flange or large washer to hold the top back of the clutch pedal . This list has been used recently for two conversions and is very accurate.

Part#	Mfg	Assy	Qty	Part Description
				CONNECTORS
ESJ-2P	Corsa Technic	Connector	**1**	Reverse switch connector (Harness side)
DL090-2P-1	Corsa Technic	Connector	**1**	Neutral switch connector (harness side)
ESJ-4P	Corsa Technic	Connector	**1**	1st/2nd switch connector (harness side)
MTU.IL-2S-2	Corsa Technic	Connector	**1**	Clutch pedal position sensor connector harness side
250ARM-3S	Corsa Technic	Connector	**1**	Clutch safety switch connector harness side
				REAR MAIN SEAL WILL LEAK AFTER DISTURBING THE FLYWHEEL
N3H1-10-508	Mazda	Engine	**1**	Seal, rear main seal oil, engine crankcase oil seal
0813-10-555A	Mazda	Engine	**1**	Stationary gear o-ring (1974-95), viton upgrade, can't use RX7
				ALL THE OTHER PARTS
Depends on Federal or CA emissions	Mazda	ECU	**1**	ECU for 5 speed car
N3Y1-11-50X	Mazda	Flywheel	**1**	Flywheel OEM 19.8 pounds
EXEKMZ01	Exedy	Clutch Kits	**1**	Exedy Stage 1 OEM Clutch Kit including release bearing, pilot bearing, pilot bearing seal, pressure plate, disc - up to 325 RWHP
1881-11-404A	Mazda	Clutch	**1**	Pilot Bearing Seal
9YA0-00-804	Mazda	Clutch	**6**	Clutch Pressure Plate Bolt (6 required w/ 8mm washer)
R564-03-000	Mazda	Transmission	**1**	NEW Manual Transmission (with clutch fork and thrust bearing, does not include: Speed sensor, shift lever, shift collar, side vent cover)
R505-17-400B	Mazda	Transmission	**1**	Speed sensor (manual transmission)
N315-16-111	Mazda	Transmission	**1**	Peeping Cover (NLA), Left side small flat cover, (Not included w/ new transmission).
9979-40-612	Mazda	Transmission	2	Bolts for (2) peep covers, M6x1x12mm, Special tapered end
9979-61-055	Mazda	Transmission	**4**	Bell Housing Bolt uses 4, (M10x1.25.x55mm)

9979-61-090	Mazda	Transmission	**1**	Bell Housing Bolt Lower Left uses 1, (M10x1.25x90mm)
P045-27-120B	Mazda	Differential	1	Companion Flange, Manual Trans (or buy used diff and replace side axle seals)
P043-27-238A	Mazda	Differential	**0**	Output shaft seal (side seals for axles)
PF03-25-100	Mazda	Driveshaft	**1**	driveshaft, FD, Manual
N315-16-921	Atkins Rotary	Clutch Hydraulics	**1**	Slave Cylinder bracket plus (3) M8x1.25x25mm flange bolts plus (2) M8x1.25x20mm for clutch slave cylinder
FD01-41-990B	Mazda	Clutch Hydraulics	**1**	Master Cylinder w/ hose - Exedy MC495 or Seiken
FD01-41-920	Mazda	Clutch Hydraulics	**1**	Slave Cylinder / Dorman CS360013 / Seiken
CHS-BAYS-FD-LHD	Chase Bays	Clutch Hydraulics	**1**	Chase Bays Clutch Line - Mazda RX-7 FD with 13B, full length
N3A1-18-400	Mazda	Starter Assy	**1**	Starter for Manual (or Duralast 17162 / Bosch SR 4212 X)
9980-01-0135	Mazda	Starter Assy	**1**	starter bolt long M10 135mm plus M10 lock washer and nut
9979-61-030	Mazda	Starter Assy	**1**	Starter bolt lower manual (M10x1.25 x30 mm) - generic
RP-DOWNPIPE	Mazda	Exhaust	**1**	Rotary Performance Downpipe FD RX7
R507-17-510A	Mazda	Shifter Assy	**1**	Manual Shift Lever or RE Amemiya shifter which includes lower boot and groove bushing
M513-17-480A	Mazda	Shifter Assy	1	Lower boot on transmission shifter (3 bolts) - Not required for RE Amemiya shifter
0398-17-462A	Mazda	Shifter Assy	1	Shifter collar Bushing (to rebuild used OEM shifter and for RE Amemiya to replace metal collar which will eventually rattle)
M501-17-515	Mazda	Shifter Assy	1	Shift lever groove bushing
FD01-64-490A	Mazda	Shifter Assy	**1**	Shift Boot Insulator
FD01-64-330C-00	Mazda	Shifter Assy	**1**	Shift Boot leather with plastic retainer
R503-17-520B-00	Mazda	Shifter Assy	**1**	Knob Change Lever
FD01-43-30XB	Mazda	Pedals - Brake	**1**	Brake Pedal Mazda 1993-1995 LHD
FD01-41-30XA	Mazda	Pedals-Clutch	**1**	Clutch Pedal assembly NEW (minus rod, fork, etc. to slave cylinder)

FB-ROD-FORK-60MM	Mazda	Pedals-Clutch	**1**	FB Rod and Fork 60mm length extended to 70mm by welding on 10mm of M8x1.0 standoff
LA01-66-490A	Mazda	Pedals-Clutch	**1**	Clutch position switch - used by idle system, cruise control
FB01664D0	Mazda	Pedals-Clutch	**1**	Miata Clutch safety switch (Can be made to fit FD by smooshing wires down and holding with RTV since they come out the wrong side).
FD01-55-461	Mazda	Instruments	**1**	Tachometer 93 style, 1k increments
				FLUIDS
IDEMITSU75-90	Idemitsu	Maintenance	**5**	Idemitsu 75-90 Gear Oil (around 2 quarts for rear diff and 3 for MT)
BUR7EQ	NGK	Maintenance	2	Spark plug BUR7EQ Leading (Lower)
BUR9EQP	NGK	Maintenance	2	Spark Plug BUR9EQP Trailing (Upper)
OIL-20W-50W	Castrol	Maintenance	1	Castrol GTX 20-50W or equivalent 1 gallon
B6Y1-14-302A	Mazda	Maintenance	1	Mazda oil filter
				I REPLACE THE RADIATOR CAPS AND FILLER NECK O RING TOO
PEAK-GREEN-ASIAN	Peak	Maintenance	2	Peak green asian 50/50 coolant, 1 gallon
KF01-15-205	Mazda	Cooling	1	Thermostat Housing Filler Cap (Yellow)
N3A1-15-205A	Mazda	Cooling	1	Cap Radiator (Round on AST)
N326-15-174	Mazda	Cooling	1	Thermostat housing cap O ring (Filler cap has a short neck on original cars, this is the O ring that leaks)

3.6 Cost for the Parts

The cost depends on how many used parts you can find and are willing to use. If I'm doing this on a low mileage car I try to buy as many new parts as possible, and I even got lucky and bought a stash of some of the last brand new Mazda 5 speed transmissions available. If you bought a transmission for $2,000 in good condition and don't have to rebuild 5th gear synchro, bought a new Exedy clutch for around $450, bought a new flywheel off ebay for $250 if you could find one, and so on, it adds up pretty quickly. If you take a used flywheel and used clutch and so on then the cost can be a lot less.

Below is how much I spent in 2022 buying almost everything new including the deal I got on some new transmissions a few years ago for around $2,000 each. This was for a near perfect 15k mile 1993 automatic so I was OK with sparing no expense on the conversion. The days of finding used 5 speed transmissions for $750 on ebay are long gone, and the few I've seen in 2022 were around $1,800 each and you'd have to expect 5th gear synchro, 5th gear hub, and improved spindle to all need replacing. With labor and parts that's easily another $750.

The last column is labeled "Ext Burdened in 2022" and that stands for extended price (not unit price) including any tax and shipping burden. That means if there were 4 parts at $5 each then it will show as $20 plus any tax and any shipping burden. I try to buy as many parts at once as possible from the same supplier to keep shipping costs down as well.

Qty	Part#	Part Description	Ext Burdened in 2022
		GRAND TOTAL pricing including tax	**$ 6,257.59**
		CONNECTORS	
1	ESJ-2P	Reverse switch connector (Harness side) from Corsa Technic	$ 3.00
1	DL090-2P-1	Neutral switch connector (harness side) from Corsa Technic	$ 3.00
1	ESJ-4P	1st/2nd switch connector (harness side) from Corsa Technic	$ 3.00
1	MTU.IL-2S-2	Clutch pedal position sensor connector harness side from Corsa Technic	$ 3.00
1	250ARM-3S	Clutch safety switch connector harness side from Corsa Technic	$ 3.00
		REAR MAIN SEAL WILL LEAK AFTER DISTURBING THE FLYWHEEL	
1	N3H1-10-508	Seal, rear main seal oil, engine crankcase oil seal	$ 13.95
1	0813-10-555A	Stationary gear o-ring (1974-95), viton upgrade, can't use RX7	$ 5.50
		ALL THE OTHER PARTS	
1	N3A1-18-881	ECU for 5 speed car used off ebay	$ 129.90
1	N3Y1-11-50X	Flywheel OEM 19.8 pounds (from one of my new crate motors)	$ 250.00
1	EXEKMZ01	Exedy Stage 1 OEM Clutch Kit including release bearing, pilot bearing, pilot bearing seal, pressure plate, disc - up to 325 RWHP	$ 450.00
1	1881-11-404A	Pilot Bearing Seal	$ 4.48
6	9YA0-00-804	Clutch Pressure Plate Bolt (6 required w/ 8mm washer)	$ 23.18

1	R564-03-000	NEW Manual Transmission (with clutch fork and thrust bearing, does not include: Speed sensor, shift lever, shift collar, side vent cover)	$ 2,000.00
1	R505-17-400B	Speed sensor (manual transmission)	$ 195.17
1	N315-16-111	Peeping Cover (NLA), Left side small flat cover, (Not included w/ new transmission).	$ 25.00
2	9979-40-612	Bolts for (2) peep covers, M6x1x12mm, Special tapered end	$ 2.93
4	9979-61-055	Bell Housing Bolt uses 4, (M10x1.25.x55mm)	$ 14.94
1	9979-61-090	Bell Housing Bolt Lower Left uses 1, (M10x1.25x90mm)	$ 4.32
1	P045-27-120B	Companion Flange, Manual Trans (or buy used diff and replace side axle seals)	$ 157.78
0	P043-27-238A	Output shaft seal (side seals for axles)	$ -
1	PF03-25-100	driveshaft, FD, Manual	$ 207.62
1	N315-16-921	Slave Cylinder bracket plus (3) M8x1.25x25mm flange bolts plus (2) M8x1.25x20mm for clutch slave cylinder	$ 70.00
1	FD01-41-990B	Master Cylinder w/ hose - Exedy MC495 or Seiken	$ 65.00
1	FD01-41-920	Slave Cylinder / Dorman CS360013 / Seiken	$ 49.47
1	CHS-BAYS-FD-LHD	Chase Bays Clutch Line - Mazda RX-7 FD with 13B, full length - removes the need for the impossible to find hard lines	$ 63.84
1	N3A1-18-400	Starter for Manual (or Duralast 17162 / Bosch SR 4212 X)	$ 159.86
1	9980-01-0135	Starter bolt long M10 135mm plus M10 lock washer and nut	$ 12.00
1	9979-61-030	Starter bolt lower manual (M10x1.25 x30 mm) - generic	$ 4.98
1	RP-DOWNPIPE	Rotary Performance Downpipe FD RX7 - $276 + tax	$ 299.84
1	R507-17-510A	Manual Shift Lever or RE Amemiya shifter which includes lower boot and groove bushing	$ 200.00
1	M513-17-480A	Lower boot on transmission shifter (3 bolts) - Not required for RE Amemiya shifter	$ 45.07
1	0398-17-462A	Shifter collar Bushing (to rebuild used OEM shifter and for RE Amemiya to replace metal collar which will eventually rattle)	$ 11.88
1	M501-17-515	Shift lever groove bushing	$ 11.71
1	FD01-64-490A	Shift Boot Insulator	$ 52.04
1	FD01-64-330C-00	Shift Boot leather with plastic retainer	$ 128.25
1	R503-17-520B-00	Knob Change Lever	$ 157.27
1	FD01-43-30XB	Brake Pedal Mazda 1993-1995 LHD	$ 377.95

1	FD01-41-30XA	Clutch Pedal assembly NEW (minus rod, fork, etc. to slave cylinder)	$ 300.00
1	FB-ROD-FORK-60MM	FB Rod and Fork 60mm length extended to 70mm by welding on 10mm of M8x1.0 standoff	$ 85.00
1	LA01-66-490A	Clutch position switch - used by idle system, cruise control	$ 16.69
1	FB01664D0	Miata Clutch safety switch (Can be made to fit FD by smooshing wires down and holding with RTV since they come out the wrong side).	$ 8.68
1	FD01-55-461	Tachometer 93 style, 1k increments	$ 410.27
		FLUIDS	
5	IDEMITSU75-90	Idemitsu 75-90 Gear Oil (around 2 quarts for rear diff and 3 for MT)	$ 55.00
2	BUR7EQ	Spark plug BUR7EQ Leading (Lower)	$ 14.61
2	BUR9EQP	Spark Plug BUR9EQP Trailing (Upper)	$ 17.30
1	OIL-20W-50W	Castrol GTX 20-50W or equivalent	$ 32.46
1	B6Y1-14-302A	Mazda oil filter	$ 10.57
		I REPLACE THE RADIATOR CAPS AND FILLER NECK O RING TOO	$ -
2	PEAK-GREEN-ASIAN	Peak green asian 50/50 coolant	$ 45.44
1	KF01-15-205	Thermostat Housing Filler Cap (Yellow)	$ 24.04
1	N3A1-15-205A	Cap Radiator (Round on AST)	$ 22.25
1	N326-15-174	Thermostat housing cap O ring (Filler cap has a short neck on original cars, this is the O ring that leaks)	$ 6.35

3.7 Clutch Pedal Push Rod

A brand new clutch pedal is available from Mazda at the time of this writing, but it's missing a hugely important piece. It doesn't include the push rod and fork that attach to the pedal and push the clutch master cylinder. The best solution I've found other than finding a used original part is to buy a 1st gen (FB) push rod which is 60mm and extend it to the proper 70mm length. I do this by buying an M8x1.0 threaded stand off, and I found some that are 20mm and have to be cut down to 10mm and then welded onto the push rod. Below is a picture of one we made, but note that it's missing the 10mm locking nut that comes with the FB push rod as we were just test fitting it at the time.

Note that we also welded on a tab to press the clutch safety switch.

Here the push rod tab that we welded on is pressing the Miata clutch pedal safety switch (since the FD safety switch is no longer available and very hard to find).

3.8 Optional RHD Pedal Conversion

https://www.rx7club.com/3rd-generation-rx-7-1993-2002-parts-99/pedal-sets-1110399/#post12154960

For those who might be interested in pedal conversion RHD to LHD here's the basic process:

BRAKE PEDAL
1. Relocate and weld steering column mount yoke to right side.
2. Bend arm to 7 degrees.

3. Position and weld pedal pad 10 1/4" from plunger pin center to pad bottom.

CLUTCH PEDAL
1. Modify top mount to a 10 degree slope and weld.
2. Bend arm to 29 degrees.
3. Position and weld pedal pad 10" from plunger pin center to pad bottom.

I've done this and the pedals came out great. It's a pain and requires aluminum welding capability, but it can be done and it can work very well.

3.9 Pre-Cat or Downpipe

The factory pre-cat damages the turbos by retaining so much heat. The harder you drive the car, the worse the problem gets, and I've seen even lower mileage cars at 35k miles with severely damaged turbo manifolds due to the excessive heat caused by the pre-cat. It's my preference to switch out the factory pre-cat which was NOT included with brand new JDM cars for the domestic Japanese market with a downpipe such as the Rotary Performance downpipe.

Another consideration is the weight savings when switching to a far lighter downpipe, plus there is a mounting bracket between the factory pre-cat and the automatic transmission that will not work with the 5 speed transmission. You will need to fabricate a bracket or modify the automatic one to work with the 5 speed if you keep the factory pre-cat or run without the bracket as many other FDs choose to do.

To help lower engine bay temperatures and reduce heat strain on the turbo manifold, I generally swap the pre-cat for a downpipe and then keep the pre-cat should any future owner of the car want to switch back.

4 Automatic Transmission Removal

4.1 Disconnect Battery

1. Disconnect the battery first

4.2 Remove Shifter Assembly Inside car

2. Underneath the car remove clip that connects shifter to shifter linkage
3. Inside car:
    a. Pull up plastic shifter panel
    b. Remove 4 Philips head screws
    c. Remove 4x10mm with deep socket
    d. Unplug shifter electrical connections

4.3 Drain transmission fluid through Dipstick pipe

4. Remove the ATF dipstick and use a siphon to pump the ATF out of the transmission. This saves multiple messes down the road and there is no drain plug on the auto transmission. Even after doing this, be careful once the transmission is out and don't tilt it backwards or sideways as the remaining ATF fluid will spill out the

back where the driveshaft goes in and the sides where the ATF cooler lines connected. Draining it helps, but next time I'm considering just drilling a hole in the pan to fully drain it and then tape up the hole with Gorilla tape.

4.4 Remove front undertray

5. Remove 2x10mm per side, 2 clips in the rear, rear bolts and 6 front bolts.

4.5 Remove rear left and right undertrays

6. Remove (5)x10mm bolts on each rear undertray

4.6 Remove Rear Most Cross Bar through Differential

7. Remove rear most cross bar that goes through the differential (4) x 12mm bolts

4.7 Remove Rear Middle Cross Bar

8. Remove middle cross bar that is in front of the diff cross bar

4.8 Remove Catalytic Converter

9. Remove Air pipe (2)x12mm
10. Remove (2)x17mm nuts securing catalytic converter to cat back and remove the ground strap from the stud
11. Remove (2)x17mm nuts at front of cat securing catalytic converter to pre-cat.
12. Remove the U shape shield at the front of the catalytic converter
13. Pry the catalytic converter rubber mount and remove the catalytic converter by sliding the catback back.

4.9 Optionally Remove Catback Exhaust

14. At rear of car, remove (2)x12mm nuts at the vertical bracket securing the catback
15. Support catback and pry the rear left rubber mount with a long pry bar.
16. Pry the front left rubber mount of the catback off and lower the catback.

4.10 Remove Forward Cross Bar under Cat

17. With the catalytic converter removed, remove the forward cross bar that has the right side underneath the catalytic converter (4)x12mm boilts

4.11 Heat Shield Removal

18. Remove ABS shield (back right on LHD car). Remove (5) x12mm bolts and then gently lift ABS pump enough to gently slide ABS shield towards the engine and out. Note that the single longer bolt
19. Remove large air intake pipe between airbox and secondary turbo (rear turbo)
20. Remove charge relief valve and pipe (Disconnect vacuum control line to charge relief valve)
21. Remove the downpipe shield bolts (2)x10mm bolts. Note: You can't remove the shield without removing additional shields listed below.
22. Remove the shield in front of the downpipe shield. One 10mm nut just below the middle of the Y pipe. This shield is behind the Y pipe shield. Another 10mm nut lower down where it is cut out. Note that a bigger

shield below the turbos has a stud that this shield mounted to. Remove this shield that is forward of the downpipe.

23. Get under the car and remove 2 nuts and 2 bolts of the large shield below the turbos. Note that a tiny shield over the turbo pre-control shaft will come off. Remove this large shield and then attach the tiny lower shield and the shield in front of the downpipe to build a massive shield and stick in your removed parts bin for now.
24. Disconnect the O2 sensor wire that goes behind the UIM.
25. Remove the O2 sensor using a 22mm wrench and thread the O2 sensor wire through the closed end of the wrench. From the bottom of the car you can get about 1 turn before resetting the wrench but it's enough to break the O2 sensor free and remove it.
26. Remove the pre-cat shield by pulling it forward towards the front of the car now that the O2 sensor is out.

Pre-cat shield is in the upper left of the photo above.

"Heat Shield in front of the pre-cat" is upper right and connects to the lower heat shield and small turbo pre-control heatshield.

27. With the pre-cat shield removed, remove the 4x14mm blots that hold the pre-cat in place. Remove 2 lower 14mm bolts from under the car and remove the 2 upper 14mm bolts from the engine bay.
28. Remove the bolt that mounts the pre-cat lower portion to the transmission.
29. Remove the pre-cat bracket from the transmission and save in case the pre-cat is going to be placed on the car instead of a downpipe.
30. Pull the pre-cat off the car and lower it to the ground.

4.12 Driveshaft Removal (Before PPF Removal)

31. Remove (4)x14mm nuts securing driveshaft to differential while the PPF is still installed.
32. Push the driveshaft slightly into the transmission to create a small gap between driveshaft and differential. Lower the rear of the driveshaft and then pull it back from the transmission.

4.13 Remove power plant frame (PPF) after drive shaft removed

33. Remove (9)x21mm bolts securing the PPF. Start with four in back plus one special side bolt in back, then remove the four in front. As the final nut is removed the PPF will drop and a helper can lower it down. You may need to lift the differential to keep it from binding up on the studs..

4.13.1 Support differential with a block of wood

34. Differential bushings are rubber and prolonged hanging of the differential will wear out the bushings. To prevent this, raise the differential with a floor jack and long 2x4 and then place a small block of wood between the back of the differential and the rear subframe as shown:

Block of wood behind rear of differential.

4.14 Remove Automatic Starter: 4 bolts

35. Unplug two connectors at the rear of the starter. These are part of the automatic transmission wiring and are in the way. Pry 3 wiring harness fasteners out of the way as well.
36. Unplug starter solenoid wire (black clip) and remove 12mm starter high current battery feed.
37. Remove (1)x10mm nut that secures the wiring bracket.
38. Remove (2)x12mm bolts at the lower back of the starter.
39. Remove (2)x12mm bolts at the upper back of the starter and pull the starter out from the back of the car side..

4.15 Remove (4) Torque Converter Bolts beneath Inspection cover x 14mm

40. Remove inspection cover with 2x10mm
41. Rotate engine using a flat blade screw driver on ring gear and remove (4) x 14mm bolts securing torque converter. I use a long 14mm closed socket and pry it against the side of the transmission peep hole to break the bolt free. Once you get it a ½ turn loose the bolt comes out with your fingers very easily.

4.16 Remove EGR Pipe Mount left side

42. Remove one 10mm bolt on the left side of the transmission. Don't need to remove the EGR pipe now as it's difficult to get the top 2x10mm nuts.

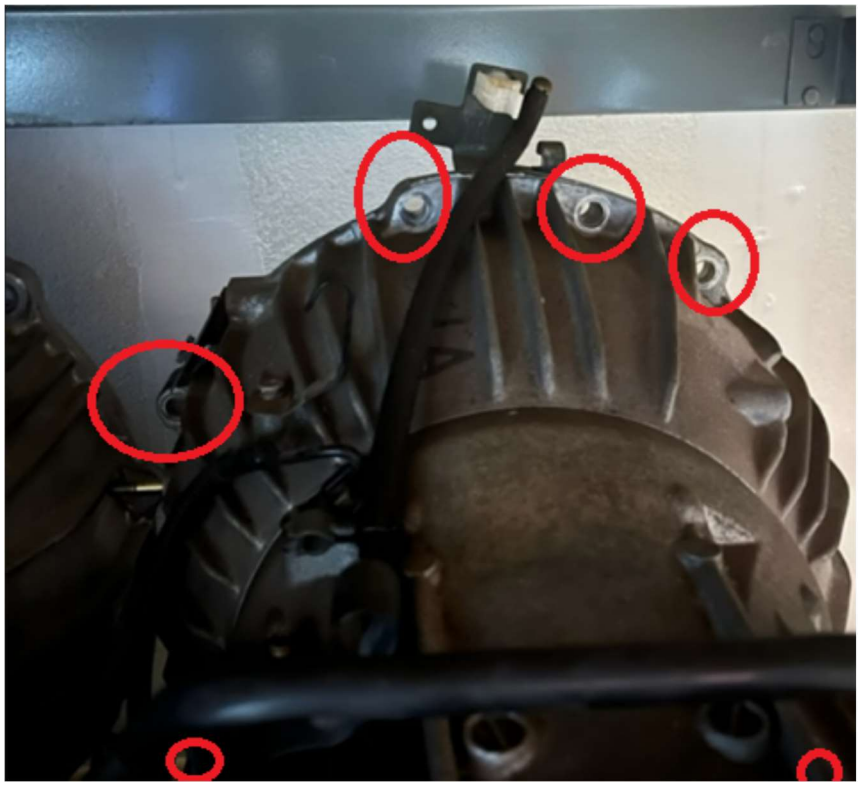
4.17 Remove ATF dipstick (3)x10mm Bolts

43. Remove lowest 10mm bolt at bottom of dip stick. Use an offset box wrench.
44. Remove middle 10mm bolt along bell housing
45. Remove upper 10mm bolt from the engine bay (can do this in the next step when the car is lowered to get access to the top 3 bell housing bolts).

4.18 Disconnect ATF Cooling Lines both sides

46. Disconnect right side 14mm transmission cooling bolt on the right side of the bell housing..
47. Disconnect right side both rubber hose clamps near the front of the transmission.

4.19 Remove 6 Bell Housing Bolts (14mm)



One lower left

One lower right

4 top – 1 left side and then 3 across the top towards the right.

48. Disconnect the 3 pin electrical connector near the upper left bel housing bolt and remove the upper left bell housing bolt with a 14mm short socket, a universal joint, and extensions.

49. Lower the car and remove the three other top 14mm bolts from the engine bay. Raise the back of the transmission with a floor jack to point the engine forward to increase the gap between the back of the engine and the firewall. Then use a long 14mm closed wrench to remove the three top bolts.
50. Remove the ATF fluid dip stick 10mm bolt near the top of the dip stick
51. Raise the car and remove the lower 2 dip stick bolts and pull the dipstick tube out
52. Remove the final two lower left and right bell housing bolts

4.20 Pull Transmission Off

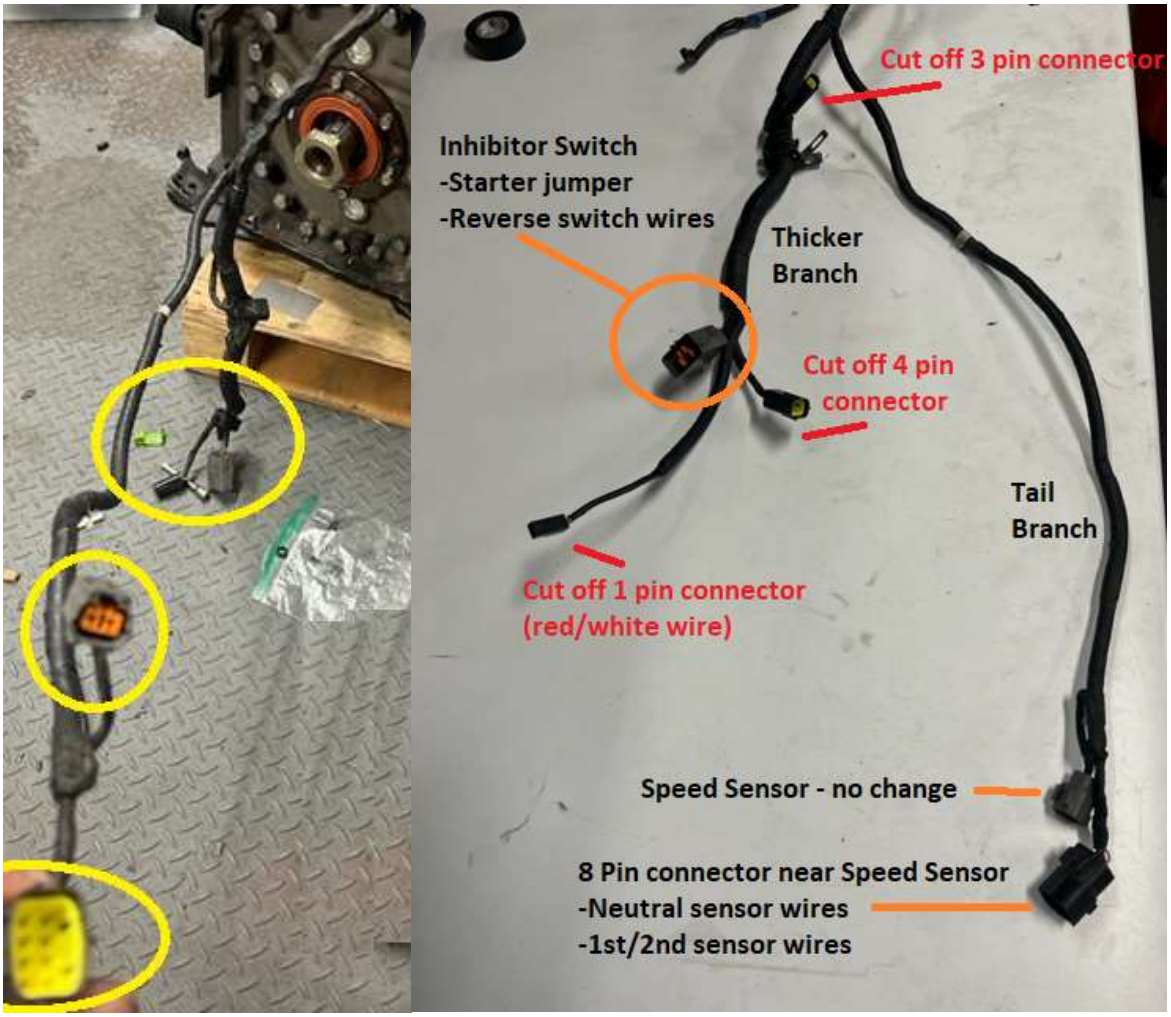
53. Using a standing transmission jack to support the transmission, pull it back gently. It should be very easy to separate as long as all 6 bell housing bolts and the 4 torque converter bolts have been removed. If it is very difficult to separate there may be one of the bell housing bolts that was missed so double check them.

5 Remove transmission cooler System

5.1 Remove hardline that ran along left side of engine towards radiator

5.2 Remove right auto transmission fluid cooler and Duct.

6 Wiring Conversion at Transmission Connections



Above pictures show two different views of the automatic transmission connectors on an original automatic emissions harness (Engine harness) before we made any changes to them.

There are two branches of wires on the original automatic harness:

The longer thinner “Tail branch” has:

- 8 pin connector (Yellow retainer in the left picture above) that we use for Neutral/1st/2nd gear switches.
- 2 pin (Orange retainer in picture above) that we use unchanged for the speed sensor.

The other shorter and thicker branch has the following:

- A funky looking two row 5+4 = 9 pin connector which is the inhibitor connector. It has two thick wires we connect together to bypass the starter inhibitor. And we also grab two wires that are part of the reverse light circuit and extend to a MT style reverse sensor connector.
- 1 pin connector with thick red/white wire that we cut off.
- 4 pin connector that only has 3 pins stuffed that we cut off.
- 3 pin connector towards the top of the branch closer to the engine rear plate that we cut off.

6.1 Trim Thicker Branch with Automatic Inhibitor Switch

54. Starting at the top of the branch between the two sections of wire, remove all of the split wire loom and wrapped electrical tape to expose all of the wires of this branch. Don't cut any wires yet!

55. Cut off the H1-04 3 pin shielded connector up near the main branch between this thicker set of wires and the thinner tail branch.

56. Cut off the H1-05 shielded square 4 pin connector that's stuffed with just 3 pins. Cut it at the branch between this thicker branch and the thinner branch.

6.2 Starter Inhibitor Switch Bypass Varies by Year

Locate the A2-04 9 pin connector (5 pins one row, 4 pins the other row. This is the inhibitor switch connector.

The starter inhibitor prevents an automatic car from starting unless it's in Park or Neutral. There is a switch inside the transmission that connects two pins on the A2-04 Transmission Range Switch together only when the car is in Park or Neutral. The starter signal comes in on Blue/Yellow from the key being turned to start and that connects to the Red/Yellow wire on the connector passing the start signal towards the starter.

For a 1993 Car, simply cut the thicker Blue/Yellow and Red/Yellow wires near the branch and connect them together securely and wrap them up to protect against shoring.

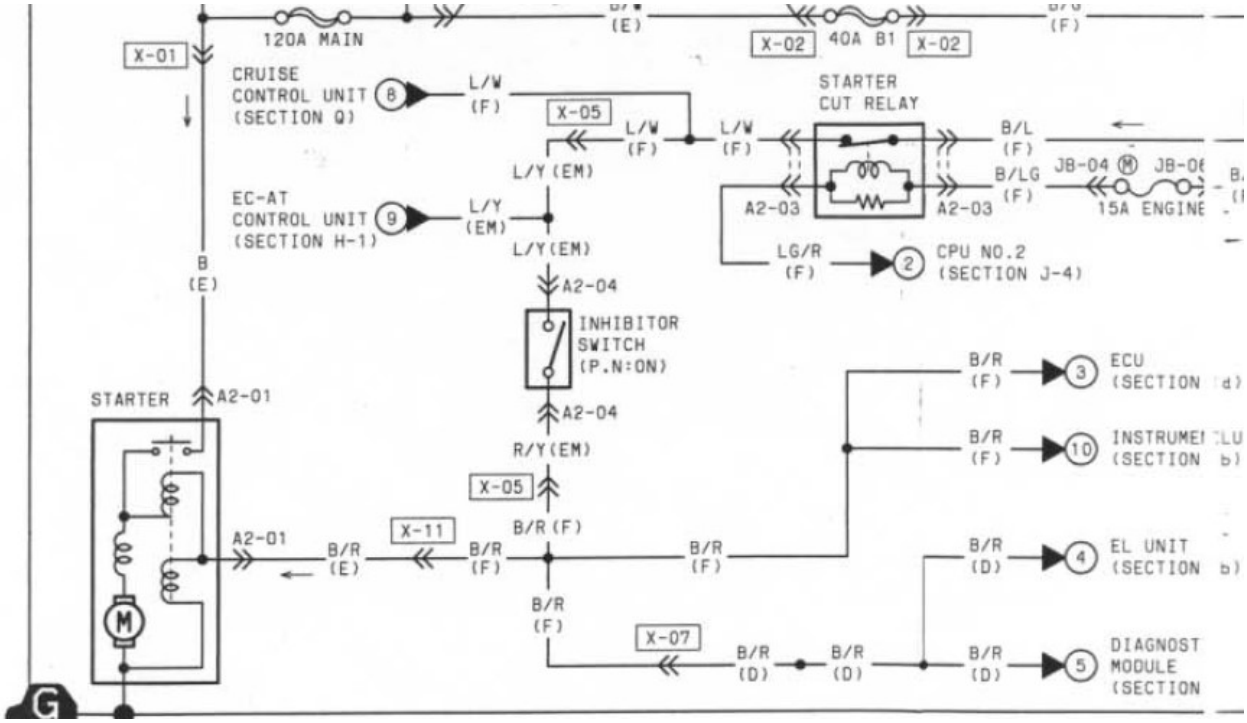
For a 1994 Car, we have to cut off the inhibitor switch, tie the Red/Yellow to the Blue/Yellow, and also keep the Starter solenoid connector that's tied to the Red/Yellow wire and have it be a reasonable length that we don't have to tie a lot of wiring up near the starter. See below for one way to do it.

6.2.1 1993 LHD Starter Inhibitor Bypass

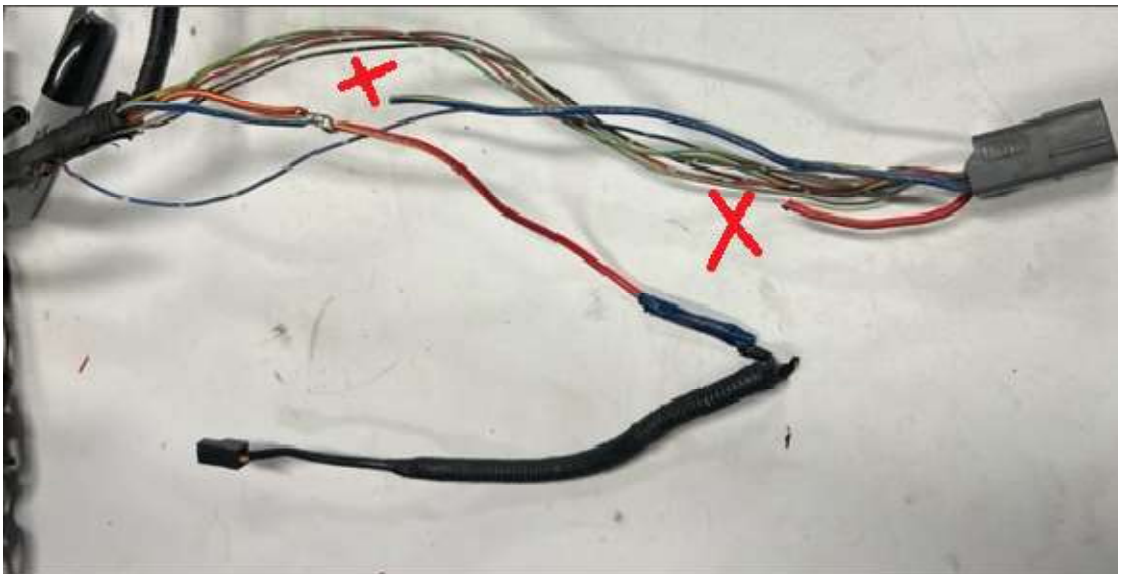
Simply cut the thicker Blue/Yellow and Red/Yellow wires near the branch and connect them together securely and wrap them up to protect against shoring. If this connection is not solid, the car will not start.

The starter solenoid connector is part of the body harness for a 1993 AT car.

Schematic for 1993 cars for the starter for AT equipped cars on page Z-26.



6.2.2 1994 – 1995 LHD Starter Inhibitor Bypass



57. For a 1994-1995 LHD car, you should see the single pin starter solenoid connector as part of the emissions harness. This is a red/yellow wire.

    DON'T CUT OFF THE SOLENOID connector.

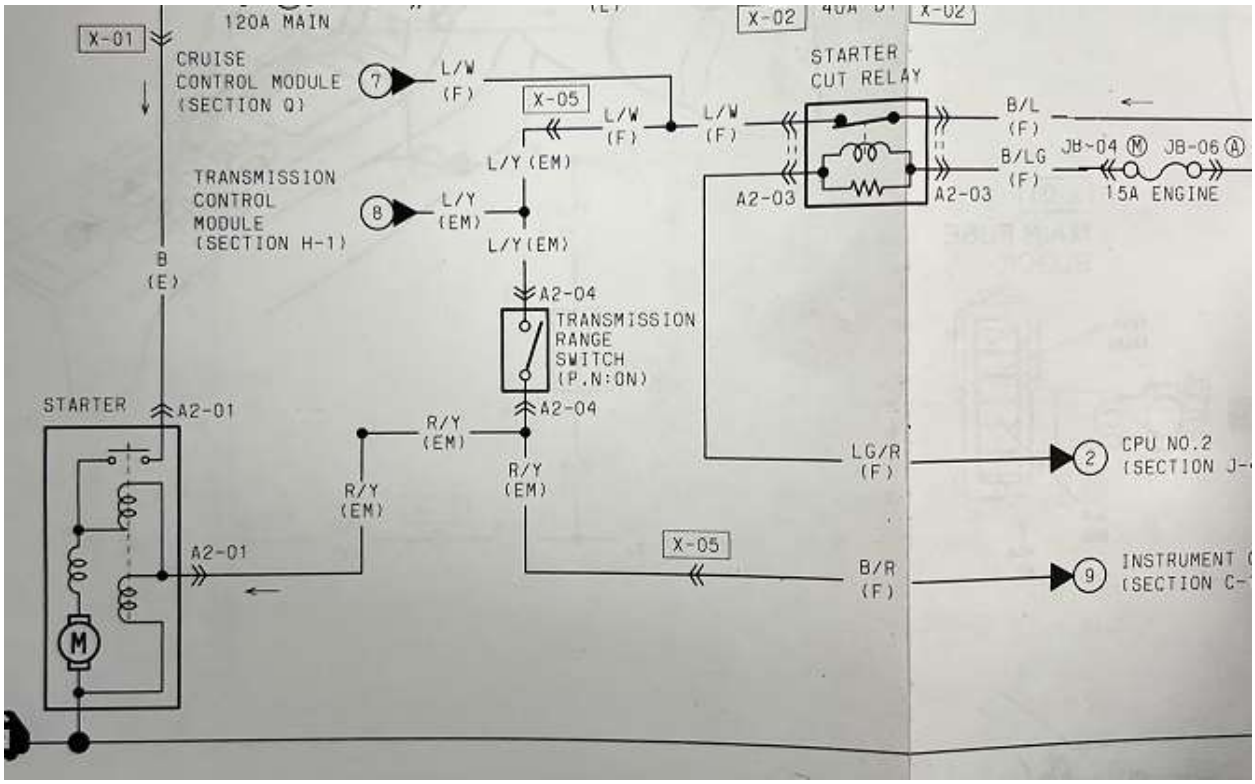
    Cut the red/Yellow wire where it branches towards the inhibitor connector as shown by the X on the right side of the picture above. Wrap this exposed wire with electrical tape near the existing blue tape Mazda installed.

Make a second cut of the Blue/Yellow wire and then tie the Blue/Yellow to the Red/Yellow and solder it. I carefully slice off the insulation for about a half inch on the Red/Yellow and then wrap the Blue/Yellow around it. This is easier and better than cutting both and trying to solder 3 wires back together. Wrap electrical tape around it securely to protect against shorting out the starter signal. We will wrap in protective split loom later.

The result is a pretty long starter solenoid wire that we can place into plastic a wire loom and do some zig zagging if there's too much length once we mount the engine back into the car and have the starter installed on the Manual transmission. For now it's OK to leave it long.

If this connection is not solid, the car will not start.

Schematic for 1993 cars for the starter for AT equipped cars on page Z-26 showing starter solenoid directly fed from inhibitor switch.



6.2.3 Reverse Switch Wires for Backup Lights (ESJ-2P)

58. For the reverse lights, there are two wires on the gray 9 pin A2-04 Transmission Range Switch connector. We're going to extend these and add MT reverse connector:

    Cut the Brown/Black wire (Reverse signal) and the Yellow/Blue (+12V power) wire a few inches from the end of the gray 9 pin connector.

    Label these as Reverse for now with some tape and we will add the connector later when we add the other Neutral switch and 1st / 2nd switch connectors so we get the correct length and wrap them all together in the same split loom.

    Further down we will extend these wires to the same length as the 8 pin connector that went to the back of the auto transmission (nearly same length as the speed sensor connector).

    Connect these two wires to the crimp pins of the Tyco 174354-2 connector.

You can test this by jumpering across the two pins and the reverse lights should light up if the battery is installed.

Reverse connector on the harness that will plug into reverse sensor.

6.2.4 Cut the Remaining wires that went to the A2-04 Transmission Range Switch Connector

59. The Remaining wires on A2-04 can be cut off further up where this thicker set of wires branched from the Tail Branch. The only wires that were re-used on this entire branch were the two starter wires Blue/Yellow and Red/Yellow plus the two wires for the reverse switch Brown/Black and Yellow/Blue.

- Brown/White
- Yellow/Green
- Red/Blue
- Light Green/White
- Blue/Red

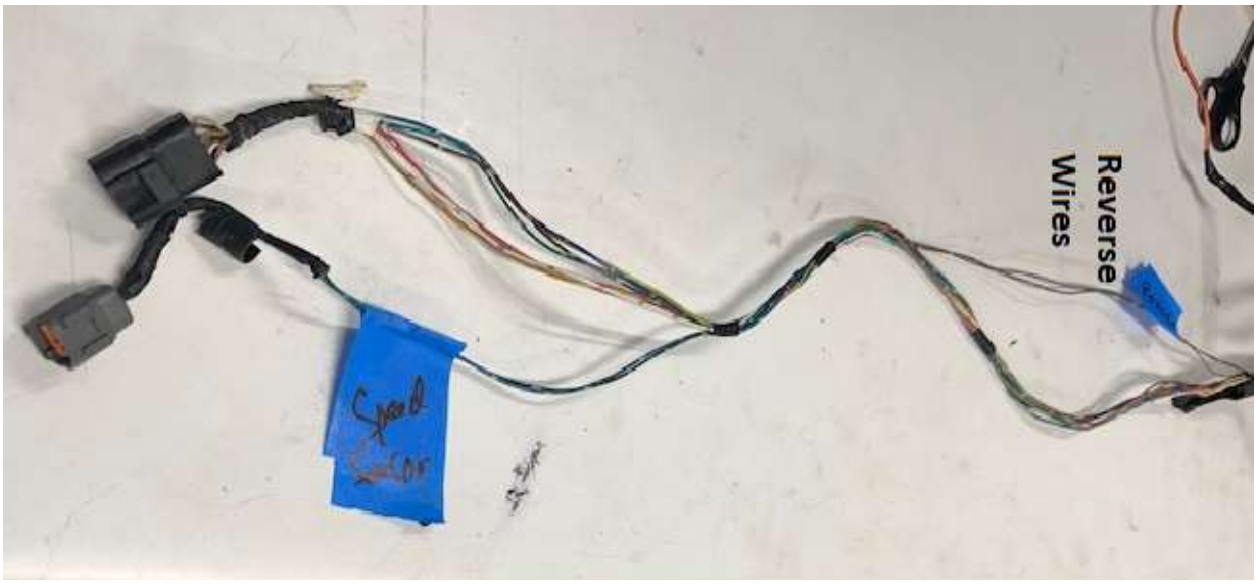
6.3 Thinner Set of Wires "Tail Branch"

Now we move on to making changes to the smaller branch of wire labeled "Tail Branch" above because it goes to the tail end of the manual transmission.

6.3.1 Automatic Speed sensor (No change)

60. Be sure to keep the auto speed sensor connector which plugs directly into manual transmission speed sensor. It is a 2 pin connector near the 8 pin connector on the longest part of the original Auto engine harness. It looks like this:

6.3.2 Peel Back the Split Loom on the Tail Branch



6.4 Automatic 8 pin connector near Speed Sensor (2 pins for neutral)

The automatic wiring harness has an 8 pin connector that plugs into the back of the automatic transmission. We are going to de-pin all 8 pins from this connector and re-use them.

- Red wire and White pins will plug into the MT neutral switch connector.
- Green wire / pin will be 1st gear signal wire on 1st/2nd gear selection switch connector.
- Yellow / pin will be 2nd gear signal wire on 1st/2nd gear selection switch connector.
- Two of the remaining pins will be used to plug into 1st/2nd connector for ground signals.

6.4.1 De-Pin all 8 Pins on the Connector to save the Pins

61. De-pin all 8 pins of the 8 pin connector as we are going to re-use all 8 pins.

6.4.2 Neutral Connector (DL090-2P-1), De-Pin and place into Housing

Later on in the car near the ECU, we will re-route the red one (used to be ATF Thermsensor) to the neutral switch input on the ECU to complete the circuit. The white wire will be re-routed to a ground lug inside the car near the ECU since the neutral switch on the MT car connects the ECU pin to ground when in neutral.

62. Pace the red and white pins from the 8 pin connector into the neutral switch connector housing (Sumitomo 6195-0006 or DL090-2P-1). Polarity does not matter as these are either open or connected by the switch. (Alternatively cut the wires and reconnect to a pigtail connector; however de-pinning is cleaner).

Neutral Switch connector that we're adding.

6.4.3 1st and 2nd Connector (ESJ-4P)

https://www.rx7club.com/3rd-generation-specific-1993-2002-16/fd-transmission-1-2-switch-function-1096284/

The 1/2 switch communicates with the ecu to vary the timing of certain twin turbo components based on rpm and when they operate.

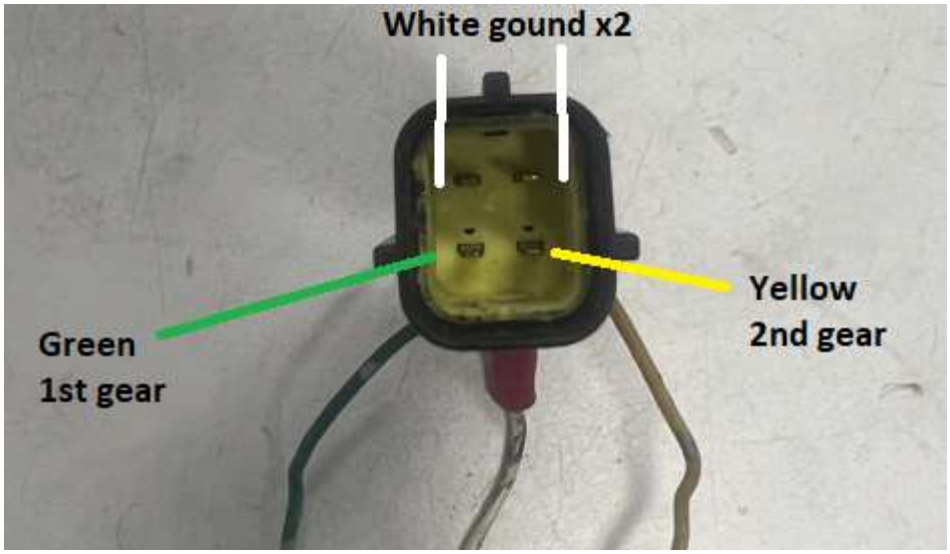
This connector looks just like the 4 pin H1-05 connector we cut off above, but this one is stuffed with all 4 pins.

See picture below for pinout

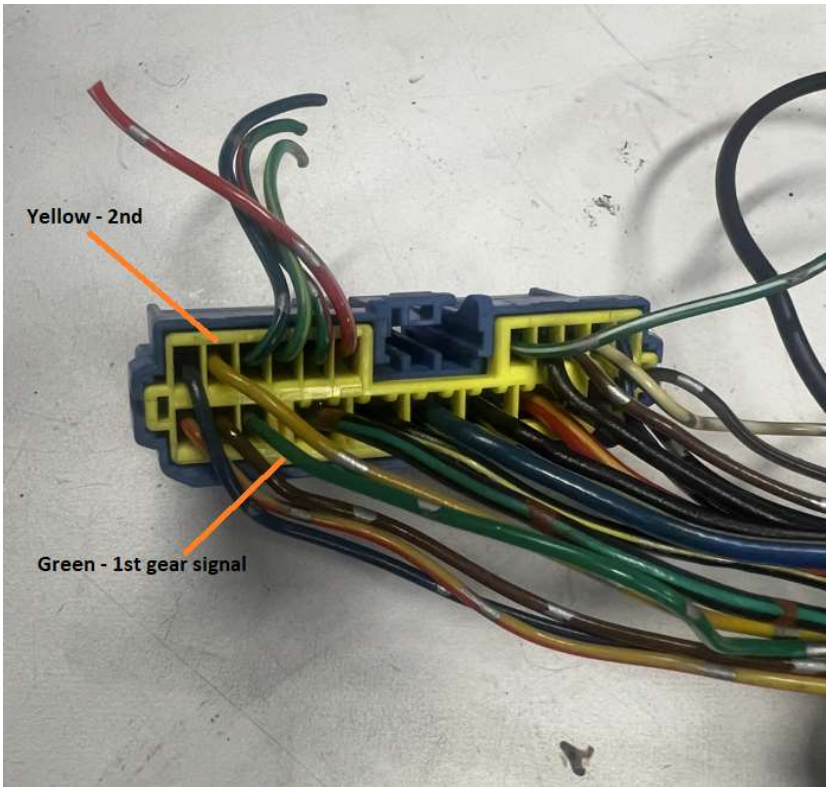
FX JDM makes 1st/2nd gear pigtails that have the correct green and blue wires that correlate to the green/blue wires on the 1st/2nd gear switch.

63. Plug the **Green wire** / pin (1st gear signal wire) into one of the two blue wires on the FX JDM pigtail connector.
64. Plug the **Yellow wire** / pin (2nd gear signal wire) into one of the two green wires on the FX JDM pigtail connector.
65. Connect the white ground wire that went to the Neutral switch to the other 2 pins on the 1st/ 2nd connector for ground.

    This White wire provides ground to the Neutral switch, 1st gear select switch, and 2nd gear select switch since 1st/2nd sensors require a ground connection to function.



Pin orientation for the 1st/2nd 4 pin connector



These two wires terminate on the X-05 big blue auto connector that connects to the body of the car near the ECU and then connect to the ECU.

1st/2nd connector on the emissions harness that will connect to the 1st/2nd gear switch sensor on the transmission.

2nd gear selection shorts the two green wires together inside the sensor. This presents < 1.0V at ECU pin 2L. (Mazda FSM section Z, page B-1). Placing the transmission in any other gear will show as 5V or 12V at the ECU pin 2L.

1st gear selection will present an open circuit on the two blue wires, and will be shorted together in any other gear or neutral. This presents < 1.0V in any other gear or Vs in 1st gear (5V or 12V) at ECU pin 2K (Mazda FSM section Z, page B-1). There is likely an internal pull up resistor in the ECU which is why an open circuit shows as Vs.

To see why we used the green and yellow wire from the 8 pin connector, refer to the FSM wiring section Z, page Z-70 section H-1 "EC-AT Control System" and note that the Solenoid Valve with the AT-Sensor No. 6 Green wire connects to Ecu pin 2K (White/Red) on page Z-34 "B-1d Engine Control System" which is 1st gear input. No 5 solenoid Yellow wire connects to pin 2L (White/Green) which is the 2nd gear input on the ECU.

6.4.4 Reverse Connector

66. Connect the reverse connector to the reverse wires that we labeled above (Brown/Black wire (Reverse signal) and the Yellow/Blue (+12V power)) and make the connector the same length as the neutral and 1st/2nd gear connectors.

6.4.5 Cut These Remaining Wires Out

67. Cut the four remaining wires from the 8 pin connector near the branch to reduce unnecessary wire in the split wire loom we are adding later to the Tail Branch.

- Blue
- Brown
- White/Red
- Yellow/Red

6.5 Route all surviving wires through the thin conduit and cut remaining wires

68. Wrap electrical tape in about 4 places along the bundle of wires to group them nicely.
69. 3/8” Split Loom is a good size to wrap the wires.
70. Wrap the ends of each connector in electrical tape.

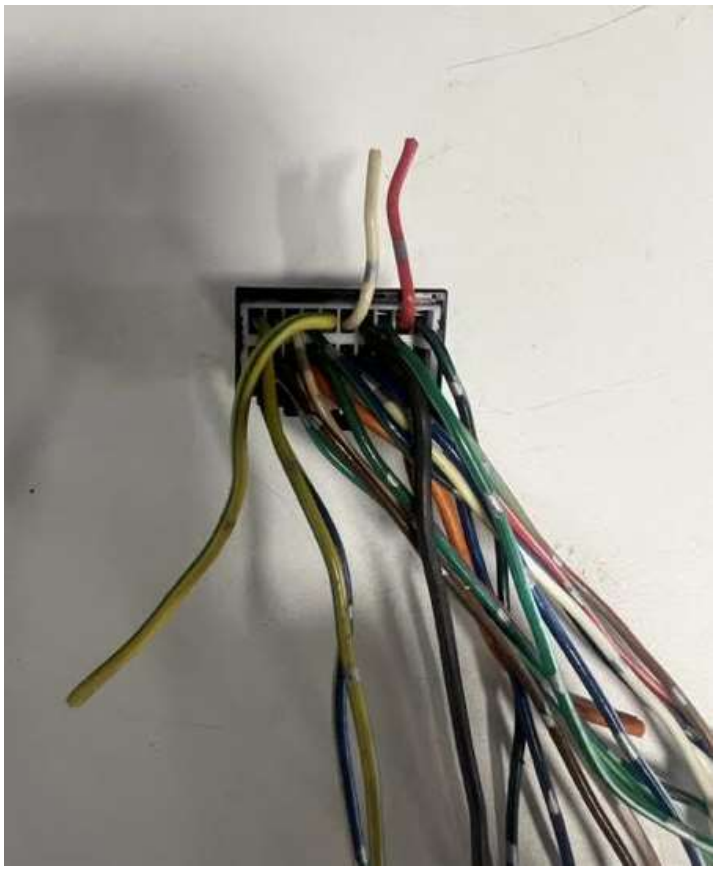
There should be 4 connectors: Reverse, Speed sensor, Neutral, and 1st/2nd gear switch.

6.6 Emissions Harness ECU Side Modifications

6.6.1 Red and White Wires off the 20 pin AT Black Connector for Neutral Switch

71. On emissions harness, there is a black 20 pin connector that plugged into the Auto ECU.

    Cut the red and white wires back like this.

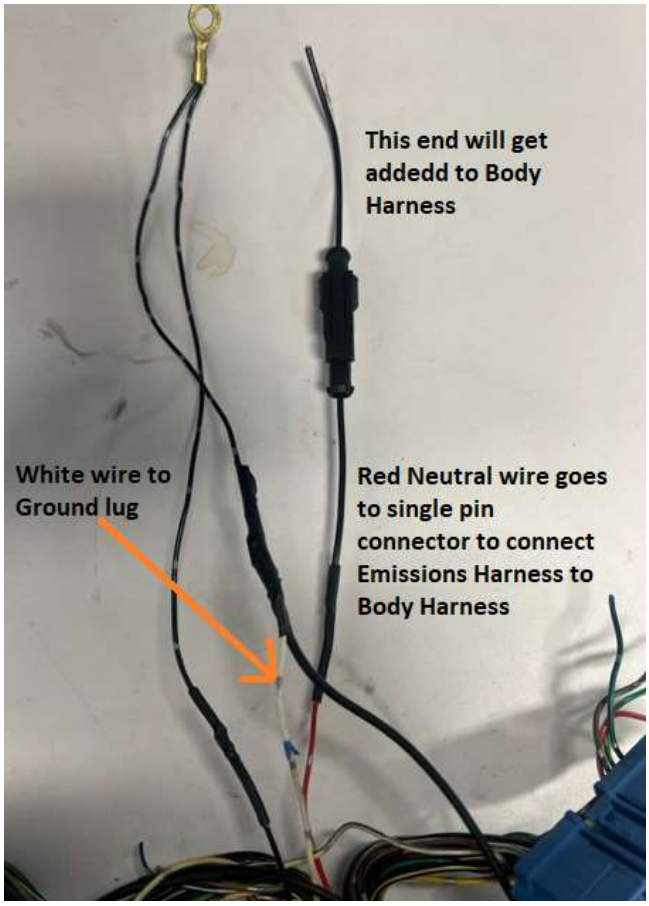


72. Take the longer end of the cut red wire and connect it to one side of a single wire connector.

    Note: The other side of the connector will go to the Front body harness later and we use a connector to be able to separate the Emissions harness and the Front body harness.

73. Connect the white wire we just cut off the 20 pin black connector to the ECU ground lug.

    NOTE: We will also add another wire to this same ground lug so consider the best way to add multiple connections to the ground lug. I usually attach the two wires in different places to avoid a blob of 4 wires all connected together at the same place.

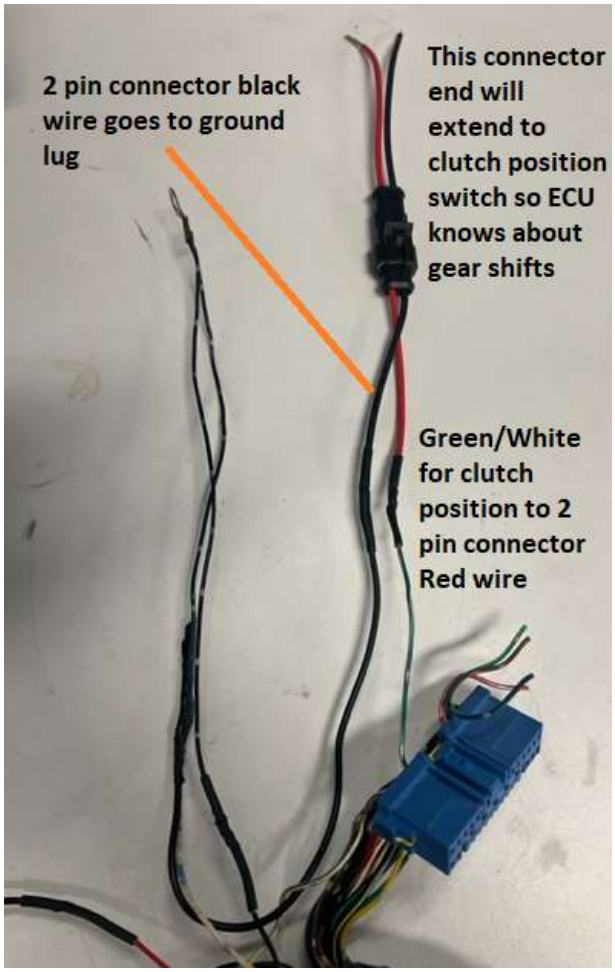


6.6.2 Add a Twin Pin Connector for Clutch Position Switch

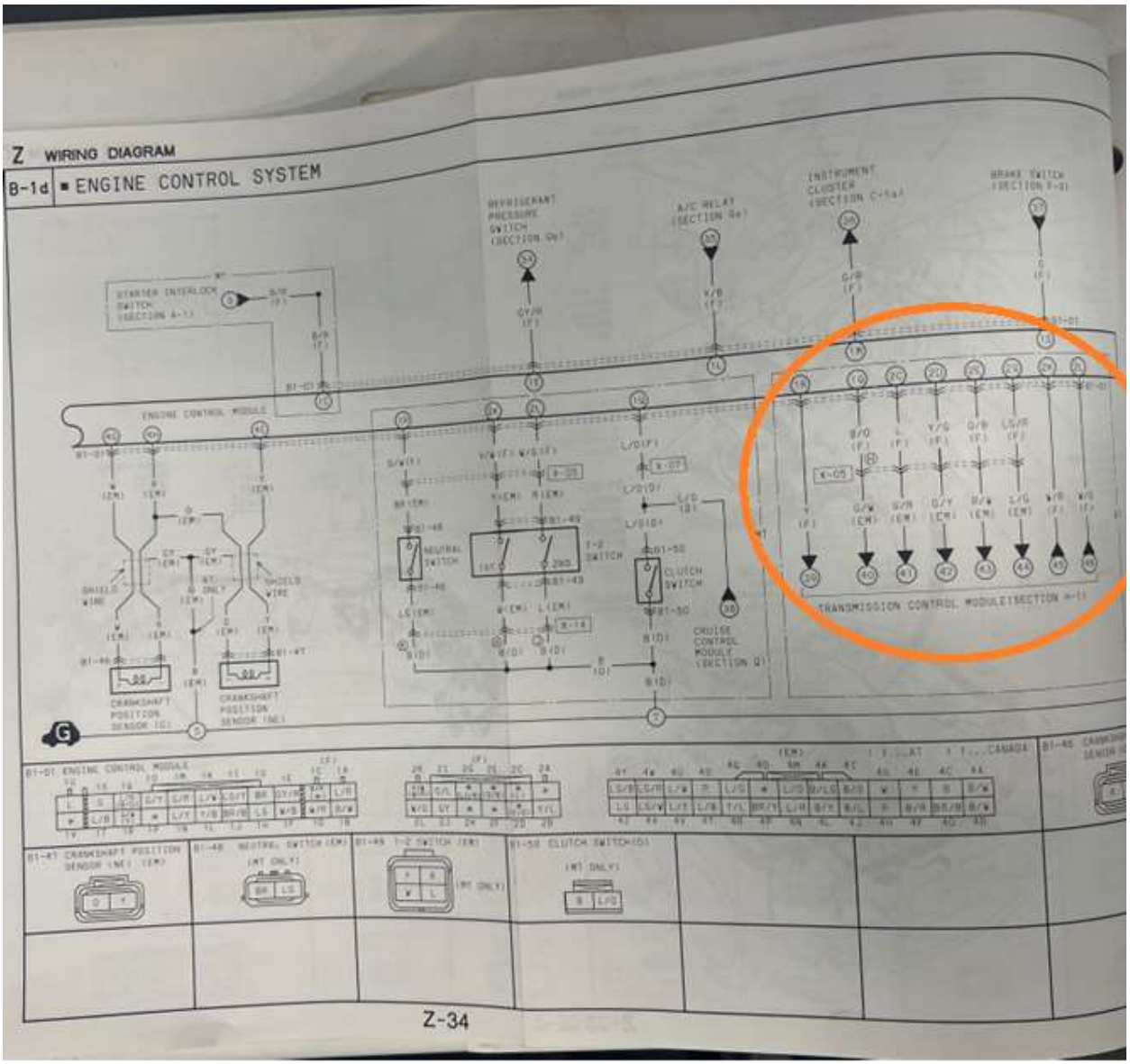
The Auto ECU used to tell the ECU when it was switching gears. For a MT car, a clutch position switch signals when the human is switching gears. This clutch position switch must be added or the car won't drive like a proper MT car.

In this section we will add a 2 pin connector near the ECU to get a ground and a signal wire for the clutch position switch. The other side of the connector gets wired to a clutch position switch so we can remove the engine without cutting wires down the road.

74. On the Emissions harness big blue connector (AT Specific) – Cut the green/white wire about 3" from the connector end. Take this 3" wire and connect it to the red wire of a 2 pin connector as shown below.
75. Extend the black wire of the two pin connector and add it to the ground lug that mounts at the ECU.


2 pin connector black wire goes to ground lug
This connector end will extend to clutch position switch so ECU knows about gear shifts
Green/White for clutch position to 2 pin connector Red wire

6.7 Schematic Info



1Q -Clutch position switch, (Black/Orange on AT harness), (schematic page Z-34) - Clutch Pedal Depressed (ground), clutch pedal released (open / pulled up in ECU), 22 pin connector

1R – Neutral switch position, (Yellow on AT harness), (schematic page Z-34) - Neutral Switch – Neutral (Ground), In Gear (Open / pulled up in ECU), 22 pin connector

2K -1st gear position, (White/Red on AT harness), (schematic page Z-34) – (12 pin connector into ECU)

2L- 2nd gear position, (White/Green on AT harness), (schematic page Z-34) – (12 pin connector into ECU)

7 Rear Main Seal, Flywheel, Clutch Installation

7.1 Ring Gear and Counterweight Removal

76. Remove (6) 14mm bolts that secure the ring gear to the counterweight.
77. Remove the counterweight using the counterweight removal tool from Mazdatrix (or similar tool)

7.2 Engine Rear Main Seal and Stationary Gear O Ring Replacement

78. Remove the pop key out (like a woodruff key)
79. Remove 6 bolts for stationary gear
80. Reinstall flywheel nut a couple of threads to protect your feet. Anytime you remove the MT flywheel in the future, be sure to do this as well. There have been instances where the flywheel popped off and dropped on toes and broke the toes. Putting the nut on a few threads protects your feet.
81. Remove the stationary gear and then flywheel nut. Can use a metal interior removal tool pry bar and gently pry it up away from the engine.
82. O ring does not require sealant. Make squeaky clean. Pick old part off.
83. Reinstall stationary gear with new O ring and torque to 17 ft-lb. Oil the outer race of the stationary gear to help push it into the engine rear plate. Use a rubber mallet gently if needed to get outer race started.
84. Install rear seal (no sealant between seal and rear plate) and mallet it gently around the edges until flush.
85. Put grease inside the valley of the seal, but no sealant between rear main seal and engine block.

7.3 Place pilot bearing and seal in the freezer to help with installation

86. Place pilot bearing and pilot bearing seal in the freezer to make them a little smaller and easier to install.

7.4 Flywheel Installation (Loctite 290-361 lb-ft)

87. Install the flywheel locking device to hold the flywheel for flywheel nut and clutch installation.
88. Blue Loctite and torque flywheel to 290-361 lb-ft

7.5 Pilot bearing and pilot bearing seal Installation

Pilot bearing and seal

89. Install pilot bearing by applying engine oil to the outer surface of the cold pilot bearing. A cold pilot bearing freshly removed from the freezer installs easier. Use an appropriately sized 3/8" deep socket such as 14mm to install the pilot bearing. Install it past the beveled edge of the eccentric shaft plus an amount just deeper than the depth of the pilot bearing seal.
90. Install the pilot bearing seal (oiled and cold as well).

7.6 Clutch Friction disc and Pressure Plate (14-19 lb-ft) Installation

91. Using a clutch alignment tool, install the clutch friction disc and pressure plate with 6 pressure plate bolts. Install gradually and in a criss cross fashion and final tighten to 14-19 lb-ft with blue Loctite. Note that the Exedy OEM clutch kit contains an alignment tool where the front part of the tool is too long. I cut the front smooth part shorter so that the friction disc fits into the wider part of the tool.

7.7 Flywheel Lock Removal

92. Remove the flywheel lock now to prevent interference when placing the transmission on.

8 MT Installation

8.1 Clutch fork and Thrust Bearing into Transmission if not Already Installed

93. Verify the clutch fork is installed and the bolts are torqued properly to 24-33 lb-ft (avg 29)
94. Install the thrust bearing. Grease the inside round of the bearing and grease the two points where the clutch fork inserts into the bearing.

8.2 Transfer PPF Bracket with 2 bolts and retaining 10mm bolt from Auto transmission to MT

Near the shifter on the manual transmission, you might see two large holes with a smaller hole between them. This means your transmission is missing two large bolts, a bracket, and a M6 bolt that holds the bracket. All of this is used to secure the transmission to the power plant frame (PPF). Be sure to swap this over from the automatic transmission.

95. Move the two PPF bolts with star head and the holding bracket along with the single 10mm retaining bolt from the Auto transmission to the manual transmission.

96. Doing this now is 100x easier than figuring this out after the MT is installed and you can't bolt the PPF fully and having to install these bolts with very little room for your hands later.

8.3 Peep cover removal (Bottom and Side)

97. Remove the lower and side clutch peep covers, but leave the top vent cover installed.

8.4 Tilt the engine back by carefully lifting the front of the oil pan with a short 2x4

98. Tilt the engine back by carefully lifting the front of the oil pan with a 2x4 the width of the oil pan. Another method is to reinstall the downpipe and have a help push down on the downpipe to tilt the engine back.

8.5 Oil the Tip of the Transmission input shaft to help insertion

99. Oil the transmission input shaft to help with installation.

8.6 Raise the Transmission into place and match the tilt of the engine.

100. Raise the transmission into place watching the tip enter the engine by peeking under the bottom peep cover. I use a lift and a tall transmission jack from Harbor Freight. Rotate the transmission to align the bolt holes and pay attention to the two large alignment pins on the engine that must line up to fully mount the transmission.

Peak through the bottom removed peep cover and watch the input shaft get centered in the pilot bearing area and then push from the rear to insert the transmission.

WARNING: YOU MAY NEED TO ROTATE THE INPUT SHAFT BY INSERTING A DRIVESHAFT INTO THE BACK OF THE TRANSMISSION AND ROTATING IT. THIS WILL ALIGN THE INPUT SHAFT SPLINES. If they are not aligned, you cannot push the transmission all the way in. Sometimes it's already aligned on its own, and sometimes you have to turn it a bit to align it.

8.7 Bell Housing Bolts: Long bolt lower left, Remaining 4 short bolts (28-38 Ft-lb)

101. Tighten 1 long lower right bell housing bolt and the other 4 shorter ones to 28-38 Ft-lbs

9 Alternate Differential Flange Swap (Retain Auto 3.9 Diff)

If keeping the original 3.9 Differential (roughly 5% taller gearing) then perform this section; otherwise to replace the differential with a Manual 4.1 gear ration skip to the next chapter.

9.1 Drain Differential Oil – 24mm Drain, 23mm fill plug at back of diff

102. Remove fill plug first to provide air flow, then remove drain plug (lower plug)

9.2 Remove Differential Flange 27mm Nut

103. Differential flange nut can be removed with a 27mm socket and an impact gun.

104. Remove differential flange and replace with new MT flange part# **P045-27-120B** (oil will flow out unless you drained the diff already).

105. Install companion flange nut and torque to 95-209 lb-ft. (Mazda page M-34)

10 Differential Swap (4.1 MT Diff versus 3.9 Auto Diff)

10.1 Replace differential side seals in the 4.1 differential before installation

106. Replace differential side seals in the new 4.1 differential before installing it while it's easy to access the side seals on the bench or floor.

10.2 Remove Differential

107. Remove Rear wheels
108. Remove rear strut top mounts 4x14mm top mount inside trunk)
109. Remove Rear sway bar mounts (4)
110. Remove rear strut to sway bar link
111. Remove

10.2.1 Swap Diff mount: 69-86 lb-ft (78 avg)

112. Remove the differential mount (4) bolts from the auto differential and place onto the MT differential. Torque to 69-86 lb-ft as per Mazda M-27 page.

10.3 Torque specs rear suspension

113. Rear strut coil spring retainer nut – 12-17 lb-ft (avg 15)
114. Rear strut upper (3) bolts – 34-46 lb-ft (avg 40)
115. Rear strut middle bolt inside trunk with stopper - 24-33 lb-ft (avg 29)
116. Rear strut lower to anti-sway bar (69-81 lb-ft / 75 avg)
117. Rear spindle upper arm blot (44-54 lb-ft 49 avg)
118. Rear spindle lower bolt to arm (44-54 lb-ft)

11 Remaining under Car Work

11.1 Power Plant Frame (PPF) Installation Before Driveshaft

119. Reinstall 22mm nuts and bolts 5 rear and 4 front. You can attach the rear of the PPF first and then rotate the diff by using the PPF as a lever as you raise the front of the PPF.

11.2 Driveshaft (37-43 lb-ft to Diff flange) Installation after PPF.

120. Place the driveshaft into the back of the transmission first and then raise it to the differential flange. Insert the bolts with the exposed threads facing front and reinstall the washer and nut. Torque all four to 40 ft-lb. Can use the parking brake to hold the differential and keep it from spinning if needed.

11.3 Front and Rear Tunnel Brace Installation

121. Install 4 bolts for rear tunnel brace through the differential, and 4 bolts for front most tunnel brace under the catalytic converter mount.

11.4 Thrust Bearing click into position with Flat Blade Screwdriver

122. Insert a long flat blade screwdriver through the bottom peep hole and push the thrust bearing into place on the pressure plate. It will click in place and move back about ¼". Make sure it can't be pulled back farther than that.

11.5 Transmission Sensor Installation

123. Replace any missing Speed sensor, neutral sensor, reverse sensor, or 1st/2nd gear sensor

11.6 Connect (4) Transmission Sensors

124. Install Reverse sensor Neutral, Speed Sensor, 1st/2nd Gear

11.7 Clutch Slave cylinder bracket and slave installation

125. Install the clutch slave cylinder bracket onto the manual transmission with (3) bolts

126. Install the clutch slave cylinder (2) bolts and hydraulic cable 12-16 ft-lb (14 avg). Run it towards the engine bay.

11.8 Starter Installation

127. Starter long bolt, nut, an washer 28-38 lb-ft (33 avg)

11.9 Peep Covers (Bottom and Side)

128. Install the bottom peep cover and side peep cover

11.10 Downpipe Installation

129. Install new turbo to downpipe studs. Note that original studs were 44.4mm long, Atkins Rotary sells 40.75mm long studs for this part, and Rotary Performance provides 38mm long studs for their aftermarket downpipe. Install the studs finger tight. The copper lock washer will help ensure the stud seats into the turbo properly before turning on the stud.

130. Install the downpipe to turbo gasket.

131. To install an aftermarket downpipe:

    a. Modify the OEM catalytic converter by removing the front M12 studs OR enlarge the holes in the aftermarket down pipe.

    b. Install the O2 sensor onto the aftermarket downpipe first with a 22mm wrench, then install the downpipe and tighten the (4)x14mm nuts.

132. To install the OEM pre-cat:

    a. Install the OEM pre-cat without the O2 sensor initially since it blocks the downpipe heat shield from being placed onto the downpipe.

    b. Add the downpipe heat shield with 2x10mm bolts

    c. Then install the O2 sensor with 22mm wrench

133. Connect the O2 sensor wire to the single pin connector on the passenger side back of the upper intake manifold. Route the O2 sensor wire through the clip on the Y pipe.

11.11 Heatshield Installation

134. Get under the car and reattach the heat shield under the turbos with 2x10mm bolts that go on each side of this heat shield. Note that it has a tiny heat shield that attaches to it that goes over the pre-control shaft, and this assembly can be placed as one unit.
135. Add the upper right heat shield that goes in front of the downpipe / OEM pre-cat. This has a nut at the bottom and a nut at the top. Install the lower nut first to help level the heat shield so you can then insert its top stud behind the heat shield under the Y pipe.
136. Reattach air bypass valve if it was disconnected from the Y pipe.
137. Replace charge relief valve and pipe and reattach vacuum control line to charge relief valve.
138. Reinstall large air intake pipe between airbox and secondary turbo (rear turbo)
139. Reattach ABS shield (back right on LHD car) by lifting the ABS pump enough to slide the ABS shield back in place and then tightening the (5) x12mm bolts. Note the single longer bolt

11.12 Catalytic Converter Installation (After Front Tunnel Brace)

140. Be sure the front tunnel brace is already installed so you have easy access to the right two bolts, then install the catalytic converter.
141. Catalytic converter to downpipe gasket should have an inner diameter of 68mm if using the factory exhaust gasket.

11.13 Catback Exhaust Installation

142. After the catalytic converter is installed, install the catback rear most portion exhaust.

11.14 Mid Tunnel Brace Installation (After Exhaust)

143. After the catalytic converter is installed, add the final mid tunnel brace which goes under the catback exhaust.

11.15 Install Two Rear Undertrays Left and Right

144. Install left and right under trays with 5x10mm bolts each.

12 Shifter Installation (Inside the Car)

12.1 Add ATF halfway up the shifter plate

145. Add ATF fluid (preferred) or MT fluid into the shifter cavity from inside the car. Fill to just about the level that the shift collar sits in so the shift collar receptacle is just submerged.

12.2 Rebuild shifter if pre-owned and grease and install

146. Inside the car, add Automatic Transmission Fluid (ATF) into the shifter area about halfway up the shifter plate (bolts to transmission with 4 bolts).
147. Replace the inner shifter boot on the shifter if it is torn or cracking.
148. Replace the shifter plastic guide that inserts into the ball
149. Replace shifter collar and liberally grease it and the shifter ball. Clean the shifter ball before greasing.

150. Install (3) 10mm bolts to retain the shifter to the transmission.

12.3 Shifter boot/pad/

151. Add the shifter boot and install with (4) M6 flanged nuts
152. Add the shifter pad
153. Screw the shifter leather cover to the underside of the automatic shifter panel using (4) M4x12 self tapping screws.
154. Place the shifter plate back on

12.4 Shift Knob Installation

155. Install the shifter knob

13 Clutch and Brake Pedals

13.1 Clutch Pedal Firewall Plate Removal

The firewall for an automatic FD already has the clutch slave cutout, but a false clutch slave is installed in place of the actual clutch slave to seal the firewall (circled in red above).

156. Peak under the dash and locate this firewall plate and remove the (2) 12mm nuts to remove the plate.
157. From under the dashboard, push on the two plastic retainers on the clutch slave firewall plate and push it through the hole.
158. Unbolt the cruise control motor if equipped but there is no need to remove the cruise control cable to access the firewall plate and remove it.

13.2 Cruise Control Removal (If Equipped)

159. Remove the cruise control motor along the driver side fender which is held in place with 3x10mm bolts. Leave the wiring connected and leave the cruise control cable connected to the throttle body. Move it out of the way temporarily to gain access to installing the clutch master cylinder.

13.3 Brake pedal Retaining Hardware Removal

160. Remove round plastic retainer clip
161. Remove 4x12mm primary nuts holding the brake pedal to the brake master cylinder
162. Remove 2x12mm nuts holding the brake pedal to the steering column
163. Remove the larger top 12mm nut at the top of the brake pedal towards the rear of the brake pedal cage. Use a flashlight to locate it.
164. Disconnect the brake pedal sensor connectors (2 of them).
165. Remove the brake pedal sensor to get easier access to the top nut
166. Remove the clip and pin securing the brake pedal to the master cylinder.

13.4 Steering Column Lowering

The steering column must be lowered to fully remove the brake pedal.

167. Open driver side door and remove the black plastic dash side trim that has two vents that feed the door. This is necessary to get the far right Philips head screw of the defrost panel off. I pull the welt (weatherstripping) away from the frame in this area temporarily to help get a grip on the outside of this part. It has tabs that can break if you're not careful.
168. Unscrew the heater panel trim under the steering column which is held in with (3) Philips head screws.
169. Disconnect cables under steering cable: wide ribbon cable with blue connectors and a large white molex connector that tucks into the steering column cover that connects to the ignition key. Note that the blue and orange large connectors under the steering column can be moved out of the way and left connected.
170. Slide large blue ribbon cable off and the blue/orange second cable off of the white plastic retainer by sliding towards the rear of the car.
171. Gently pry the white plastic retainer off of the steering column to gain access to the steering column bolts. Do this by pressing two thin vertical tabs one on each side.
172. Remove the (2) 12mm steering column bolts and lower the steering column. It can fit in front of the front seat if you move the seat all the way back.

13.5 Brake Pedal Swap out Auto to Manual

173. With the steering column lowered, you can pull the automatic brake pedal out of the way and remove it from the car.

174. Install the brake pedal in the reverse order of how it was taken out.

13.6 Clutch Pedal Grease and Installation

175. Attach the Miata safety switch to the clutch pedal and modify it slightly by cutting off the plastic piece that the wires were tie strapped onto. Fold the wires over and secure with silicon sealant. The standard Miata switch won't fit unless the wires are pushed down. Tie strap the cable to the round circle on the clutch pedal cage lower right corner.

176. Attach the clutch pedal push rod to the clutch pedal if it is not already attached and grease with multipurpose synthetic grease. Grease the following areas:

    a. push rod tip that goes into the clutch master cylinder

    b. pin that attaches the fork

    c. Remove large bolt that pedal attaches to cage with and liberally grease

    d. Grease the spring if it's not already well greased.

    e. Clutch pedal can squeak terribly if not greased well

177. Place the new clutch master cylinder into position and hold it with some towels or get a helper to push it against the firewall while you place the clutch pedal.

178. Reuse the two nuts that secured the clutch pedal firewall plate to secure the clutch pedal.

179. Add another M8 nut with a large flange or large washer to secure the top of the clutch pedal cage to the car.

13.7 Clutch Master Cylinder Connections

180. Attach clutch hydraulic stainless steel cable to the clutch master cylinder and be sure to place a copper crush washer on either side of the fluid passage bolt or it will leak.

181. Remove the brake master cylinder stub plug and clip and attach the clutch master cylinder feed line to the brake master cylinder reservoir. The clutch and brakes will be in a later step.

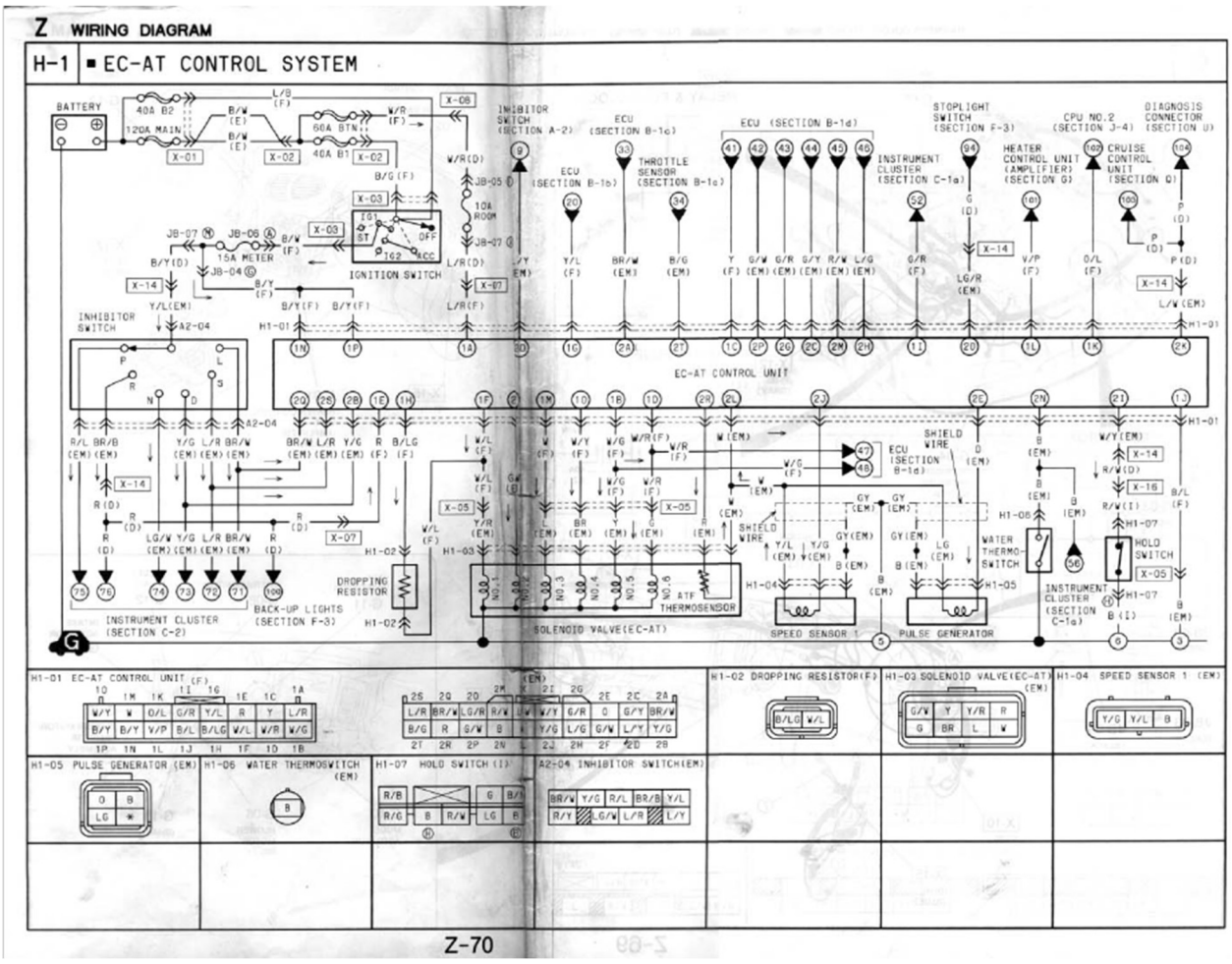
13.8 Cruise Control Re-installation

182. Re-install the cruise control actuator 3x10mm bolts after verifying the clutch hydraulic cable is not leaking at either end.

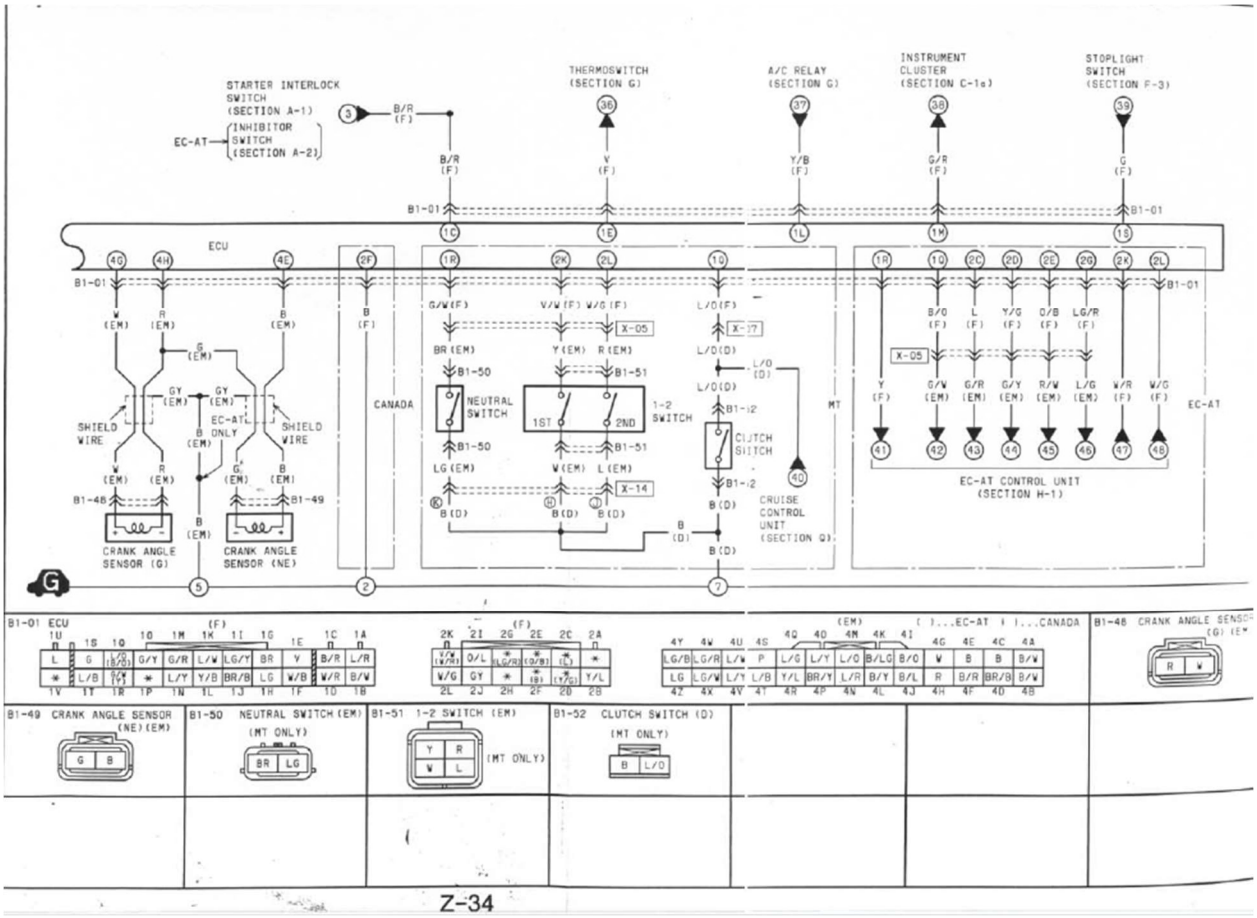
14 Wiring Interior of theCar

14.1 Wiring inside at the ECU

14.2 Schematic Info



FSM Pag Z-70 above shows the automatic transmission solenoid connections on the 8 pin H1-03 connector. We use 4 of these wires below Red, Green, Yellow, and White for the 5 speed Neutral, 1st, and 2nd gear sensors.

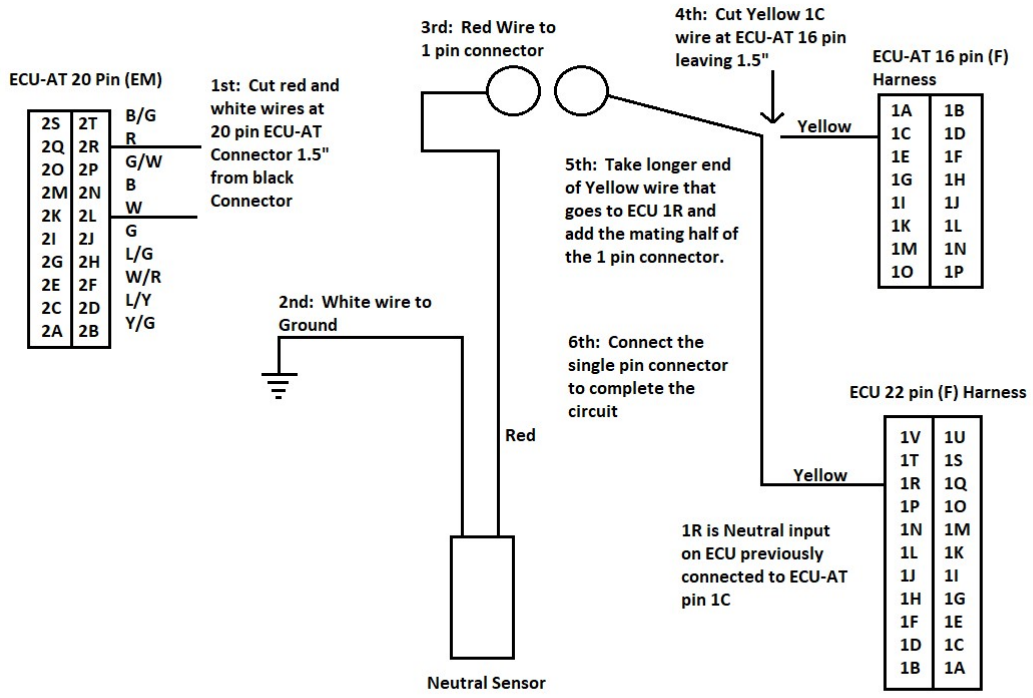


FSM page Z-34 above shows the ECU 1st/2nd/Neutral, and Clutch switch inputs for both the original 5 spd wiring and an original Automatic car. For the automatic, bubbles 47 and 48 show the connection to the ECU-AT for 1st/2nd outputs that went to the automatic transmission solenoids to force the car into 1st or 2nd gear under ECU-AT control and also told the ECU that the car was in 1st or 2nd gear. We rewir these to go to the 5 spd 1st/2nd gear sensor which tells the ECU when the human has shifted the car into 1st or 2nd gear.

14.3 ECU-AT Removal / ECU Access

183. Pry up the passenger side door sill
184. Remove the passenger side kick panel
185. Remove the ground nut on the ECU that holds 2 ground lugs
186. Remove (2) 10mm bolts on the bottom of the ECU
187. Remove (1) 10 mm bolt on the top of the ECU
188. Remove the ECU and then unplug the automatic ECU (ECU-AT) two connectors.
189. Unbolt the ECU-AT from the ECU / ECU-AT / Fan controller assembly and set aside and then bolt the fan controller back onto the ECU as shown below:

14.4 ECU Neutral (Add Single Pin Connector)



ECU-AT refers to the automatic ECU which is being removed.

ECU refers to the main engine ECU which is being retained.

These steps connect the neutral switch red wire (formerly auto ATF temperature sensor) to the ECU neutral input. The Automatic ECU-AT Yellow pin 1C already outputs a neutral signal to the ECU Pin 2R. All we have to do is connect the new red neutral switch signal to the yellow wire that already feeds the ECU.

190. At the ECU-AT 20 pin connector, cut red wire pin 2R (2nd pin from the end and adjacent to black/green wire), but leave a couple inches in case you cut the wrong wire. See FSM schematic page Z-70 "EM" connector diagram showing the pin colors and locations to help make sure you have the correct wire before cutting.
191. At the ECU-AT 16 pin connector, cut Yellow wire pin 1C (adjacent to blue/red wire) and leave a couple of inches on the ECU-AT side.
192. Tie the two cut wires harness side together using a connector since these two wire bundles are on different wiring harnesses. Otherwise the engine can't be pulled out without breaking this connection for a future rebuild.
193. Add a label to each side of the wiring that labels this as the "Neutral switch signal".

The two black automatic ECU connectors are disconnected and the red wire and yellow wires are cut and then the wiring harness side is connected together through a connector.

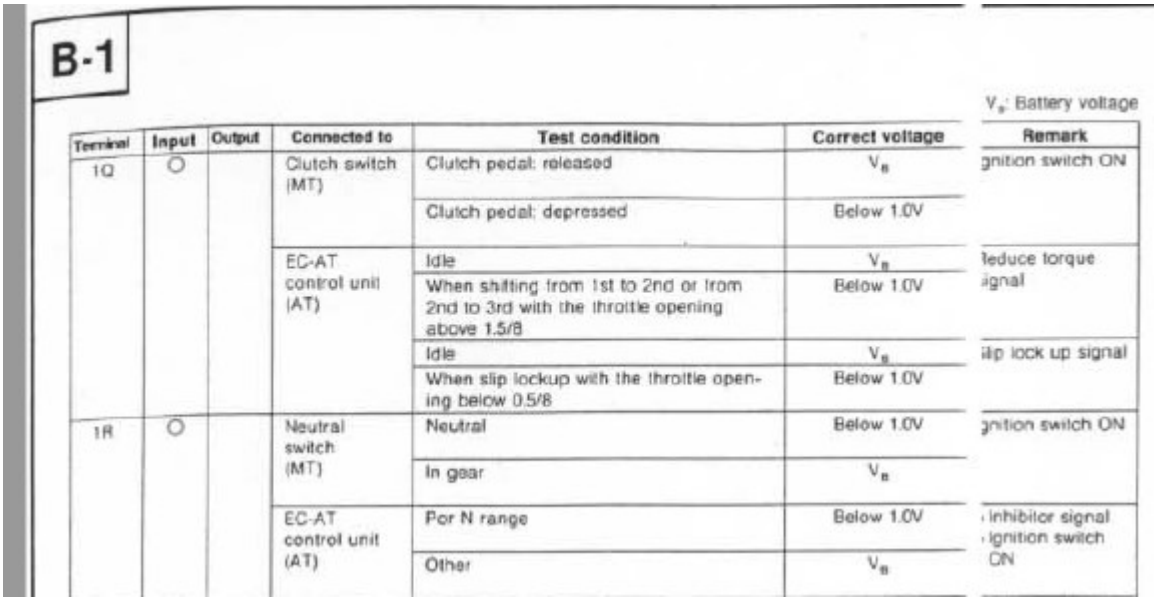
14.5 ECU Ground Connection for Neutral/1st/2nd

EC-AT 2L- **Ground**

194. At the 20 pin auto ECU (AT-EC) connector cut the white wire at pin 2L (3 down from the red wire cut above and near the center of the connector) and leave 2" in case the wrong wire gets cut. Connect the wiring harness side of the white wire to a ground lug to supply ground to the white wire that routes into the engine bay to the neutral switch.

You can test this after making the ground wire connection below by measuring 0V at yellow pin 2R on the ECU when the car is in neutral and 5V when not in neutral.

14.6 Clutch Position Switch (Add Two Pin Connector)



B-1

V_B: Battery voltage

Terminal	Input	Output	Connected to	Test condition	Correct voltage	Remark
1Q	○		Clutch switch (MT)	Clutch pedal: released	V_B	gnition switch ON
				Clutch pedal: depressed	Below 1.0V	
			EC-AT control unit (AT)	Idle	V_B	leduce torque ignal
				When shifting from 1st to 2nd or from 2nd to 3rd with the throttle opening above 1.5/8	Below 1.0V	
				Idle	V_B	ilip lock up signal
				When slip lockup with the throttle opening below 0.5/8	Below 1.0V	
1R	○		Neutral switch (MT)	Neutral	Below 1.0V	gnition switch ON
				In gear	V_B	
			EC-AT control unit (AT)	For N range	Below 1.0V	Inhibitor signal Ignition switch ON
				Other	V_B	

Clutch Pedal switch (B1-52), Page Z-35

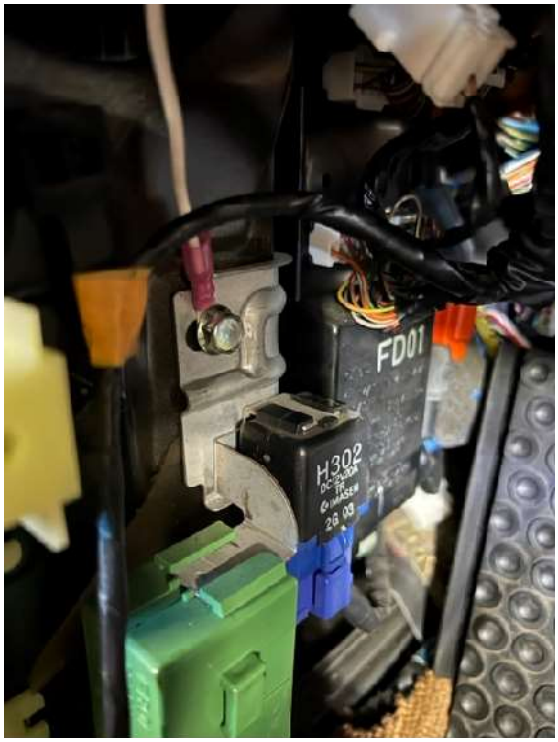
On the AT cars, the EC-AT signals the ECU that the car is changing gears. On the MT cars, the clutch pedal switch signals the ECU that the car is changing gears.

195. Cut wire at pin 2P (Green/White) on the ECU-AT (3rd pin from the end on the 20 pin black -connector and adjacent to the red wire already cut). This will connect to one side of the clutch position sensor connector in a step below. This works because pin 2P is already wired to ECU pin 1Q black/orange (automatic ECU shifting or human clutch pedal pressed).

196. Run this wire from the ECU to the clutch pedal position sensor. Start at the clutch pedal and tie strap the wire in 2 places up to the wiring harness and then fish the wire through the AC duct using a wire “fish tape” tool. Then open the glovebox and gently pry the sides inward to release the glovebox so it can flip all the way down. Then tie strap again to a wiring harness and feed the wire to the ECU area and connect to the green/wire on the harness side.

Glove box is flipped down and this is the clutch position switch wire on its way to the ECU.

197. Run the other pin of the clutch switch to a ground lug behind the drive side kick panel. I attach it to the bolt that held the H302 relay (which is going away in the next step).



White wire with the ground lug was added to one side of the clutch position switch in the driver side kick panel area.

14.7 Clutch Safety Switch

198. Create a 16" long pigtail using a 250.ARM-3S connector for the clutch safety switch using 16 gauge wire.

199. Remove the driver side kick panel to gain access to the OEM security starter cut relay H302. Remove the relay (which is defective after 30 years on every car no matter the mileage or storage condition of the car). Cut the two thick wires from the back side of the connector and wire these to the pigtail.
200. Loosen the clutch pedal and route the pigtail above the clutch pedal in an area that doesn't get pinched. There is a recess that is safe for the pigtail to route through.
201. Tighten the clutch pedal and make sure this wiring is loose and not pinched.
202. Test Start the Car and Verify it won't start unless clutch depressed

14.8 Test 1st/2nd Gear, Neutral, and Clutch Sensor Wiring

Now that the ECU-AT has been removed and the 1st/2nd/neutral ground is hooked up, the wiring changes done to the emissions harness should be enough to make the 1st/2nd gear switch function properly. Test it as follows:

203. Test 1st gear switch by verifying at the ECU 12 pin connector on pin 2K White/Red on ECU is 0V in any gear except 1st gear and Vs in 1st gear. See schematic page Z-34 in the FSM for where this pin is on the (F) ECU connector.
204. Test 2nd gear switch by verifying at the ECU 12 pin connector on pin 2L White/Green on ECU is 0V in 2nd gear and Vs in any other gear.
205. Test neutral switch by verifying at ECU pin 1R (Yellow for an automatic, see page Z-34 for where this pin is on the connector)
206. Test clutch position switch by verifying ECU pin 1Q (Black/Orange for the automatic wiring harness) as shown on page Z-34 goes to 0V when clutch is depressed and goes to Vs when the clutch is not depressed.
207. Test clutch safety switch by verifying the car starts if the clutch pedal is depressed and will not start if the clutch pedal is not depressed (test in neutral to avoid the car lurching forward if this safety feature is not working properly).

14.9 ECU Swap and Installation

208. Swap the ECU with one from an OEM 5 speed car, or go with a Power FC which has improved overall smoothness plus the ability to modify the power output.
209. Find original (2) black ground wires with Ring plus the 3rd one that we added as part of this conversion and slide onto the ECU stud oriented towards the rear of the car and secure with the original 10mm nut.
210. Reconnect ECU (4) connectors
211. Slide ECU so that upper tab slides into place behind interior plastic, align lower 2 bolt holes
212. Install (2) 10mm bolts at the bottom of the ECU near the carpet plus the third bolt at the top of the ECU where it slides behind the plastic.

15 Cluster Reconfiguration

15.1 Metering Hood with Cluster Removal

213. Remove the heater trim piece beneath the steering wheel held in place with 3 Phillips screws.
214. Remove the drive side dash side trim piece which clips into place. Remove the side screw that holds the hood meter that was behind this trim piece.
215. Unscrew (2) Philips head screws at the lower front of the metering hood.
216. Pull the hood meter directly towards you (towards back of the car). There are three clips at the back and they are strong and an original hood meter that hasn't been removed before takes quite a bit of effort and multiple tries to remove successfully.

15.2 Tachometer Swap Faceplate for Redline and PRNDL Removal and Redline 7500

Automatic cars show a 7,000 RPM redline, but manual cars had a 7,500 RPM redline. Auto cars also show PRNDL in the tachometer face plate.

This step assumes you have a new tachometer or a used manual transmission tachometer that can be used to swap the faceplate.

Start with the hood meter face down on a towel on a work bench to keep from damaging it.

217. Unscrew (4) Philips head screws that hold the cluster assembly into the hood meter and gently remove the cluster from the hood meter. Set the hood meter aside in a safe location.

218. Place the cluster with the clear lens facing up and **remove the two Philips head screws** that secure the clear lens and the black plastic top of the cluster to the white back part of the cluster

219. Turn the cluster lens side down on the towel and gently push each of the (8) black plastic tabs going around the cluster and gently pry the white and black halves apart. Set the top of the cluster aside

220. Remove the odometer reset button and set aside for now. Also be careful to not lose the turn signal green lenses and the warning lamp lenses lower left and lower right corners.

221. Remove the tachometer by unscrewing 3 philips head brass colored screws that secure it to the cluster. If you need to adjust the speedometer for a differential swap, modify the speedometer in the next step and then reinstall the new tachometer since the tach must be removed to pull the speedometer out.

15.3 Optional Tachometer Faceplate Swap

A broken tachometer from a 5 speed car can be used to swap the faceplate to remove the PRNDL and change the red line.

222. Start by gently removing the needle from the donor tachometer. It pries up and is easily damaged. Remove the 4 plastic retainers that secure the faceplate to the tachometer. Repeat these steps on the original automatic tachometer and then transfer the faceplate over, reinstall the face plate retainers, and replace the needle.

15.4 Speedometer Calibration for Rear End Gearing (If Swapped Diff to MT 4.1)

Remove the speedometer and adjust the blue potentiometer as indicated below:

223. Flip the cluster back side up and remove the 4 outer Philips head screws for the speedometer plus the shorter center screw.

224. Remove the black plastic cover in the corner that's held in with one wider Philips head screw.

225. Lift up the ribbon cable retainers with a flat blade screwdriver and carefully separate the ribbon cable.

226. Flip the cluster onto its back and unplug the speedometer reset button electrical connector.

227. Remove the speedometer.

228. Adjust the potentiometer as shown below.

Once you remove the speedometer from the instrument cluster, one side of the speedo has a small blue potentiometer which accepts a philips head or small flat blade screwdriver. Measuring the resistance between one side and the middle pin on the back of the circuit board, I took these measurements:

82.4 K ohms 5 speed with 4.1 gear ratio (4.1 turns of drive shaft to one turn of wheels)

86.9 K ohms automatic with 3.9 gear ratio (taller gearing where only 3.9 turns of drive shaft turns the rear wheels once)

I then carefully adjusted the potentiometer of my auto speed to match the 82.4 K ohms value of the 5 speed speedo. Moved it a very tiny fraction of 1/4 turn. At first I tried 1/4 turn and it went all the way to 20 K 0hms or 137 K ohms which was way off. Turn Counter clockwise to raise it and clockwise to reduce the resistance.

Lowering the gearing from 3.9 to 4.1 meant reducing resistance from 86.9 K ohms to 82.4 K ohms. So, if you had a manual already at 4.1 and you wanted to lower even further to say 4.5 ratio, you'd want the resistance even less than 82.4 K ohms.

Playing around with the numbers finds that the K ohms times the gearing is constant. 82.4 * 4.1 gives 337.84 and 86.9 * 3.9 gives 338.91 which is pretty close given the measurements varied a few tenths of an ohm some measurements.

I think you could take the constant value 338 and divide by the desired gearing 4.5 (for example) and you'd need to set the pot to 75.1 K Ohms for a 4.5 ratio.

15.5 Speedometer – Replace 7 Capacitors to Prevent Odometer Missing Digits

229. Many FD RX7s suffer from the digits on the odometer disappearing fully or intermittently depending on heat. In 2022, I've seen this on 3 out of 7 recent FDs I've owned even though they are mostly low mileage cream puff cars. The issue is the capacitors used in the 90s fail over time. There are 7 total capacitors that can be replaced and should be while the speedometer is out of the car unless they have already been replaced.

    Refer to this forum post on how to replace the capacitors.

https://www.rx7club.com/3rd-generation-specific-1993-2002-16/just-got-done-figuring-out-how-fix-fd-odometer-599220/page2/

The following is an updated list of the capacitors that can be ordered from Digikey at the time of this writing summer of 2022. The Digikey part numbers are shown in **BOLD**.

1x 1000 micro farad 6.3 volt 105 degree C 1 **P19628CT-ND**

2x 10 micro farad 50 volt 105 degree C 2 **P19649CT-ND**

1x 47 micro f*** 25V* 105 degree C 1 **P10267-ND**
3x 1uf (micro f) * 50v* 105 degree C 3 **565-1332-ND**

16 Fluid Top Off, Test Start, Test Drive

16.1 Refill Differential Oil

230. Refill the differential oil now that the PPF an driveshaft are installed and the differential is level. It takes about 1.9 quarts of 75-90 weight and does not require a friction modifier based on the type of limited slip differential used..

231. Drain the 23mm lower bolt and remove the top 24mm bolt to provide airflow to speed up the draining process

232. Reinstall the lower 23mm drain bolt and then use a power fill tool to fill the differential until oil flows out the fill hole. Reinstall the upper 24mm fill bolt.

16.2 Fill Transmission / Verify it is Full

233. If the transmission fluid needs to be drained, there are two drains. One is a large drain plug facing the floor and a second square drain plug beneath the fill plug.

234. Remove the fill plug (square plug) with a 14mm wrench and fill the transmission until fluid just starts to leak out the side of the fill plug.

235. Replace the 14mm fill plug.

16.3 Engine Oil Change with 4.5 US quarts

236. Drain engine oil using a 19mm socket and remove the oil fill cap to help the oil drain out faster.

237. Change the oil filter

238. Fill the engine oil with 20W-50W with 5.4 liters / 5.7 US quarts (realistically we only can fill 4.5 US quarts with an oil and filter change).

16.4 Bleed Clutch Pedal and Brakes

239. Most RX7s have old brake fluid so unless you know it has been changed within a reasonable time, bleed all 4 brakes: rear right, rear left, front right, then front left.

240. Bleed the clutch pedal and verify if feels correct.

16.5 Reconnect Battery

241. Reconnect the battery

16.6 Test Start in Neutral

242. With the car in neutral, test start the car with the clutch pedal in. Test the starter safety switch by trying to start the car again with the clutch pedal not pressed to make sure the starter does not engage.

16.7 Test Start in Gear with space in front just in case

243. With space in front of the car in case the clutch isn't disengaging properly, test start the car in gear with the clutch pedal depressed and then release the clutch pedal and verify the car moves forward correctly.

16.8 Test Drive

244. Take it for a spin.

16.9 Adjust Clutch Pedal

245. Adjust the clutch pedal if necessary so the clutch engagement point is not too close to the firewall and not too far out to where you have to almost fully release the pedal to move the car.

16.10 Test Tachometer Accuracy

246. Once the car warms up, see if the tachometer is showing idle at the same place it used to.

16.11 Test Speedometer Accuracy and Adjust

247. Using a GPS based speedometer app on your smartphone take the car for a drive on a road with a 45-55 mph speed limit and verify the speedometer accuracy and adjust if necessary.

16.12 Remove Automatic Shift Warning Beeper @7,000 RPM

The automatic car has a shift warning beep at 7,000 RPM, but the 5 speed car has the beep at 7,500 RPM. It's preferable to move the beep up to 7,500 RPM when performing the conversion. Even after changing the ECU-1 to one from a 5 speed, the beep still happens at 7,500 RPM.

I believe that swapping out ECU2 will increase the shift beep to 7,500 RPM, but I haven't tried it yet.

17 Final Assembly (After Multiple Test Drives)

These steps should be completed after test driving since the tachometer and speedometer likely need adjustment and the hood meter is difficult to install and remove.

17.1 EGR Pipe Bending and Installation

248. The EGR pipe from the automatic can be bent and a tab can be moved so that it fits perfectly with the manual transmission. Doing this properly is fairly involved and takes around 60-90 minutes so we usually test drive the car with an EGR cap or even an open EGR and then reshape the pipe and install it as part of final assembly. It's kind of fun to drive it with an open EGR pipe and hear the random bwap bwap that you get with a pinhole exhaust leak.

17.2 Reinstall Cluster into Metering Hood

249. The cluster mounts into the metering hood with the original 4 Philips screws.

17.3 Hood Meter Reinstall

250. Attach (4) main speedometer wide molex connectors
251. Connect one special black cable that goes into the black connector on the back of the cluster
252. Connect the cigarette lighter and LED
253. Connect a control panel on each side of the hood meter (left one for lights and right side for cruise control)
254. Slide the hood meter directly and make sure the alignment pin fits into the channel.
255. Check the bottom left corner and make sure the tab fits into a slot and the metal brace that a Philips head screw goes into fits into its slot. These tend to not line up and must be lifted up otherwise the Philips screw cannot be installed.
256. Re-install (2) Philips head screws that hold the hood meter in place. One in the lower left corner and one along the bottom right which is easier to see.

17.4 Raise Steering Column and Reconnect Wiring (After Hood Meter)

257. Raise the steering column back into place and reinstall the 2x12mm main bolts that hold the steering column into place
258. Bolt the steering column to the brake pedal cage using the original (2) 14mm nuts.

17.5 Heater Panel Under Steering Column Reinstall

259. Place the heater panel in place and carefully slide it into position behind the lower steering column and on the far right side.
260. Install 3 Philips head screws, one on the far left side where the black dash side trim has been removed and two along the bottom.
261. Reconnect the heater corrugated tube to the heater box.

17.6 Dash Side Trim Reinstall

262. Press the dash side trim panel back into place after the heater panel and hood meter are installed.

17.7 Passenger Side Kick Panel Reinstall after Test Drive

263. Replace the passenger side kick panel and door sill and secure with (2) push pins.

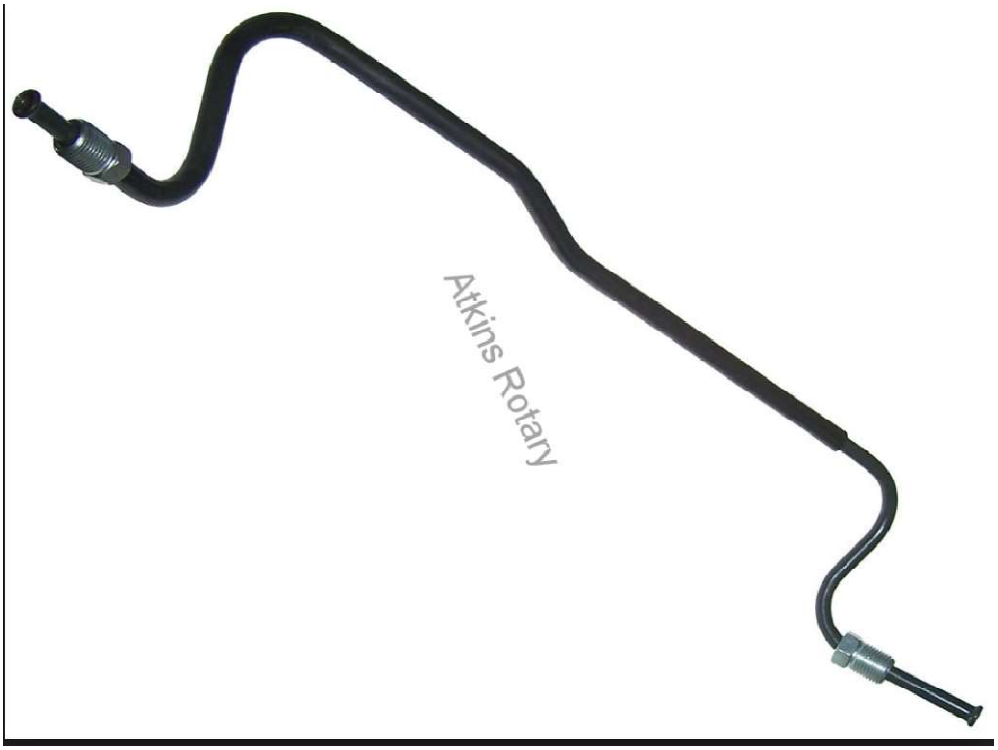
17.8 Driver Side Kick Panel Reinstall after Test Drive

264. Replace the driver side kick panel and door sill and secure with (2) push pins.

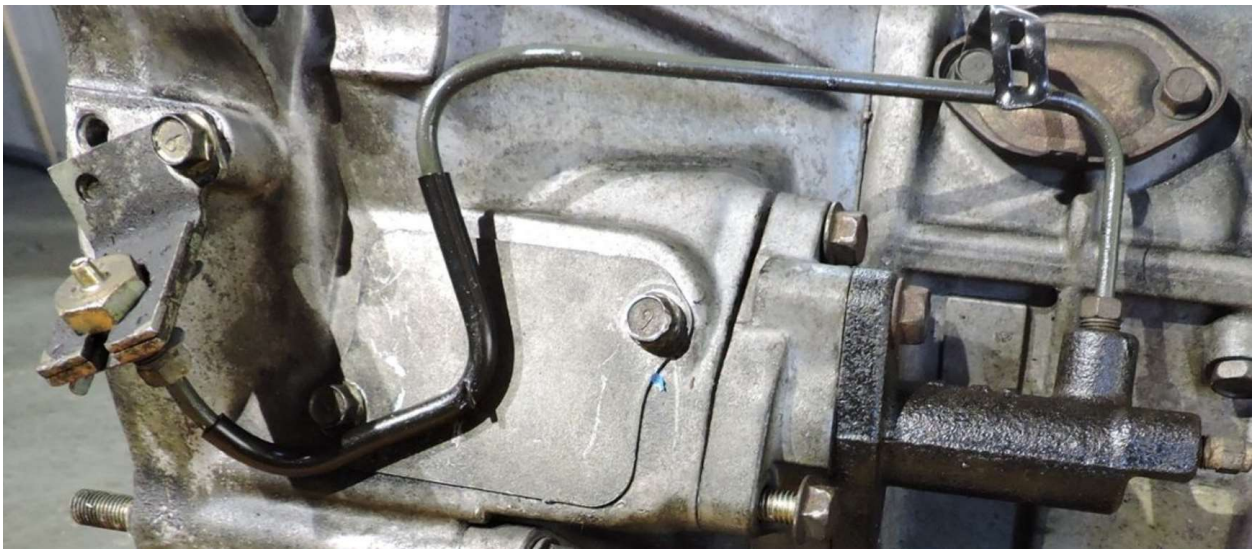
18 Appendix: Original Clutch Hydraulic Hardlines

These hard lines are no longer available, the brackets that hold them are no longer available, and they are difficult to find used, but here's some pictures of them if you're interested.

18.1 Steel Line Master Cylinder to Firewall (FD01-45-510D)



18.2 FD01-41-360A – Steel Hardline to Clutch Slave Cylinder (At Transmission)



19 Appendix: Torque Specs

This includes some additional torque specs that I commonly run into.

19.1 Clutch and Flywheel

Flywheel nut – 350 lb-ft

Flywheel drive plate to counterweight bolts: 32- 45 ft lb

Clutch cover (pressure plate) 14-19 lb-ft (17 avg)

19.2 Engine

Stationary Gear 6 bolts: 12-16 ft lbs (14 avg), p C-63 in FSM

19.3 Transmission

Clutch Fork (24-33 ft lbs)

Bell Housing Bolts

Clutch Master Slave bolts (2) – 12-16 ft lbs (14 avg)

Starter

19.4 Propeller Shaft

37-43 lb-ft on the 4 rear bolts

19.5 Brake Calipers

Front Caliper Mounting Bolts (17mm): 58-72 lb-ft, page P-21

Rear **Carrier** Bolts (14mm): 34-49 lb-ft (Smaller bolt mounts bracket to hub)

Rear Caliper Mounting Bolts (17mm): 47-62 lb-ft

Rear ABS speed sensor 12-16 lb-ft

19.6 Suspension

19.6.1 Rear Suspension

Strut to anti-sway bar: 40 to 56 (48 avg)

Sway bar holder 14-19 (16.5 avg)

Strut lower: 69-81 lb-ft (75 avg)

Strut upper x3: 34-46 Lb-ft (40 avg)

Hub to lower lower arm (I arm): 44-54 (49 avg)

Hub to upper arm: 44 to 54 (49 avg)

Upper arm to frame: 44 to 54 (49 avg)

Toe Control to hub (short link): 48-57 (52 avg)

Toe Control to frame: 44-54 (49 avg)

19.6.2 Front Suspension

Strut lower: 69-86 (77 avg, 17mm)

Strut upper x3: 34-46 (40 avg)

Sway bar threaded end: 27-39 lb-ft (43 avg)

Sway bar holder 12mm: 14-19 (16.5 avg)

Sway bar bolt near lower strut bolt: 44-54 (49 avg, 14mm)

Upper arm bolts through frame: 44-54 (49 avg, 14mm)