

Out with the Old, in with the New (BW35 to AW70 Conversion)

The following are a compilation of several articles written by Mike Illyes and are presented here with his permission.

You may recall that awhile back in SEES I mentioned the possibility of installing the AW70/71, four speed automatic, transmission into the early BW35, three speed automatic, transmission equipped models. I have since received several inquiries from members on the subject and I have personally contemplated this conversion for some time. Anyone with a pre 1982 automatic transmission equipped Volvo is familiar with the engine's high rpm drone at highway speeds. (i.e.: 1800 with BW35 auto. trans.). At 65 mph the engine is spinning at approximately 3500rpm. If this same vehicle was equipped with an AW70/71 transmission the engine would be rotating at a leisurely 2500 rpm. The reduction in engine noise, improved fuel mileage and reduced engine wear are convincing reasons to give this conversion further consideration.

Earlier this year I decided to proceed with development of a prototype adapter. Those of you who attended the Elkhart Lake National meet likely saw the result. I had the prototype adapter installed on an AW70 transmission for display purposes. I plan to make the actual transmission installation over the winter. Numerous issues remain, my thoughts on how I plan to address them follows. All B20 and B30 powered Volvos equipped with automatic transmissions came with the Borg-Warner model BW35 as the original equipment automatic transmission. This transmission has three forward speeds and uses bands for gear engagement. Four and six cylinder models produced from 1976 to 1981 utilized one of two more advanced versions of three speed automatic transmission, the AW55 produced by Warner or the BW55 from Borg-Warner. The AW55 and BW55 are very similar transmissions, both utilize discs for gear engagement.

The AW70/71, which was introduced in Volvo models beginning in 1982, is essentially an AW55 transmission with another gearset installed into an extended converter housing. It has four forward speeds, fourth being an overdrive ratio. The AW70/71 transmission was used on the B21, B23 and B230 series of engines which share the bellhousing bolt pattern with the B18 & B20. However, the B21, B23 and B230 series engines were installed in an inclined orientation, while the B 18 and B20 were mounted in an upright configuration. Direct fitment of the AW70/71, or for that matter the AW/BW55 onto a B18/B20 engine is possible, however the transmission will not sit level. This will negatively impact fitment into vehicles and longevity of the transmission. Additional differences between the BW35 and the AW70/71 transmissions and their fitment into vehicles exist and they will need to be addressed when contemplating the BW35 to AW70/71 conversion.

These concerns are listed below:

Flywheel! torque converter mounting: B20(8-bolt)and B21/23/230s have similar automatic transmission flywheels so there are no concerns here. However if my memory is correct, the BW35 equipped models use a different pilot bearing than the AW70/71 equipped models. If so, the proper pilot bearing will need to be purchased and installed. Be sure to use the AW70/71 torque converter bolts.

Crankshaft to flywheel (flex plate) mounting: 6 bolt through 1973 and changing to 8 bolt for 1974 on. If converting from manual transmission to automatic check which you have before sourcing these parts. Torque converter to flywheel (flex plate) mounting bolts: Use the bolts for the torque converter being used. All BW35s were SAE, but some AWs used metric others SAE.

Transmission mounting: The BW35's transmission mount and crossmember will bolt directly to the AW70/71. However due to the extra length of the AW70/71, the crossmember will be positioned much further back. There are no existing holes in the frame that will line up with the transmission crossmember's new positioning. Reinforced mounting holes will need to be drilled and tapped, or a new crossmember fabricated.

Driveshaft: The driveshaft will need to be shortened relative to the overall length increase of the AW70/71 over the BW35.

Kickdown cable: The kickdown cable is located on opposite sides of their respective transmission. Although cable routing should not be an issue, the cable ends are different and will likely require modification to the cable end, throttle lever and/or bracket to maintain proper action.

Converter housing: The AW70/71's converter housing was designed for the inclined orientation of the B21,B23 and B230 engines. Since the B20 engine sits upright, an adapter will need to be fabricated(see drawing above) to rotate the converter housing in relation to the transmission body. To maintain proper torque converter engagement with the adapter installed, the rear face of the converter housing must be machined by an amount equal to that of the finished adapter plate thickness.

Dipstick tube: The BW35's dipstick tube is located on right while the AW70/71's is on the left. Additionally, the AW70/71 's tube was shaped to accommodate the B21's inclined mounting The AW70/71 tube will need to be bent to match the B20's upright positioning. Mounting tabs will likely need to be relocated or otherwise modified.

Transmission cooling lines: Due to the extra length of the AW70/71 the cooling lines will need to be replaced or re-bent to accommodate the increased length.

Start Inhibitor/back-up light switch: Aside from fabricating the adapter plate, this is probably the most difficult aspect of the conversion. The BW35 has a combination neutral safety/back-up lamp switch threaded into the transmission case. The AW70/71 uses a combination switch mounted inside the gear selector assembly. There is no way to mount the BW35's switch into the AW70/71's transmission case. Early AW/BW55 transmissions used a gearbox mounted switch (about \$75) that may be adaptable to the AW70/71 if it is still available. Otherwise, the AW70/71's gear selector switch will need to be adapted to the BW35's gear selector assembly or a complete AW70/71 shifter assembly will need to be installed in the vehicle. I plan to keep the original shifter assembly if at all possible. If forced to use an AW70/71 shifter assembly, be sure to wire the shift indicator light for gear selection visibility at night.

Shifter/linkage: If the BW35 gear selector is retained be sure to check for proper detent action at the transmission. The shift linkage rods and/or levers will likely need modification to obtain proper action. More details will be provided after my initial installation is completed.

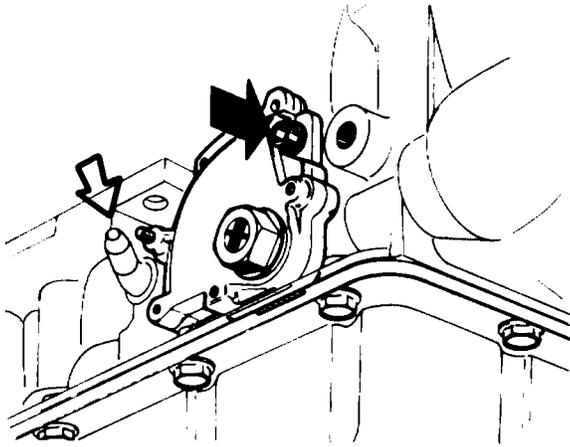
Overdrive wiring: Since the BW35 did not have overdrive, no wiring exists for the overdrive circuit. The AW70/71 overdrive switch, relay and wiring from a 200 or 700 series model should be usable though some minor modifications may be required. Alternately, an M41 overdrive switch could be used to provide manual O.D. activation. Be sure to include some type of indicator light to signal overdrive status (ON/OFF). An M41 overdrive light could be used to serve this function.

AW Update Spring 1999

Since the release of the Nov/ Dec issue of SEES I have had numerous conversations, letters and phone calls regarding the BW35 to AW70/71 conversion. My thanks go out to all of you whom wrote and called. It is gratifying to know that there others who share an interest in the subjects that I have researched and written about. Based on these conversations and the larger than anticipated interest, I am proceeding to have additional adapters produced. A small number of adapters should be available by early January. If you are interested in purchasing one, I can be contacted at the VSA - Lake Michigan Chapter address and phone number.

The early start inhibitor/ reverse light switch, Volvo part number 1215201-3 (list price \$80.24), finally arrived. It attaches to the right side of the transmission case with a single bolt (see illustration). The attached wiring is too short to reach all the way the main wire harness connector located at the left side of the firewall. I plan to replace the switch's electrical terminals with male spade connectors, Volvo part number 949490-7 and insulators, Volvo part numbers 958207-3 (male), and 9582908-1 (female). This will allow the switch to be connected to the transmission wire harness without irreversible modifications to the original transmission wire harness itself. You will need five of each part number. Installation of this switch also requires the use of a 45 degree fitting, Volvo part number 1233069-2, for the front transmission cooling line to transmission connection, in place of the 90 degree fitting. Some AW70 transmissions may already have the 45 degree fitting installed.

During some of the conversations it was mentioned that the M41 is about the same length as the AW70/71 and possibly the front driveshaft from an M41 equipped model may fit without modification. I had access to both of these transmissions, so I measured their overall lengths. The M41 is 28-7/8 inches overall length, while the AW70/71 measures in at 27-3/4 inches. The AW70 is 1-1/8 inch shorter than the M41. With-in a give model, an M41 driveshaft would be 1-1/8 inch too short for the AW70/71 installation. So, just what are the driveshaft alternatives? Possibly the front driveshaft from another Volvo model would be the appropriate length or shorten the front driveshaft from a BW35 or M40 equipped model. When searching for that donor front driveshaft be aware that Volvo has used at least two different flange sizes on the front driveshaft, so be sure the flange on the prospective replacement shaft matches the one on the original. In the Nov/ Dec SEES article I forgot to mention that the original speedometer cable can be utilized. However, be advised that 700, 900 and late 200 series models have electric speedometers. The transmissions used models with such speedometers do not have a speedometer cable receptacle on the tailshaft housing. These transmissions are useable, but the speedo cable type tailshaft housing, spacer, drive gear, driven gear and gear holder will need to be purchased or obtained from an appropriate donor transmission.



Solid arrow - Mounting bolt.

Outline arrow- Cooling line fitting (45 degree)

March 02 article.

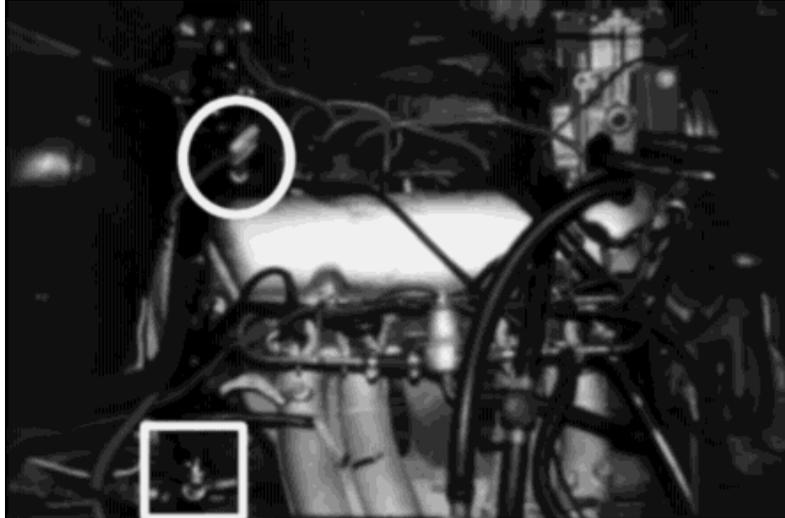
Actually, two such conversions have been completed. An ambitious Don Schmidt completed his conversion about a week before mine, using a 240 shifter assembly and one of my adapter plates. Though not as concours correct, Don's conversion is just as functional.

My AW70 Conversion is complete, though not without some compromise. However, the end product has proven to be worth the effort. Most notable is relaxed highway cruising as the B20 is spinning at around 2500 RPM instead of a dizzying 3500 RPM. Most in-town driving is accomplished using first through third gears, as the overdrive is really only usable above/around 50 MPH (2000 RPM).

There are three items that I would classify as compromises. The first is the low stall speed, about 1500 RPM provided by the AW70's torque converter when mated to the low torque, B20 engine. This can result in sluggish initial acceleration. This sluggishness may be partly a result of the somewhat tired engine in my ES.

Second is that the original 1800 kickdown lever does not provide enough kickdown cable movement for sufficient kickdown sensitivity. I will address this by fabricating a new kickdown lever that will provide more cable pullout relative to throttle movement. The third and final compromise is that my current shift linkage arrangement does not allow all shift positions to be selectable. See further details on this later in the article.

Appearance wise, it would take an observant individual to detect the visible changes in the engine and passenger compartments. The most obvious change is the relocation of the transmission dipstick, it has moved from the right side of the engine to the left side.



The actual swap was performed virtually as outlined in the first installment. The only glitch occurred when I inadvertently installed the AW70 using an M41 transmission mount bracket rather than the BW35 bracket. This caused the transmission to sit too high in the transmission tunnel, which resulted in an interference between the speedometer cable and the floor. Switching to the BW35 bracket corrected the interference issue. A complete recap and clarification of the installation follows:

Recap:

Flywheel to torque converter mounting: The AW70 Torque converter bolts directly to the B20's auto transmission flywheel using the bolts from the AW70 converter. The original B20 pilot bushing was retained.

Transmission mounting: The 1800's BW35 transmission bracket, mount and cross member bolt directly onto the AW70 transmission. Note: the automatic and manual transmissions use different brackets. Be sure to use the one for the BW35 automatic trans. To mount the transmission crossmember into the place holes were drilled into the floor pan for the new, rearward crossmember mounting position. Four flat metal plates were cut from 1/8 inch thick metal and drilled to create upper and lower floor pan reinforcement plates for the new crossmember mounting points.



Driveshaft: The front driveshaft was replaced with one from a 140. It was shortened to the needed length then rebalanced. This cost \$75.00 locally.

Kick down Cable: The kickdown cable for the AW70 transmission is shortened by snipping off the cable's lead barrel end and pulling the cable out of the sheath. Next, the sheath was cut to the desired length using a cut-off wheel. The threaded adjustment end was then removed from the cut off portion of sheath and reinstalled onto the newly shortened sheath. A hardware store eyelet was positioned on the threaded sheath end with flat washers and jam nuts on either side of the eyelet. A short section of rubber hose was used as a spacer between the threading and the eyelet to eliminate play and prevent thread damage. This eyelet is used to mount the sheath to the original kick down bracket.

A new cable end (cable clevis) was fabricated using a piece of 3/8 inch square by 1-1/2 inch long key stock. First a hole was drilled through the length of the piece to allow the cable to pass through it. Next a centered, 1/8 inch wide and 3/4 inch deep slot was cut into one end of the key stock using a cut-off wheel and flat, hand file. A hole for the original clevis pin was then drilled in the slotted end perpendicular to the slot and approx. 1/4 inch from the end.

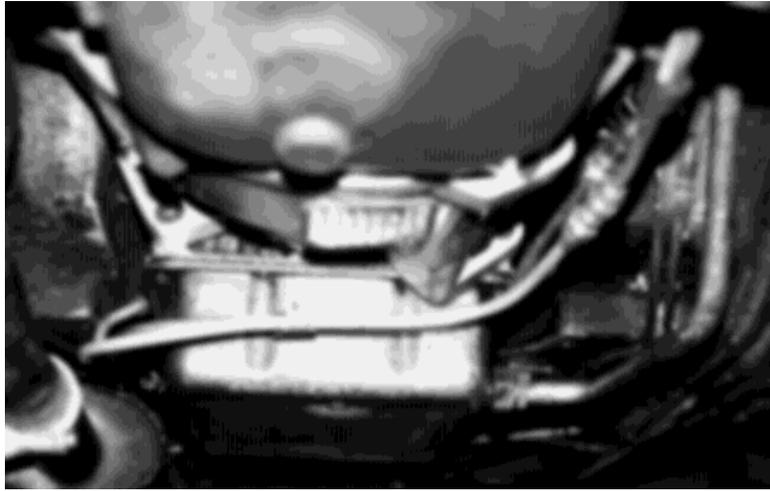
A small hole, perpendicular to the lengthwise hole, was then drilled and tapped on the other end. This hole only passes partially through the key stock, so that it just intersects with the lengthwise hole drilled initially. This hole accepts a setscrew to secure the cable clevis to the cable.

Once the transmission was fitted into the vehicle, the cable was snipped to length and the setscrew was secured and the cable clevis was joined to the kickdown lever with a clevis pin. The cable was then adjusted using the jam nuts of threaded sheath end in the eyelet located at the kick down bracket.



Converter Housing: As shown in previous installments, I designed an adapter plate that fits between the converter housing and transmission case. The adapter rotates the converter housing in relation to the transmission case. This allows the AW70 transmission, which was designed for the B21, 23, 230 engine's reclined mounting, to be fitted to the upright orientation of the B20. This adapter allows fitment of the AW70 to Volvo B18, B20, B21, B23 B230 four cylinders and possibly the B30 six cylinder engines when mounted in an upright fashion. This would help to facilitate the installation of a vertically mounted B21, B23, B230 engine and an AW70/71 transmission combination into 1967 or later 120, 140, 160 or 1800 series Volvos. Prior to fitting the adapter, I had the converter housing milled one inch to make up for the thickness of the fabricated adapter plate. The transmission was then bolted directly to the back of the B20 Engine.

The AW70's dipstick was re-bent slightly to clear the starter hump in the converter housing. The tube's short mounting bracket was cut-off and the long bracket was reshaped to align with one of the upper, converter housing to engine mounting bolts, which were used to retain it.

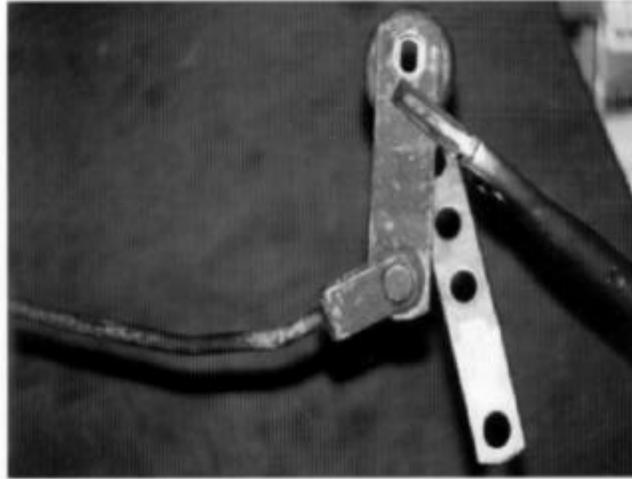


Transmission cooling lines (pipes): Due to interference with the transmission start inhibitor/back up lamp switch (Volvo PN-1215201) that I was using, I had to replace the forward 90-degree cooling line fitting with a 45-degree fitting. Two 24 inch long cooling pipes obtained from an auto parts store were bent to the appropriate shapes then installed in place of the two original, rear pipes.

Start Inhibitor/Back up light switch: I used a switch (Volvo pn 1215201) intended for an early AW/BW55 transmission as it bolts directly to the AW70 transmission case with just one bolt. The switch was then wired to the ES's transmission harness. Using wiring diagrams for the ES and a 240 I determined which color wires on the 1800's trans. harness should be connected to which color wires on the switch harness. I then made the appropriate connections.



Shifter/Linkage: I retained the ES's original BW35 shifter. To mate this shifter to the AW70 transmission, I used the levers and shift rod from a 240 series AW70 shift linkage. The linkage is in close proximity to the driveshaft flange, transmission and trans. tunnel. I filed out the eccentric slot in the AW70 shifter lever so it would fit onto the 1800 shifter assembly, and realign it to gain clearance between the lever and driveshaft flange when the transmission is in park. After adjusting the shift rod to fit, I was able to select all gears, except D1. As it is unlikely I would ever want to select D1, this was a condition I could live with.



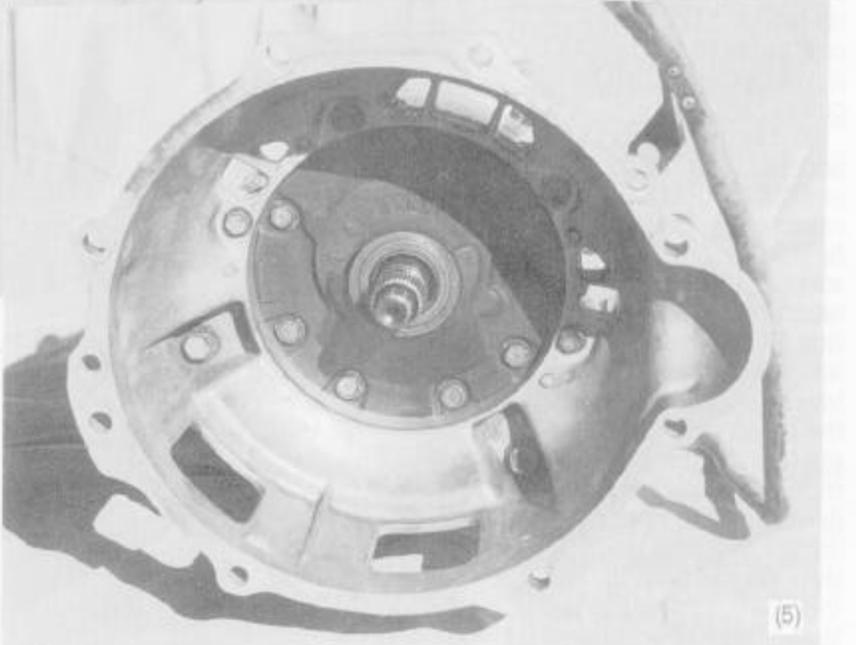
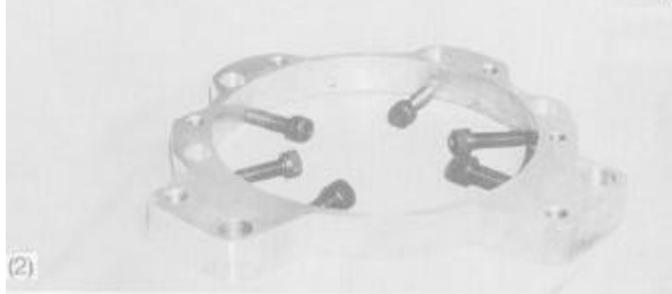
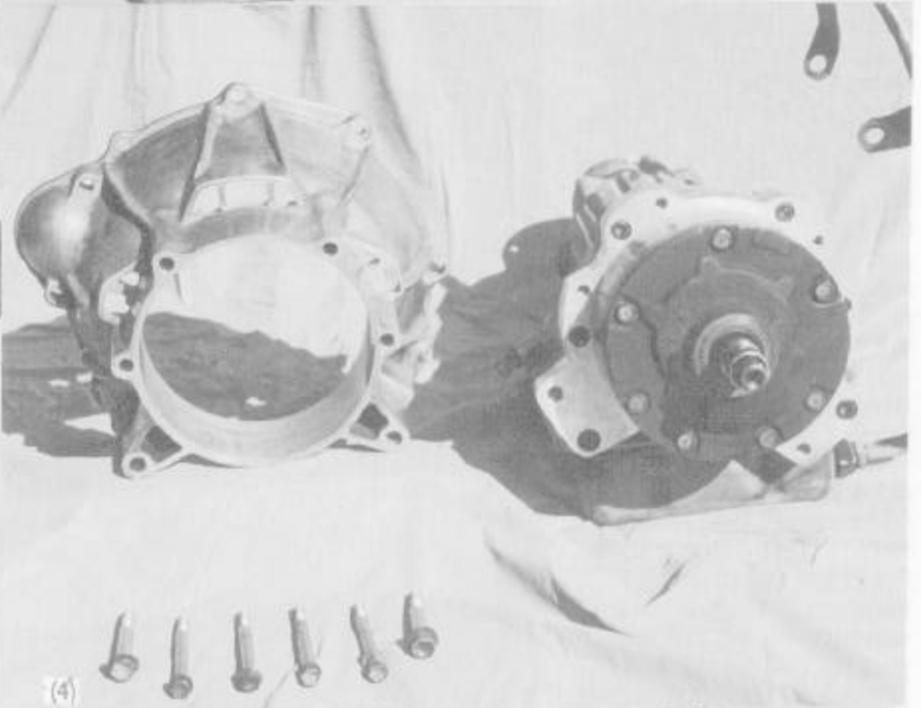
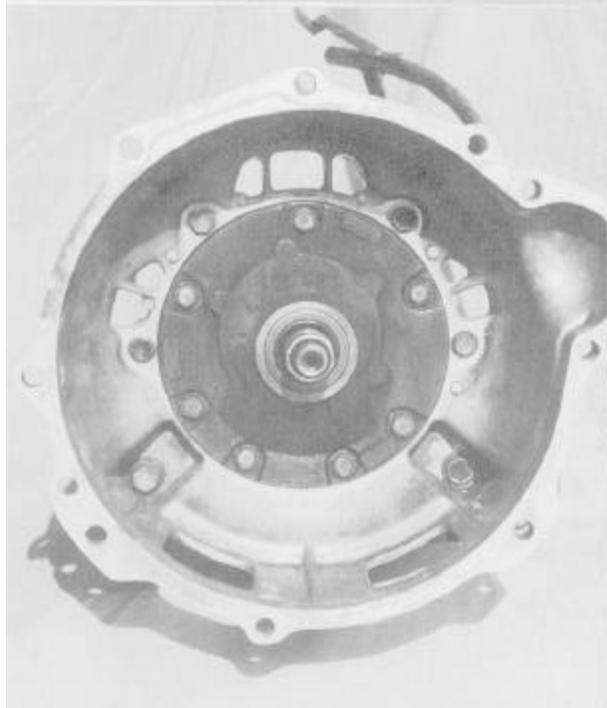
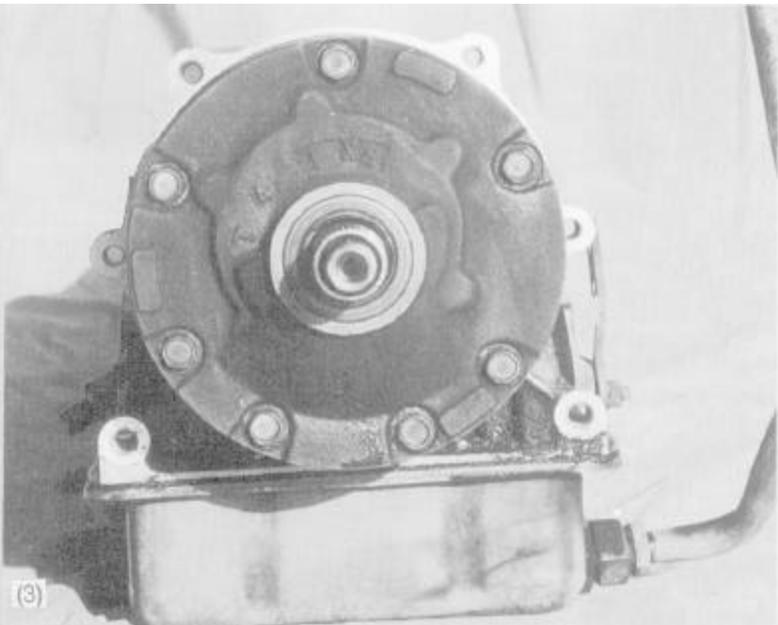
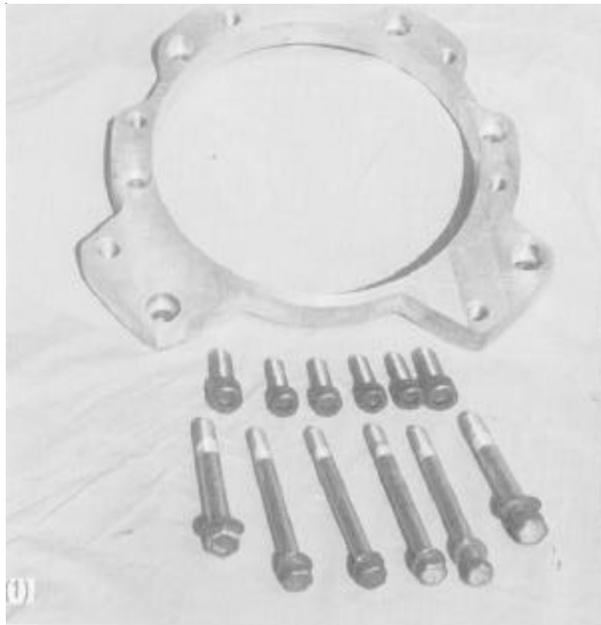
Overdrive Wiring: Our ES had been converted to a 4 speed + OD by a previous owner. So I just connected the M41's overdrive solenoid wire to the AW70's solenoid. The AW70's overdrive is switched on and off using the M41's column mounted switch. When the "OD" lamp is lit, all forward gears are available, including overdrive 4th. When the

"OD" lamp is "OFF", overdrive fourth gear is locked out.

Thanks to everyone for their encouragement, and their help when it was needed during this project. -
Mike-

Non-technical - tech article.

Mother's day brought our 1800 for the first time this year. Over the winter Mike put in the new conversion transmission. I don't know (or should I say keep up) with all the technical aspects of the installation. I did notice an improved, smother ride in the 1800. When we reached a cruising speed of 67 mph the car was humming along the highway. The drive on the highway way is not far behind our 760. The innovating idea that Mike had, adds a new pleasure to driving the 1800 cross-country. -ji-



(1) AW70/71 notice starter cut-out position
(2) Adapter Plate
(3) AW70/71 with converter housing removed
(4) AW70/71 with adapter plate installed
(5) AW70/71 with adapter and converter housing installed. Note relocated positioning of the starter cut-out.

Instructions for converting from BW35 transmission to AW70 transmission in late model Volvo 1800 model vehicles.

Much of the information also applies to other Volvo models that used the BW35 transmission as original equipment (120, 140 and B20 powered 240 models). However, there may be additional or different installation modifications required to complete such installations. I have not made an installation into any of these other models at the time this instruction guide was written. However, I am willing to discuss the changes that need to be considered with anyone interested in performing the conversion on these models. Call Mike Illyes at 847-658-6584 for such inquiries.

Read the instructions thoroughly before beginning the conversion process. This is to assure that you have a full understanding of the conversion process and are of all the parts you may need to complete the conversion.

Required additional parts not included with the adapter. Prices listed are the Volvo suggested list price for new parts from a Volvo dealer. Most parts can be obtained used for a fraction of the new price. Parts such as gaskets and seals that must or should be replaced are marked as “New” in the parts listings.

<u>Qty</u>	<u>Volvo PN</u>	<u>Description</u>	<u>approx. retail price - US</u>
1	N/A	AW70 transmission, 240series unit (with speedo cable attachment preferred)	\$250.00
Note: If purchasing a used transmission, be sure to get the torque converter, torque converter bolts, converter housing to engine mounting bolts. Also, consider obtaining the dipstick/dipstick tube assembly and all shift linkage components located in the transmission tunnel. If you are going to use the 240 series, AW70 shifter assembly get that as well as the shifter cover, overdrive wiring harness and relay at this time. You will likely pay little or no extra to get all these additional parts if you get them when you buy the used transmission.			
1	1220295-8	AW70 dipstick and tube (get with transmission if buying used) requires modification	\$36.00
1	687335-0	front drive shaft BW35, 1800 series. Must be shortened per instructions	\$341.18
2	N/A	24 inch long transmission cooling pipes (New)	\$5.00
1	N/A	hardware store eyelet (New)	\$2.00
2	N/A	nut for above eyelet (New)	\$0.25
1	1239673-5	pump o-ring, AW70 transmission (New)	\$11.00
1	1239689-1	converter housing o-ring, AW70 transmission (New)	\$9.00
1	1220513-4	cable stop for AW70 transmission kick-down cable (comes with new cable) (New)	\$5.00
6	quarts	Dexron II ATF (automatic transmission fluid)	\$18.00

Note: AW70 and BW35 use different types of ATF. Do Not mix. Drain and flush the BW35 transmission cooling system with Dexron II fluid.

If installing a used transmission with over 50,000 miles I suggest that you check the front and rear transmission seals and pan gasket for signs of leakage. Repair any leakage before proceeding with the conversion.

Additional parts needed list (not supplied in kit) if using an original 1800 shifter assembly.

<u>Qty</u>	<u>Volvo PN</u>	<u>Description</u>	<u>approx. retail price - US</u>
1	1215201-3	combination, start inhibitor/ back-up lamp switch (New)	\$81.00
1	959202-3	bolt for combination switch mounting (New)	\$0.75
1	941906-0	spring washer for combination switch mounting (New)	\$0.25
6	949490-7	male spade connectors (New)	\$0.75
6	958207-3	insulator for male spade connector	\$0.80
6	958208-1	insulator for female spade connector	\$0.65
1	1233069-2	45 degree fitting for transmission cooling pipe (New)	\$13.00
1	1220165-2	240 series AW70 shift lever at bottom of the shifter (requires modification)	\$5.00
1	1220157-0	240 series AW70 gear selector lever on left side of transmission case	\$5.00
1	1220159-6	240 series AW70 shift control rod fits between above levers in the trans tunnel.	\$21.00
1	687980-3	1800 series overdrive indicator lamp (alternate: aftermarket 12V indicator lamp)	\$11.00

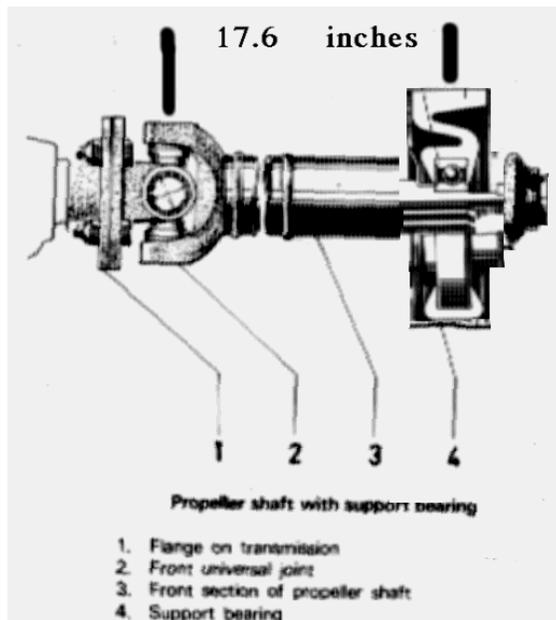
1	1210334-7	late 1800 series overdrive switch	\$58.00
1	1210121-8	dimmer switch for overdrive indicator lamp	\$35.00

Additional parts needed list (not supplied in kit) if using an 240 series AW70 shifter assembly.

<u>Qty</u>	<u>Volvo PN</u>	<u>Description</u>	<u>approx. retail price - US</u>
1	381954-7	240 series AW70 shift lever assembly (partial shifter only) Get a used shifter along with all the parts listed below, except for the overdrive indicator lamp. Note: the overdrive relay is mounted on the right side of the center panel.	\$81.00
1	1220165-2	240 series AW70 shift lever at bottom of the shifter (requires modification)	\$5.00
1	1220157-0	240 series AW70 gear selector lever on left side of transmission case	\$5.00
1	1220159-6	240 series AW70 shift control rod fits between above levers in the trans tunnel.	\$21.00
1	1259708-4	240 series AW70 overdrive switch mounted in the shift knob	\$13.00
1	9130036-8	240 series AW70 overdrive switch wire harness	\$15.00
1	9139231-6	240 series AW70 main overdrive wire harness	\$155.00
1	1307793-8	240 series AW70 overdrive relay	\$43.00
1	687980-3	1800 series overdrive indicator lamp (alternate: aftermarket 12V indicator lamp)	\$11.00

Components requiring modification before installation:

Drive shaft



The length required for the front drive shaft is approximately 17.6 inches (1800ES). The measurement is from the centerline of the front universal joint to the centerline of the center support bearing. Note: For comparison the original, BW35 front drive shaft for an 1800ES measures approximately 21.4 inches while the stock, M41 front drive shaft for an 1800ES measures approximately 16.5 inches.

Preparing the AW70 transmission

Take the AW70 converter housing to a machinist and have 1 inch milled off the rear face (small end of the converter housing). This is to make up for the thickness of the adapter plate when it is installed. If you can't locate a machinist to do this. I can have this done on an exchange basis for \$100.00, a \$200.00 core charge and shipping costs. The core charge will be refunded when I receive your useable converter housing.

Removing the converter housing

Remove the 6 torque converter housing bolts located with-in the torque converter recess . With a rubber mallet tap off the converter housing. In some cases the pump will need to be removed. To do this you will need to remove the 7 bolts retaining the pump body. If you need to remove the pump, it is suggested that the transmission be stood up on the output flange to keep the clutch plates and planetary gears from falling out. Be sure the mating surfaces are free of debris when reassembling a torque the pump bolts to 15-20 lb./ft. Before/ during re-assembly it is suggested that new pump and converter housing o-rings and front and rear transmission seals be installed to prevent fluid leaks.

Installing the converter housing

Install a converter housing to transmission case o-ring over the overdrive spacer, then install the adapter plate with the bolt recesses facing the front of the transmission. Install the socket head bolts, provided with the adapter plate, through the recessed holes of adapter plate holes and into the transmission body. torque these bolts to 20-30 lb./ ft. for the 10mm bolts and 35-45 for the 12mm bolts. Install the machined converter housing and secure using the supplied hex head bolts. torque these bolts to 20-30 lb./ ft. for the 10mm bolts and 35-45 for the 12mm bolts.

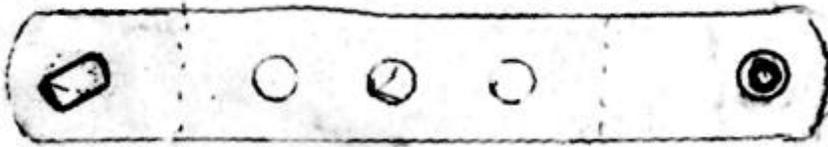
Replacing the Transmission driveshaft flange

If the driveshaft flange of the AW70 does not match the BW35 flange size, you will be to swap the flange from the BW35 to the AW70. This is easily done by removing the flange retaining bolts and pulling the flange out of the rear of the tailshaft. Repeat for second transmission. Reverse the procedure to install the flanges. Torque these bolts to 30-35 lb./ ft. during re-installation.

Shifter lever

240 series, AW70 shifter lever modification template. Area to be modified is on the left.

The hard line drawing represents the new orientation hole, while the dotted line represents the smaller, original hole. If you flip the lever over and reverse the bends, less filing will be required. The illustration below is not to scale, see Template page for full size template.



Kickdown cable

The kick down cable sheath needs to be shortened to approximately 24 inches. This is best accomplished with the cable removed from the transmission. Snip off the barrel end at the engine compartment end of the cable and pull the cable out of the sheath. Cut the sheath to approximately 24 inches using a cut-off wheel or hacksaw. Be sure to de-burr the cut edge before continuing, or a sticking and short lived cable may result. The threaded adjustment end is then removed from the scrap portion of the just cut sheath and is re-installed onto newly shortened sheath. The threaded end may need to be expanded slightly in order to fit it over the cable sheath. This can be done by expanding the crimped opening of the threaded cable end. Expand the crimped end using a round object such as a punch or a phillips screw driver. Once the threaded end is re-installed lightly re-crimp using an electrical terminal tool or pliers, DO NOT OVER CRIMP, it will split the metal. Re-install the cable into the sheath with the remaining barrel end towards the transmission end of the sheath (end with the plastic flange). Now assemble the cable adjustment pieces onto the threaded end of the cable sheath. First thread a jam nut onto the threaded sleeve followed by a flat washer, then a short section of rubber hose, the hardware store eyelet, followed by another flat washer and finally the remaining jam nut. With the forked end facing away from the cable sheath, slip the fabricated clevis onto the cable about 6 inches from the end of the cable sheath. Lightly tighten the clevis to prevent it from

falling off. If the cable was removed from the transmission while performing the previous steps, it should now be installed/ re-installed onto the transmission. Be sure to re-engage the remaining barrel end onto the cam pulley inside the transmission. With the cable re-installed onto the transmission, it may be properly shortened. First install a cable stop (clip), Volvo part number 1220513-4. There must be no cable slack with-in the cable sheath while installing the cable stop. To assure there is no pull lightly on the cable until you feel the resistance from the cam pulley. Back-off until no tension is felt, then mark the cable at the end of the sheath using a felt tip marking pen. The cable stop should be positioned to provide approximately .040 inch between the stop and the mark on the cable. Crimp the cable stop at the .040 inch clearance position using a pair of pliers. Be careful not to damage the cable. Now slide the clevis down the cable stop and lightly tighten. Mark the cable 3 inches out from the sheath end, then cut the cable at this mark. Slide the clevis to the end of the cable and tighten the set screw(s) firmly.

Modifying the combination switch (PN1215201-3) harness and the original BW35 transmission harness.

(Only for installations using the 1800 series BW35 shifter assembly)

Cut the female spade connectors from the ends of the combination switch's wire harness. Replace with male spade connectors, PN 949490-7 using a terminal crimping tool. Install the male spade insulators, PN 958207-3 onto the male spade connectors of the combination switch. The female spade connector insulators, PN 958208-1 are to be installed on the female spade connectors of the original 1800 BW35 transmission wire harness' combination switch connectors once they have been disconnected from the BW35. These two harness can now be connected together during installation using the conversion wiring chart as a guide.

Preparing the AW70 transmission:

Removing the converter housing:

Remove the six torque converter housing bolts located with-in the torque converter recess. With a rubber mallet, tap the torque converter housing loose from the main body of the transmission. In some cases the pump may need to be removed. To do this you will need to remove the seven bolts retaining the pump body. If you need to remove the pump, it is suggested that the transmission be stood up on the output flange to keep the clutch plates and planetary gear assembly from falling out. Position the transmission so that it is in secure and stable before proceeding with pump removal. Be sure that the mating surfaces are free of debris when reassembling and torque the pump bolts to 15-20 lb./ft. during reassembly it is suggested that new pump o-ring, PN 1239673-5, qty 1, converter housing o-rings, PN 1239689-1, qty 2 be installed to prevent transmission fluid leaks.

Installing the adapter plate and modified converter housing:

Install a converter housing to transmission case o-ring over the overdrive spacer, then install the adapter plate with the bolt recesses facing the front of the transmission. Install the socket head bolts provided with the adapter plate through the counter-bored holes of the adapter plate and into the transmission body. Torque the bolts to 20-25 lb./ft. for the 10mm bolts and 35-40 lb./ft. for the 12mm bolts. Install the machined converter housing and secure using the supplied hex head bolts. Torque the bolts to 20-25 lb./ft. for the 10mm bolts and 35-40 lb./ft. for the 12mm bolts.

Replacing the transmission drive shaft flange:

If the drive shaft flange of the AW70 does not match the BW35 flange size, you will need to swap the flange from the BW35 transmission onto the AW70 transmission. This is easily done by removing the flange retaining bolts and pulling the flange out of the rear of the tailshaft housing. Repeat the process on the remaining transmission. Now would be a good time to replace the rear transmission (drive shaft flange)

seal and bushing if leaking or worn. Swap the flanges and install by reversing the procedure. Torque the flange retaining bolts to 30-35 lb./ft. during installation.

Installation of the 45 degree transmission cooling line fitting:

(Only for installations using the 1800 series BW35 shifter assembly)

Install the 45 degree fitting, PN 1233069-7 into the forward transmission cooling line port of the AW70 transmission. Loosely tighten the fitting so it faces downward. Recommend covering the opening of the fitting until the transmission is installed to prevent foreign matter from entering the fitting.

Installation of the combination switch:

(Only for installations using the 1800 series BW35 shifter assembly)

Install the combination switch, PN 1215201-3 onto the shift stub shaft located on the right side of the AW 70 transmission case. Install spring washer, PN 941906-0 onto bolt, PN 959202-3. Insert bolt with washer through the bolt hole of the combination switch body and into the threaded hole of the transmission case. Tighten to ??? lb./ft.

Installation of the 240 series AW70 shifter lever onto the 1800 series BW35 shifter:

(Only for installations using the 1800 series BW35 shifter assembly)

Install the previously, modified AW70 transmission shift lever onto the left side of the 1800 series BW35 shifter assembly. The lever must extend down and towards the rear of the vehicle. Re-install the retaining washer and nut, tighten to ??? lb./ft. The control rod end of the shifter lever should be adjacent to the AW70's drive shaft flange when the shifter is in the Park position.

With all the previous steps completed the transmission is now fully prepped for installation

Remove the BW35 transmission from the vehicle using the directions found in the Volvo or other appropriate service manual.

Basic recap of steps:

Disconnect battery

Disconnect kickdown cable clevis from the lever and bracket on the firewall.

Raise the vehicle and place on appropriate jackstands.

Note: Vehicle must be high enough to allow removal of the transmission out from under the vehicle.

Remove the four front drive shaft flange nuts and bolts.

Remove the four rear drive shaft flange nuts and bolts.

Remove the two bolts retaining the center support bearing strap.

Remove the front and rear drive shafts. Before separating the drive shaft halves be sure to make alignment marks on both so they can be properly re-aligned during re-installation.

Drain transmission fluid and properly dispose of the fluid. The BW35 and AW70 use different AFT fluids so you will need to replace all of the old fluid with Dexron II ATF.

Remove the four bolts from the torque converter housing to engine block brace and remove the brace.

Remove the front exhaust pipe support clamp, if present.

Remove the four bolts retaining the torque converter to flywheel and push the torque converter back away from the flywheel.

Disconnect the shift control rods at the transmission and at the shifter.

Place a transmission jack under the BW35 transmission and raise it until it just contacts the transmission sump (pan).

Remove the four bolts retaining the transmission crossmember.

Lower the transmission until the dipstick tube touches the firewall.

Disconnect the electrical cables at the combination switch of the transmission.

Disconnect the speedometer cable from the transmission.

Remove the two upper torque converter housing to engine mounting bolts.

Disconnect the transmission cooling lines.

Remove the four remaining torque converter housing to engine mounting bolts.

Lower the transmission jack and pull the transmission towards the rear so that the guide pins on the converter housing are released.

Caution: The transmission must not be tilted forward as the torque converter may slide off of the input shaft.

Fully lower the transmission jack and remove the BW35 out from under the vehicle.

Transfer of the BW35 transmission mounting bracket, rubber cushion and crossmember from the BW35 transmission to the AW70 transmission.

After removal of the BW35 transmission from the vehicle, remove the 1800 series BW35 mount/crossmember assembly from the BW35 transmission. Next remove the 1800 series shifter cross-shaft assembly from the BW35 crossmember assembly. The cross-shaft assembly will not be re-used. Install the BW35 transmission crossmember assembly (transmission mounting bracket, rubber cushion and crossmember) onto the AW70 transmission using the original mounting hardware.

Installation of the 240 series AW70 shifter assembly (Installations using the 240 series AW70 shifter assembly only)

The transmission tunnel opening for the shifter assembly must be enlarged to accept the 240 series AW70 shifter. With the shifter in the 'PARK' position, determine how far back the shifter must be positioned to allow the shift lever to clear the heater controls and/or the A/C unit and controls. With the shifter in this position, mark the transmission tunnel sheet metal using a marking pen. Enlarge the shifter hole using metal shears, hack saw, cut-off wheel or other appropriate sheet metal cutting device. Once the hole has been sufficiently sized four drill holes for the shifter mounting screw positions. Secure the shifter to the transmission tunnel with appropriate mounting screws. Wire the shifter/overdrive electrical components using the conversion wiring chart as a guide.

Installing the prepared AW70 transmission:

Read this entire section before proceeding.

Remove the front carpeting to prevent damage when drilling the new crossmember mounting holes.

Place the AW70 transmission onto the transmission jack.

Make sure that the torque converter is fully seated into the pump assembly by rotating the torque converter while pushing it towards the transmission case.

Slide the transmission under the vehicle keeping the transmission slightly inclined at the front to prevent the torque converter from unseating. Raise the transmission using a transmission jack until the guide pin holes in the converter housing align with the guide pins. Move the transmission forward to engage the guide pins into the converter housing. Start all five converter housing to engine bolts before fully tightening any of them. If the bolts become tight before the converter housing has seated against the rear face of the cylinder block, it is likely that the torque converter has become unseated. Lower the transmission and re-seat the torque converter and try again.

Once all five bolts are started go back and tighten all to 35 lb./ft.

Caution: Trying to force the converter housing to seat against the cylinder block using these bolts can lead to catastrophic damage to the torque converter and/or transmission. Remove the transmission, re-seat the torque converter then continue with installation.

Install and loosely tighten all four torque converter to flywheel bolts. Once all bolts are installed go back and tighten to 30 lb./ft.

Install the shift control rod onto the shifter lever positioning it so the forward free ends rests on the top, left side of the transmission. Install the retaining pin and clip holding the control rod to the shifter lever.

Connect the combination switch wiring to the 1800 series original transmission wire harness using the conversion wiring chart as a guide. Secure the wiring with wire ties so that the wires do not hang

loose or become damaged during the remainder of the installation. (Only for installations using the 1800 series BW35 shifter assembly)

Connect the overdrive solenoid wire from the over drive harness to the overdrive solenoid using the conversion wiring chart as a guide.

Raise the transmission jack so that the transmission crossmember gently contacts the floor pan. Adjust the position of the transmission so that it is centered in the transmission tunnel. Checked by measuring from the edge of the transmission crossmember to the edge of the inner rocker panel on each side. Side to side measurements should be equal.

Adjust the position of the transmission crossmember so it is parallel to the frame's rear crossmember which is slightly to the rear of the transmission. Checked by measuring from the rear edge of the transmission crossmember to the front edge of the rear crossmember. , measurements on both sides should be with-in 1/8 inch. Recheck above measurements, when satisfied with the crossmember positioning, mark the floor pan for two of the crossmember mounting points (one on each side) using a marking pen or center punch inserted through the crossmember bolt holes. The front muffler may need to be moved or removed to gain access for drilling. Unbolting the exhaust head pipe from the exhaust manifold and moving the front of the exhaust to the side should provide sufficient clearance.

Caution: be sure to remove the front carpeting to prevent damage to it while drilling the new crossmember mounting holes.

Drill a 5/16 inch diameter hole centered on each of the to markings.

From the passenger compartment insert a reinforcement plate with the square hole over each drilled hole and insert one of the supplied carriage bolts through each plate and the newly drilled mounting holes. From underneath the vehicle install the guide plates with the round holes over the carriage bolts followed by the transmission crossmember, a flat washer, a lock washer and finally the lock nut. Align the upper and lower plates with the mounting holes in the crossmemeber then tighten the nuts. Mark and drill the holes for the two remaining mounting points. Install the remaining carriage bolts, washers and nuts. Tighten all four nuts securely to 30 lb./ft.

Install the converter housing to engine block brace and the four, converter housing to engine brace bolts.

Adjust the positioning of the 45 degree transmission cooling line fitting to provide maximum clearance for the fitting and cooling line path. Tighten the fitting to 15-20 lb./ft.

Bend the two, 24 inch long sections of new, transmission cooling line pipe to fit between the transmission cooling line fittings and the front transmission cooling lines. Install the newly formed cooling lines and tighten the fittings. Route and secure these cooling pipes o prevent the from rubbing against surrounding components.

Install the speedometer cable into the receptacle on the right side of the transmission and tighten the retaining collar snugly.

With the transmission and shifter in the 'PARK' position, fit the control rod onto the transmission shift lever and install the retaining pin and clip. Check for proper gear selection. Note: with this shifter/ linkage combination D1 may not be selectable. This is a trade-off that results from maintaining the original shifter and therefore an original interior appearance. All other gears should be selectable, if not check and readjust the length of the control rod. The control rod length is changed by turning the fitting on the threaded end of the control rod.

Install the overdrive wiring using the overdrive wiring schematic included elsewhere in the directions.

Install the drive shaft using a front section that has been shortened according to the directions listed earlier in these instructions. Make sure the drive shaft alignment marks are properly aligned to avoid vibrations.

Install and tighten all eight drive shaft flange bolts and nuts.

Re-install the drive shaft, center bearing support and tighten the two bolts.

Fit the transmission dipstick and tube. Note that the tube needs to be re-bent to clear all engine compartment obstacles.

Also, the dipstick tube mounting brackets will need to be modified. I cut off the short, lower bracket and re-bent the long, upper bracket to align with one of the bolts retaining the converter housing to the cylinder block. To do this, I cut a large v-shaped section out if the middle of the bracket, bent the bracket to close up the v-cut and align the bracket with the mentioned bolt hole location, then welded the seam of the cut area. This could also be accomplished by cutting off the long bracket, leaving a stub that could be drilled. A new bracket could the be fabricated from the removed section of the bracket or some flat stock. Which would be bolted to the stub and the converter housing

mounting point. **Note: do not change the horizontal portion of the dipstick tube, doing so will affect dipstick accuracy. Also, be careful not to crimp the tube while reshaping it.**

Install the kickdown cable into the firewall mounted bracket and lever. Adjust the cable using the jam nut at the eyelet end of the cable. **Note: make certain that there is some additional cable pull-out available when the throttle pedal is fully depressed or the inner cable will be highly stressed and therefore short lived.**

Flush the transmission cooling system with fresh Dexron II automatic transmission fluid, then fill the transmission with fresh Dexron ii automatic transmission fluid.

Reconnect battery cable and front exhaust pipe if removed earlier.

Check for fluid leaks and re-check fluid level after running the engine and moving the gear selector through all of the gears.