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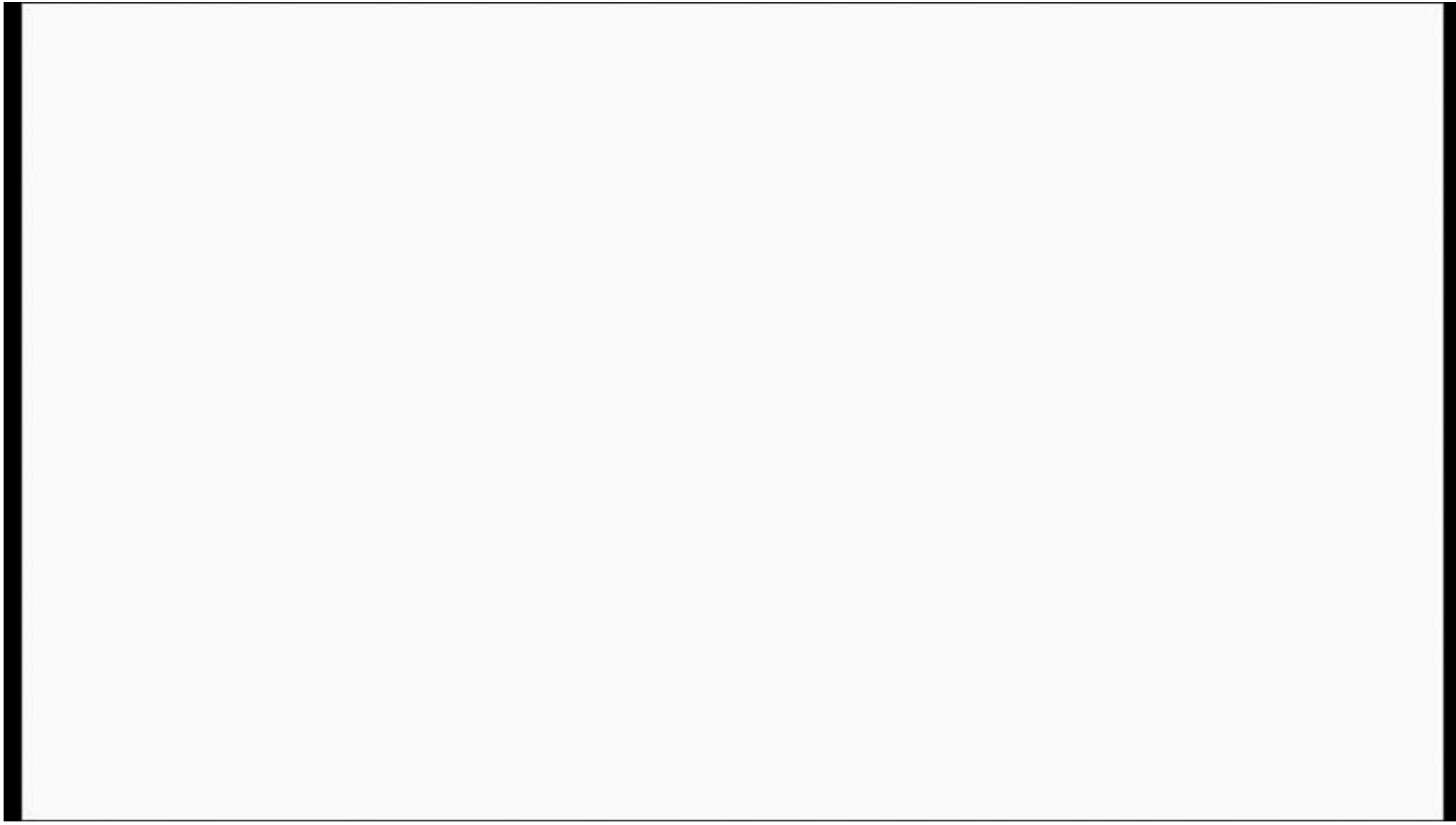

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Webinar Schedule

June 2/3	ZF8HP	Rebuild
June 23/24	6R140	Introduction
July 7/8	DPS6	Internal Operation
July 21/22	U660	Introduction and Rebuild
Aug 4/5	8L90	Internal
Aug 18/19	01J	Problems & Fixes
Sept 1/2	948TE	Internal
Sept 15/16	5R110W	Problems & Fixes
Sept 29/30	Lineartronic CVT	Problems & Fixes
Oct 13/14	6R140	Problems & Fixes

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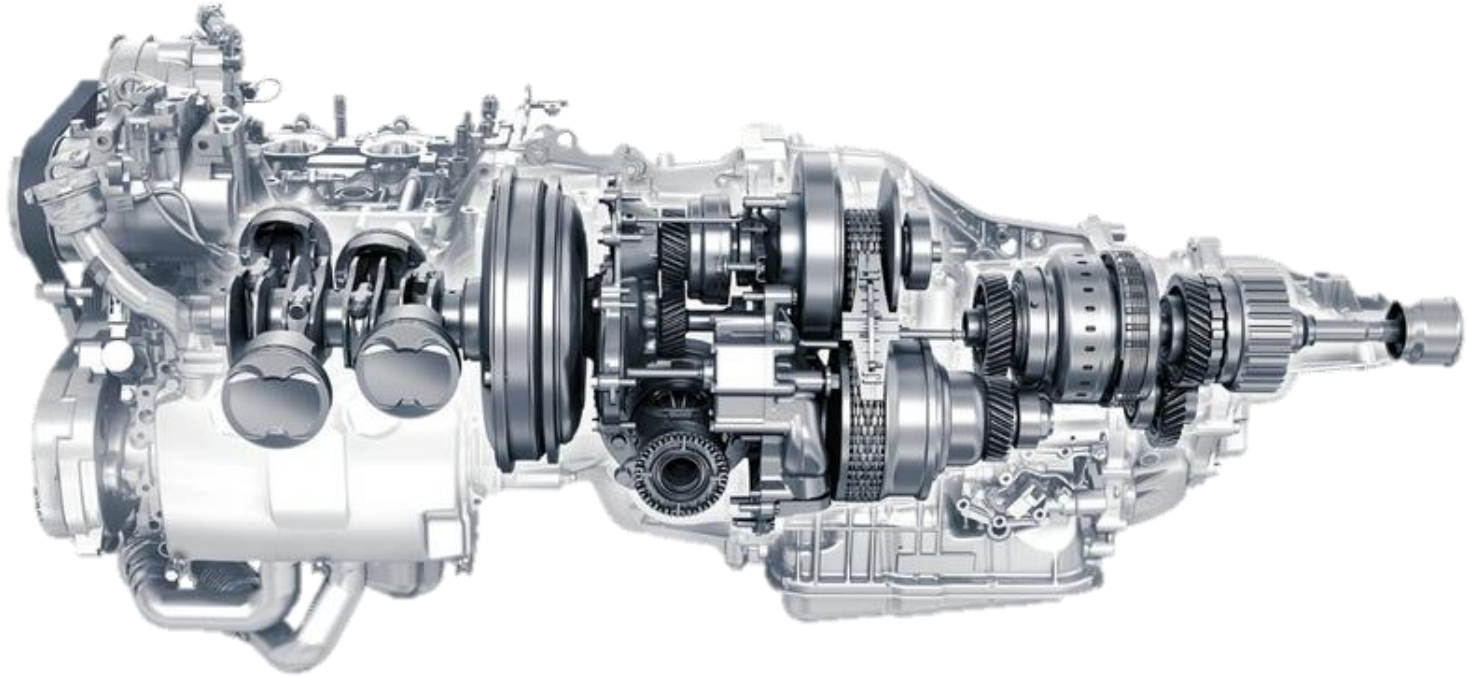
Subaru Lineartronic CVT Rebuild

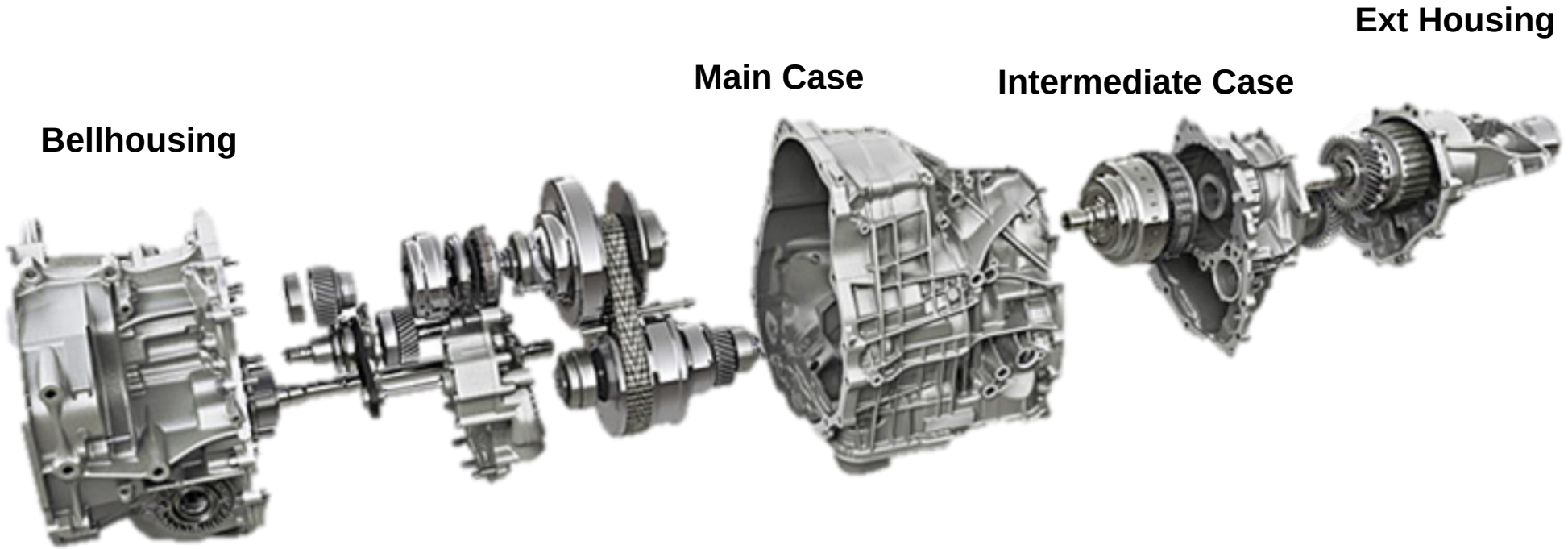


Presented by:
Mike Souza
ATRA Senior
Research Technician

Transmission Construction

The Lineartronic CVT is divided into four sections.

- **Torque Converter Bellhousing**
- **Transmission Main Case**
- **Intermediate Case**
- **Extension Housing**



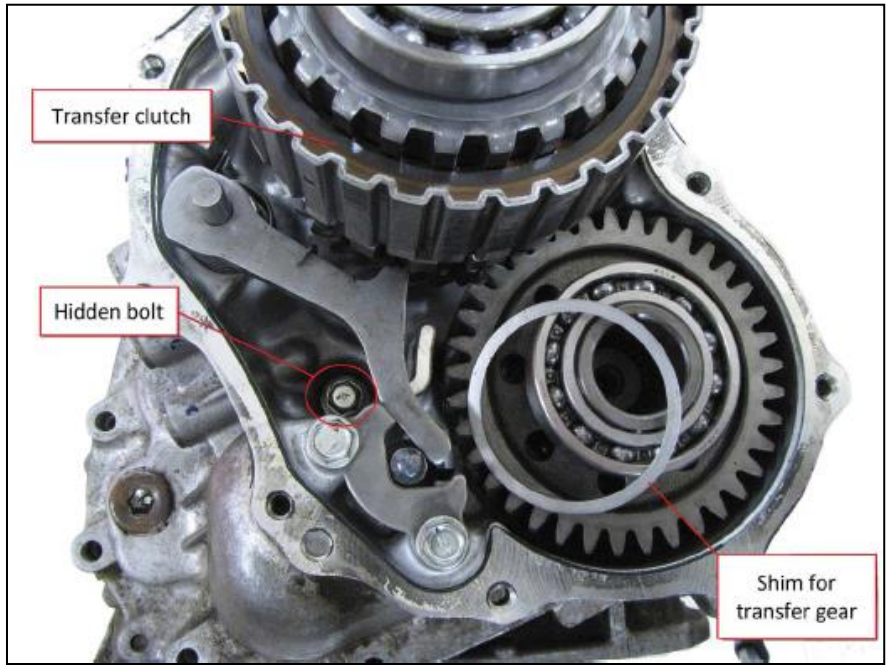
Transfer Clutch

Start from the rear of the unit; remove the tail housing bolts and take the tail housing off. There's nothing unusual here; just the normal Subaru transfer clutch, transfer gear and park mechanism.

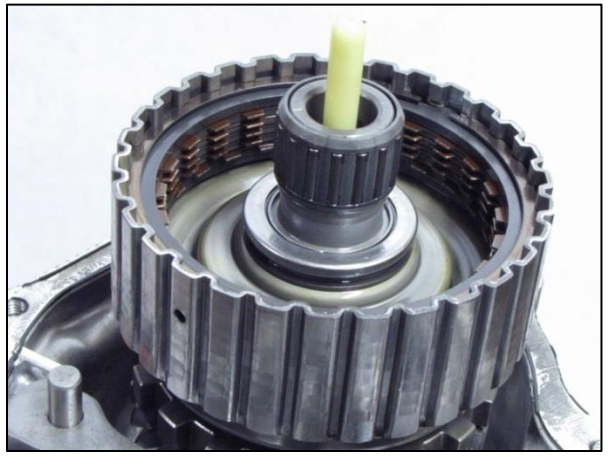
Notice the shim(s) for the transfer gear, they go on the tail housing side. All of the shims are different in size, make sure you have them organized for their location.

Tail Housing

Rear view of Intermediate Case



Lube Tube



Transfer Clutch

The transfer clutch has five clutch plates, five steel plates, and two pressure plates.

Lay the apply plate on top of the piston. Then start with a steel plate and alternate clutch plate and steel plate until you have five clutches installed. Finish with a pressure plate and snap ring.

The transfer clutch specification is 0.028" to 0.043" (0.70 to 1.1 mm) clearance. Subaru says if clearance is over 0.063" (1.6 mm), replace the clutches. There are four different selective clutch pack kits available to help you get the correct clearances.

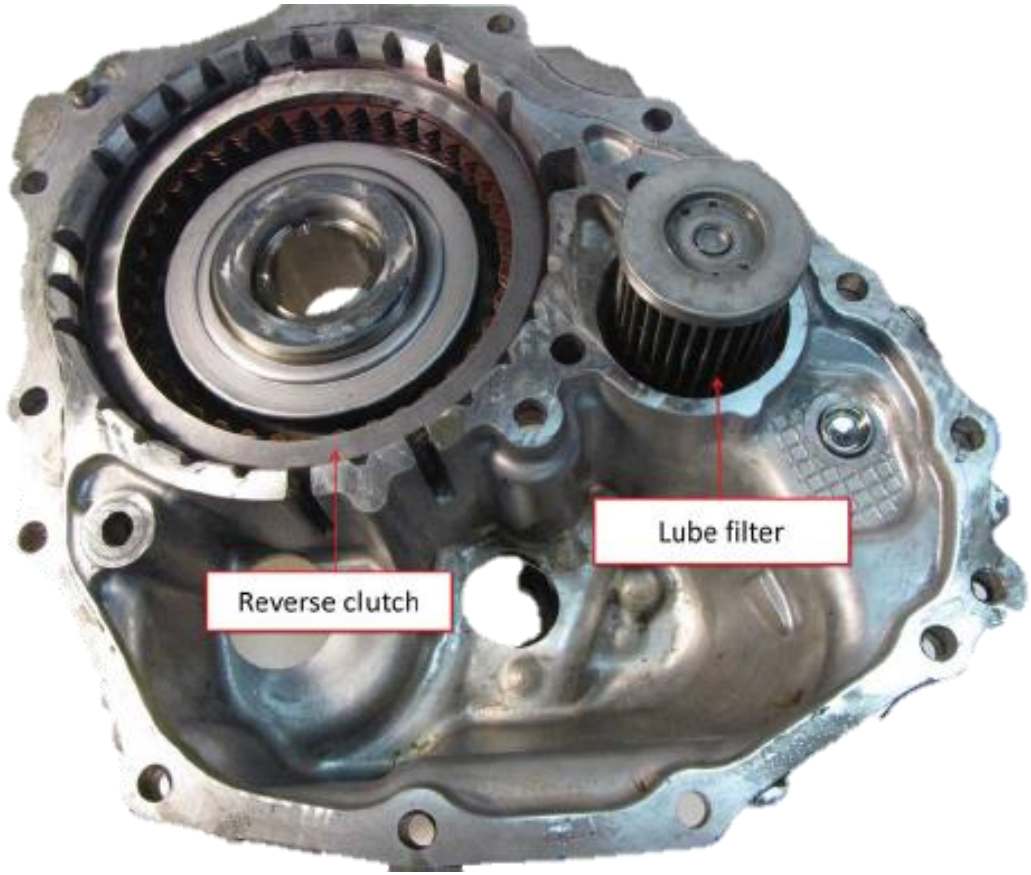
Measure your plates when ordering. Remove the thirteen (13) outside bolts to the intermediate case housing; there's one hidden bolt in the middle (shown on previous page).

Reverse Clutch

Remove the intermediate case to reveal the reverse clutch pack and a lube filter on the <u>inside</u> of the intermediate case housing.

The reverse clutch has a pressure plate, five clutch plates, five steel plates, and a beveled cushion plate. The beveled cushion plate's inside edge rides on the reverse clutch piston.

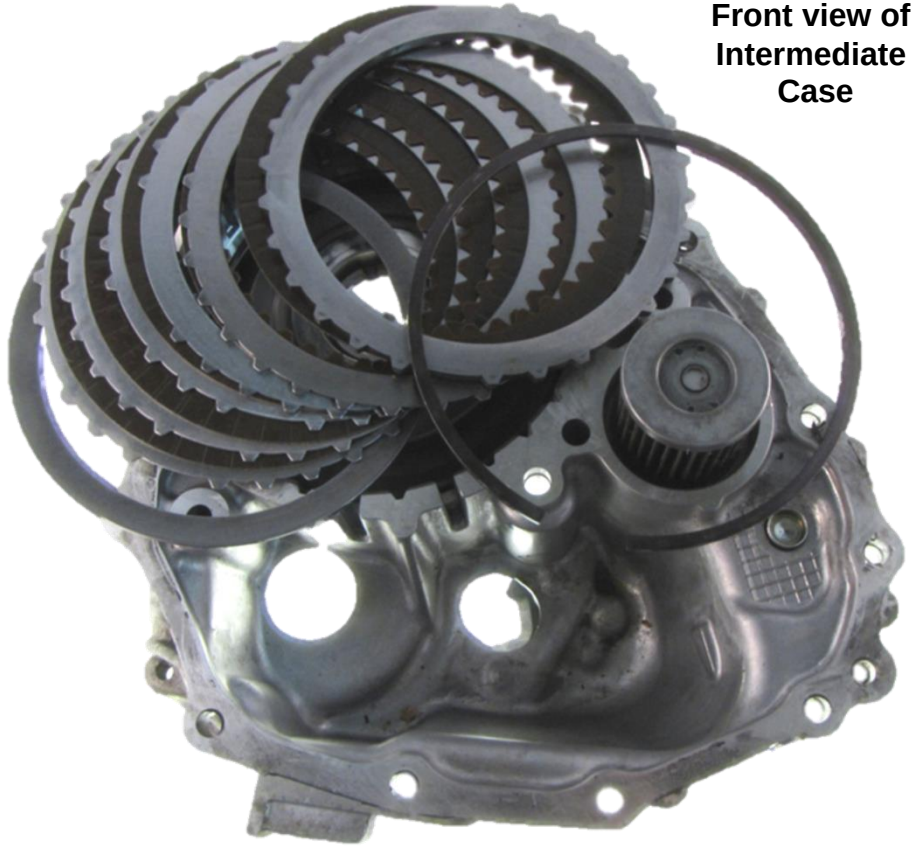
Then alternate steel plate and clutch plate until you've installed five clutches. Install the pressure plate on top of clutch plate and snap ring.



Front view of Intermediate Case

Reverse Clutch

Check the stroke of the reverse clutch piston. The stroke should be between 0.113" - 0.125" (2.9-3.2 mm). If it isn't within specification replace the pressure plate, there are four different selections to choose from.



Front view of Intermediate Case

Bevel Faces Down

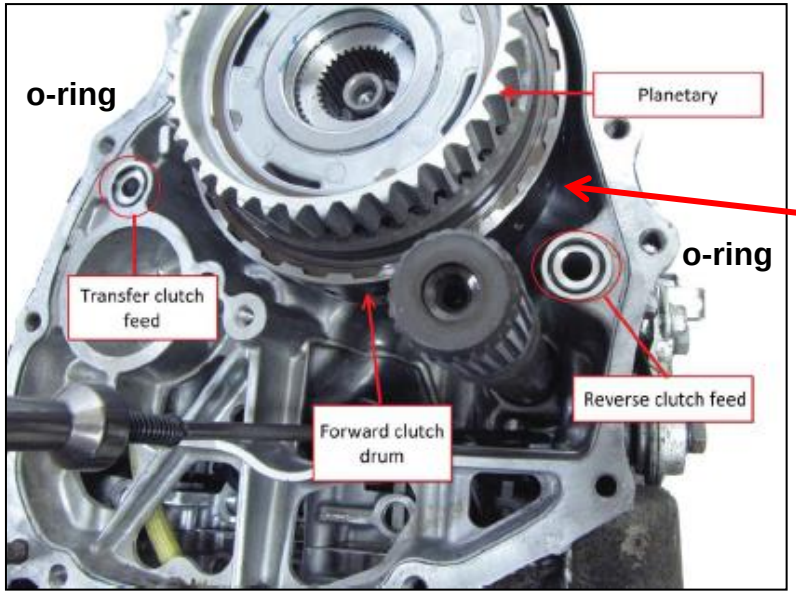
Forward Clutch

Remove the planet assembly and forward drum from the main case. Pay attention to the shim on the forward clutch drum, don't misplace it. Watch for the two case seal passage o-rings that may fall out. One is from transfer clutch feed the other for reverse.

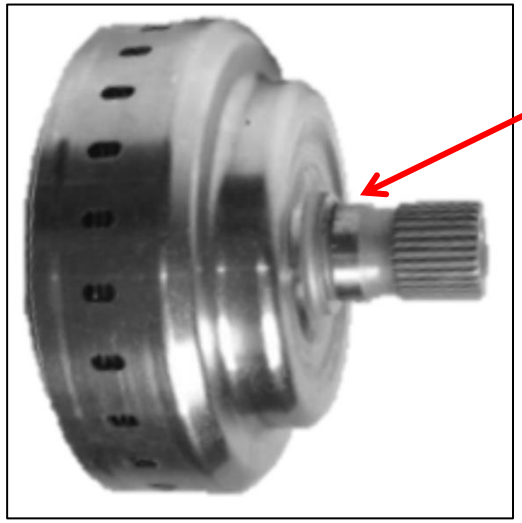
The forward clutch drum also holds the ring gear for the planetary system and a clutch hub. Remove the snap ring, ring gear, and one more snap ring that holds the ring gear in place.

The forward clutch pack consists of a beveled cushion plate, six steel plates, six clutch plates and a pressure plate.

Rear view of Main Case



Forward Clutch Drum

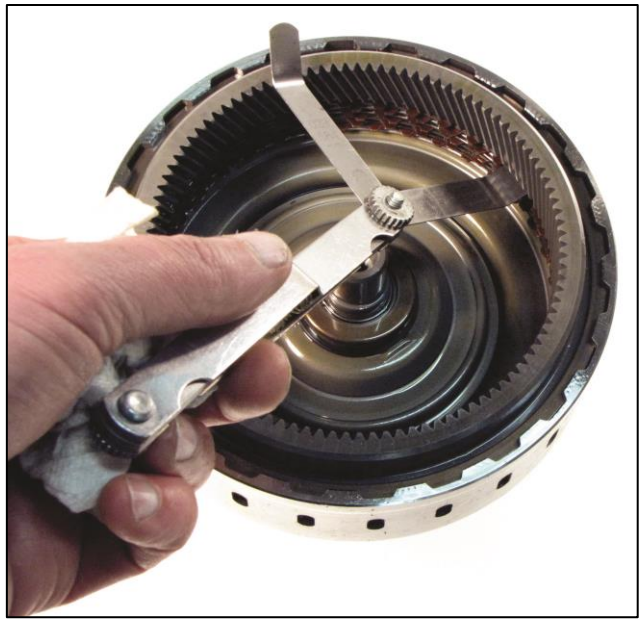


This shim falls off the drum during disassembly.
The shim sets forward clutch/planet end play.

Forward Clutch

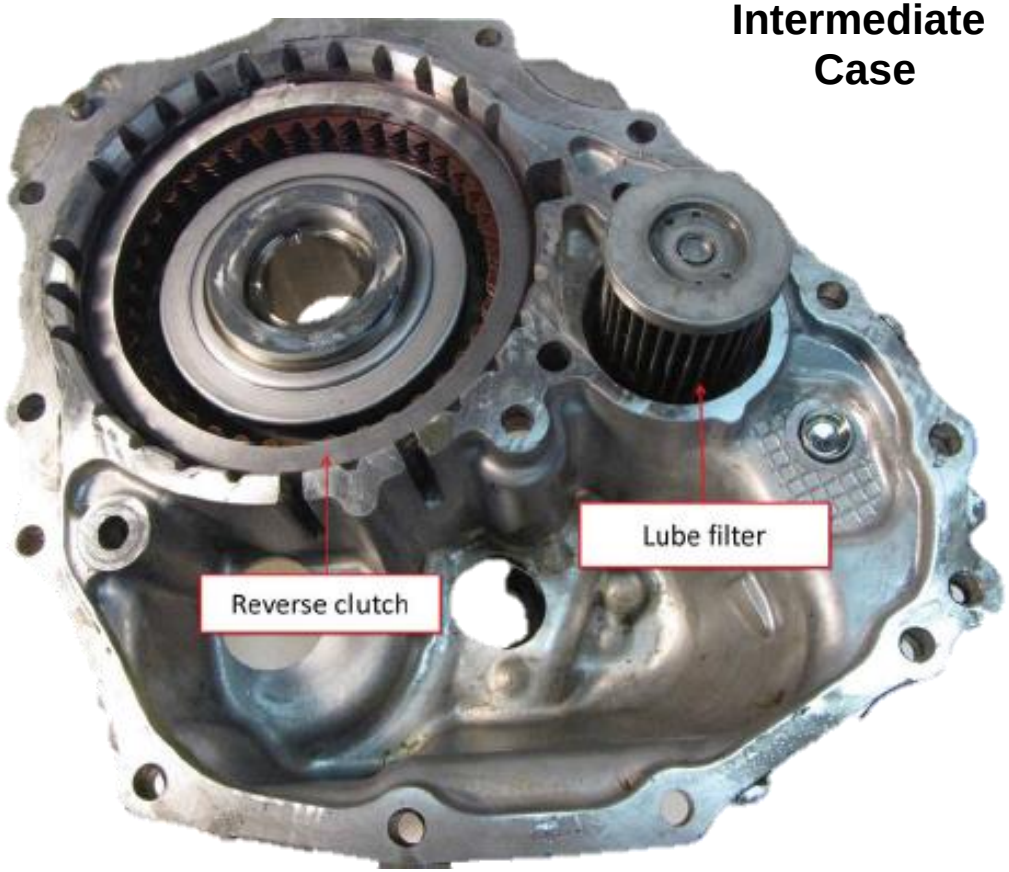
Leave out the forward clutch hub for now; install the lower snap ring, ring gear, and top snap ring. Measure the forward clutch clearance between the bottom of ring gear and the top of the pressure plate with a feeler gauge. It should be between 0.047" - 0.063" (1.2-1.6 mm).

If it isn't within specification replace the pressure plate, there are four (4) different selections to choose from. Once you have the clearance right, take it back apart to install the forward clutch hub.

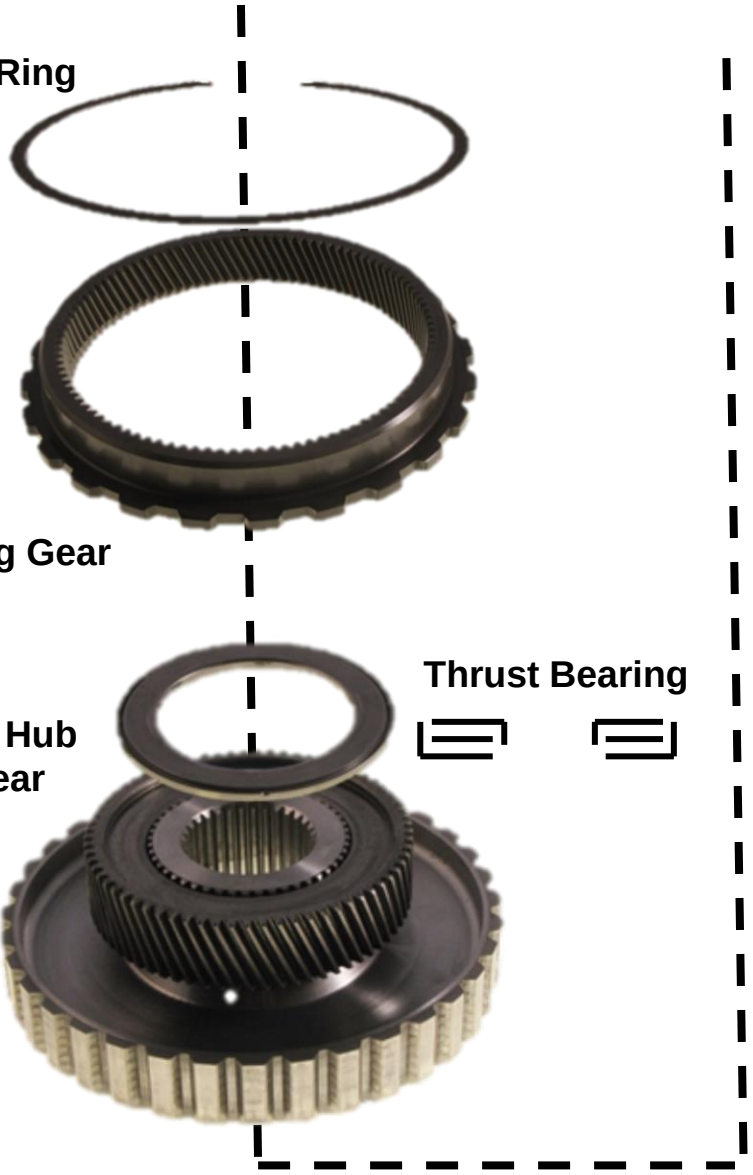


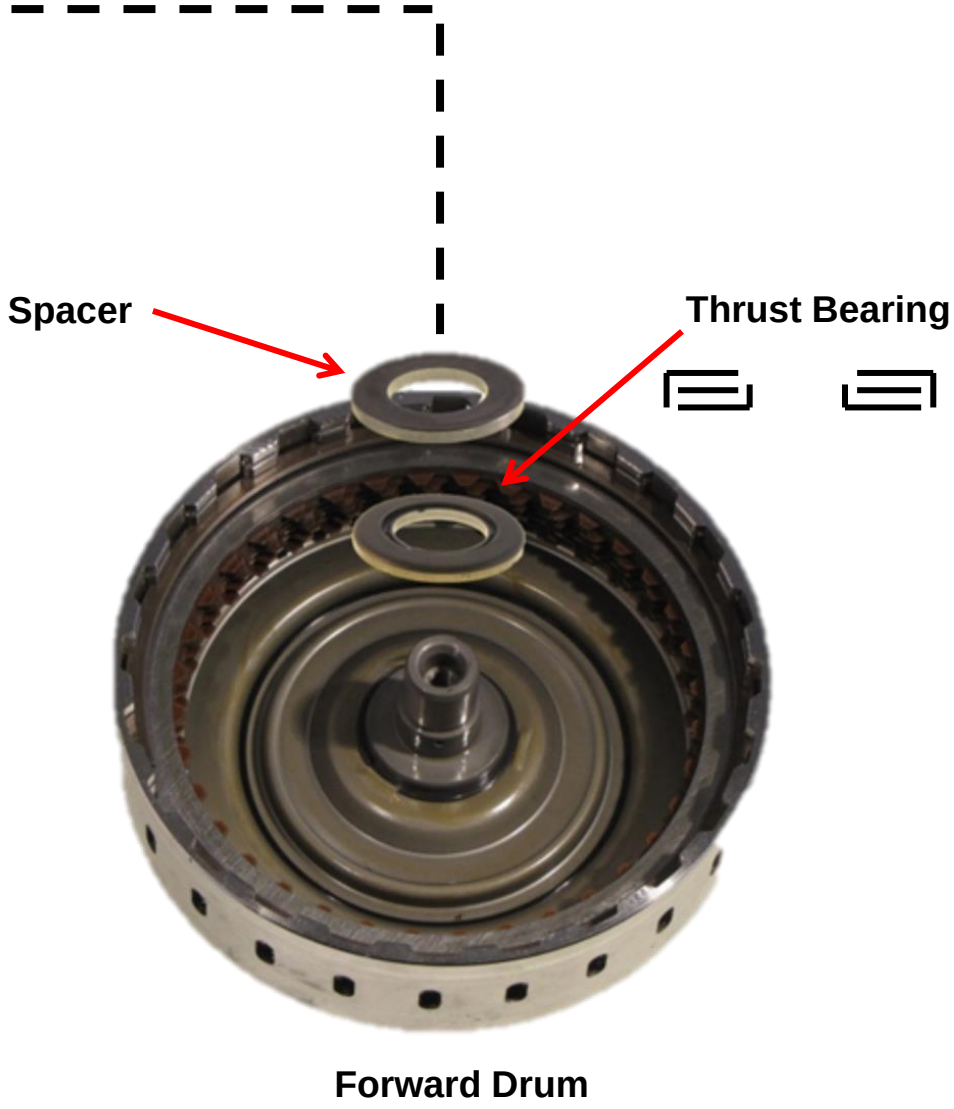
Note: During re-assemble spline the planet into the reverse clutch assembly first. Then it's much easier to rotate the forward drum with the sun gear hub and ring gear into the reverse clutch assembly.

Front view of Intermediate Case



Forward Clutch

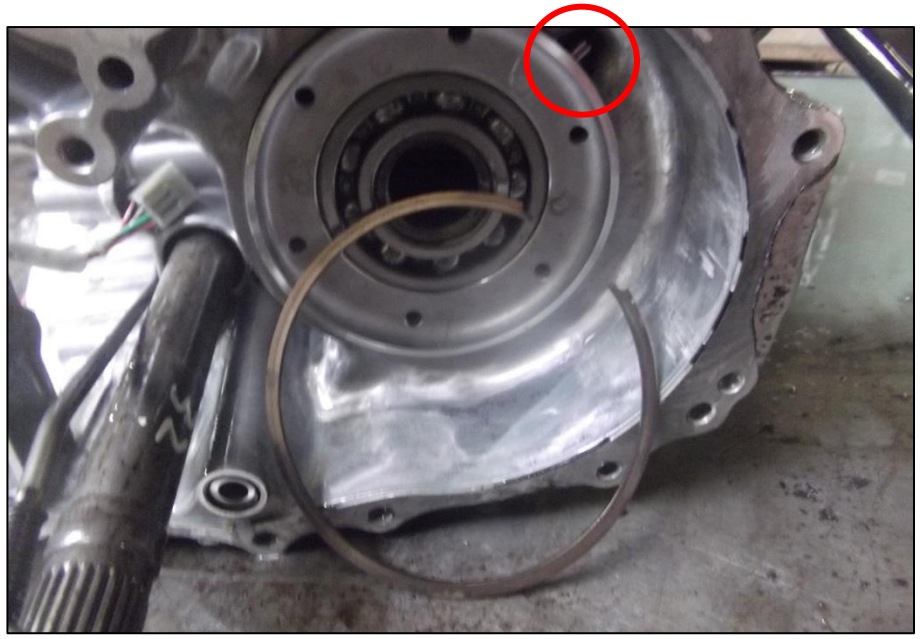




Transfer Gear Assembly

The transfer gear is located behind the forward clutch assembly. Driven by the secondary pulley and splines into the forward drum.

Stationary Dowel Pin



Rear view of Main Case

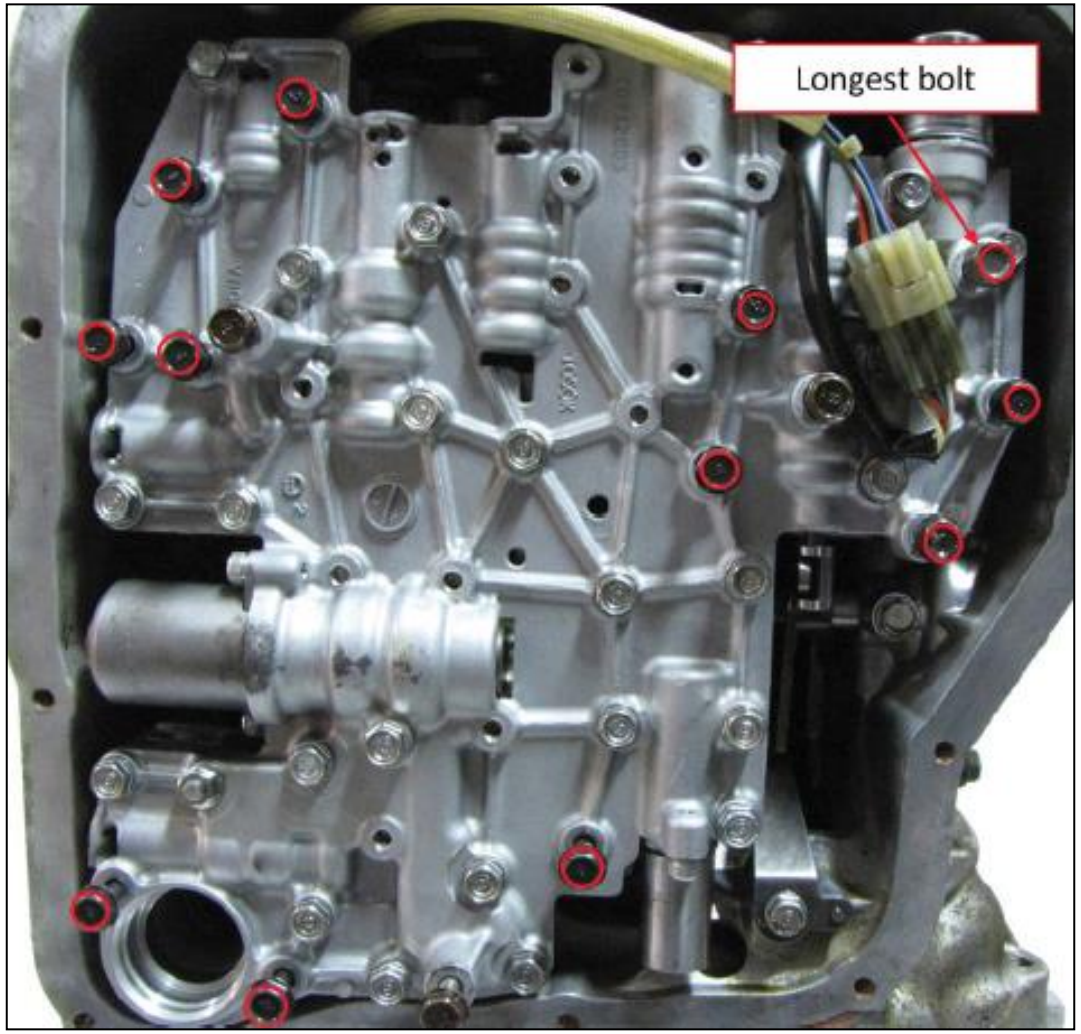
Note: Does not have to be removed to separate the main case from the bellhousing.

Valve Body

The valve body will have to be removed to get to the two feed tubes that go through the main case. Once the tubes are removed then the main case can be taken off.

Remove the pan, three filter bolts, and the filter, and disconnect the solenoid connector. Next remove twelve (12) valve body bolts.

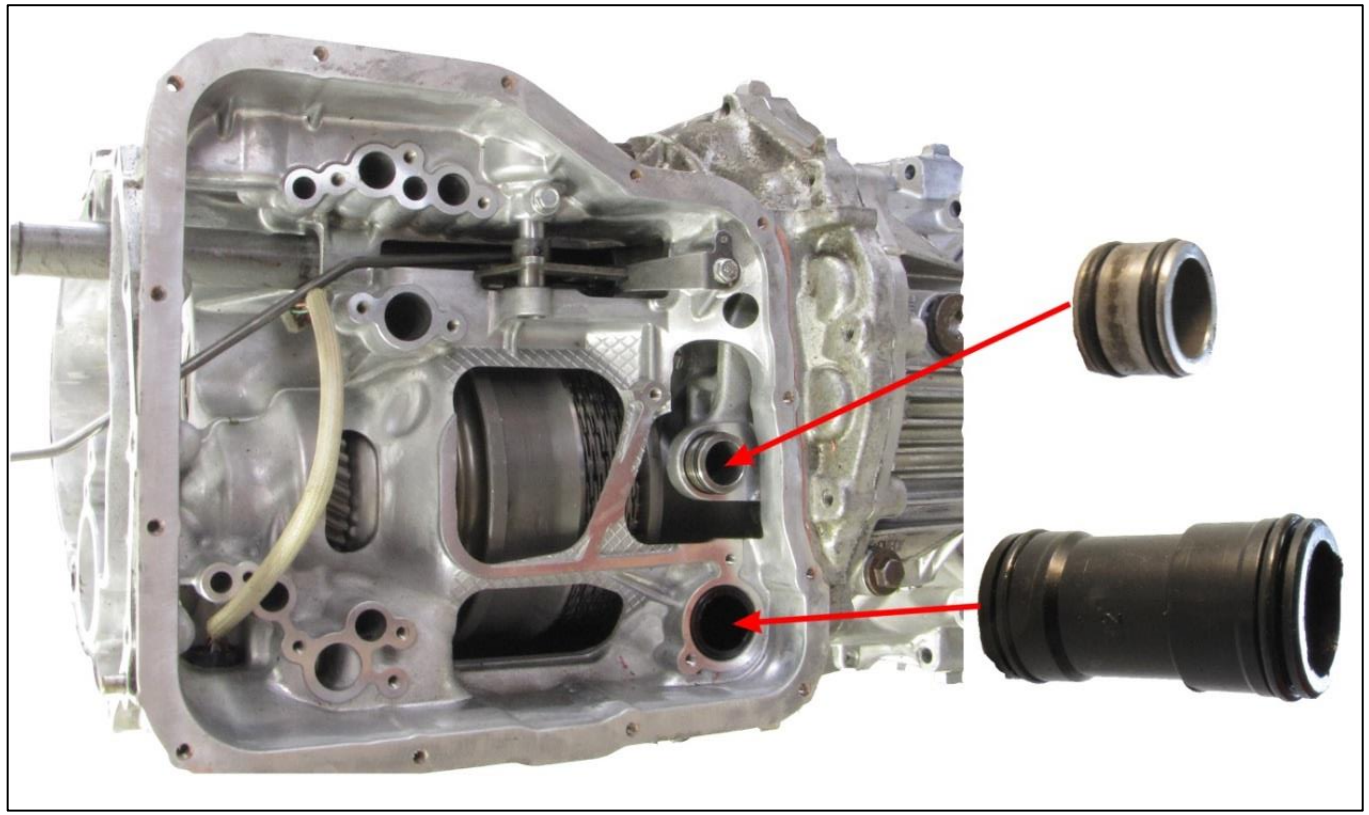
One of the bolts is longer than the others.



Case Tubes

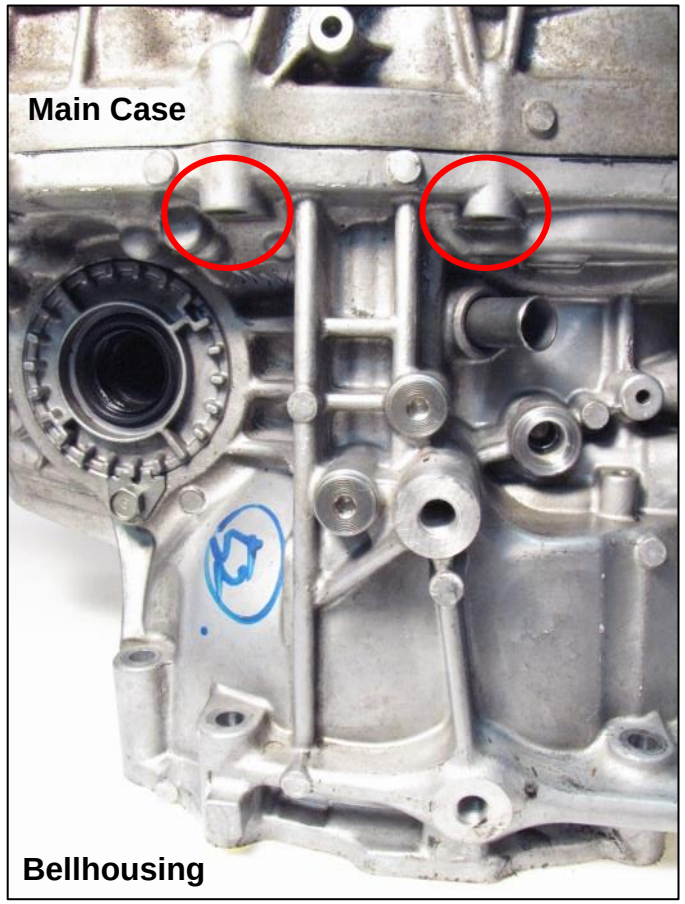
With the valve body removed, pull out the two oil pipes. The black plastic pipe is for the suction side of the pump.

The steel pipe is the pump pressure pipe. If you forget to take the tubes out, you can't lift the case half off.



Main Case / Bellhousing Removal

Now remove the case to bellhousing bolts and pry the case up off the bellhousing.



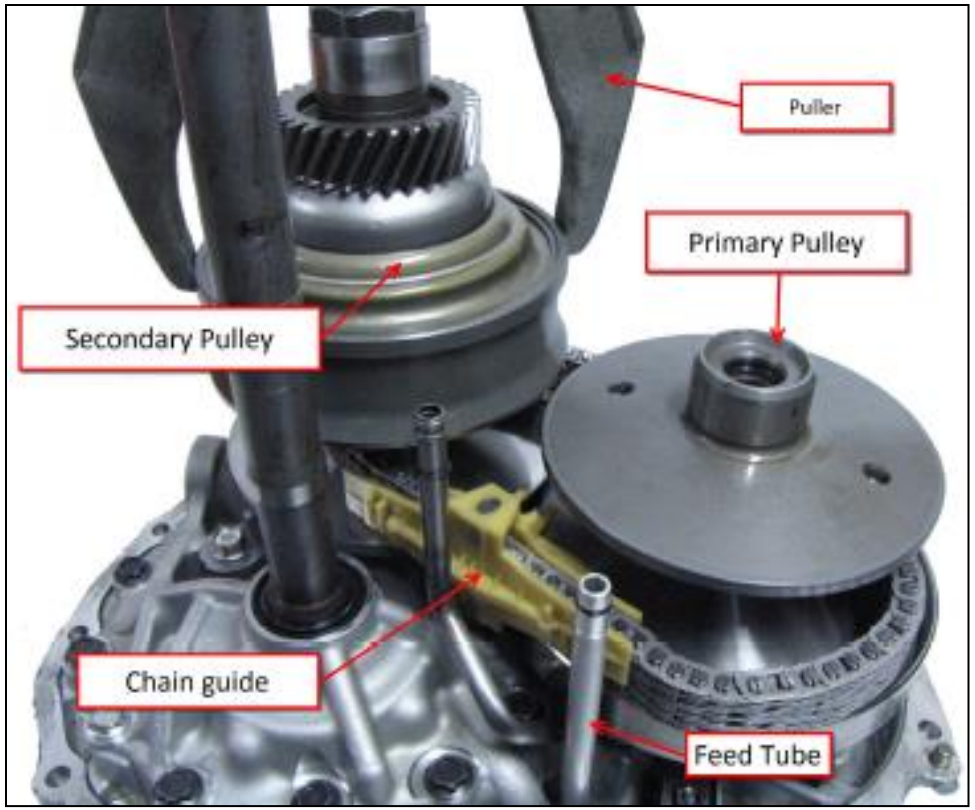
Main Case

Chain Removal

When the case is off, remove the feed tube that's about 1/2" diameter and 6" long on the passenger's side of transmission. To remove the pulleys, you'll first need to remove the chain.

CAUTION: The secondary pulley has a very large spring inside for controlling gear ratios. Be careful! This spring is strong!

To remove the chain, spread the secondary pulley: Use a large puller on the outside of the pulley. There's a ridge to pull on: Don't pull on chain pulley surface. With the puller applied the chain will be loose.



Puller is available at www.posilock.com TJ-1 Long Standard Jaws tool #11054.

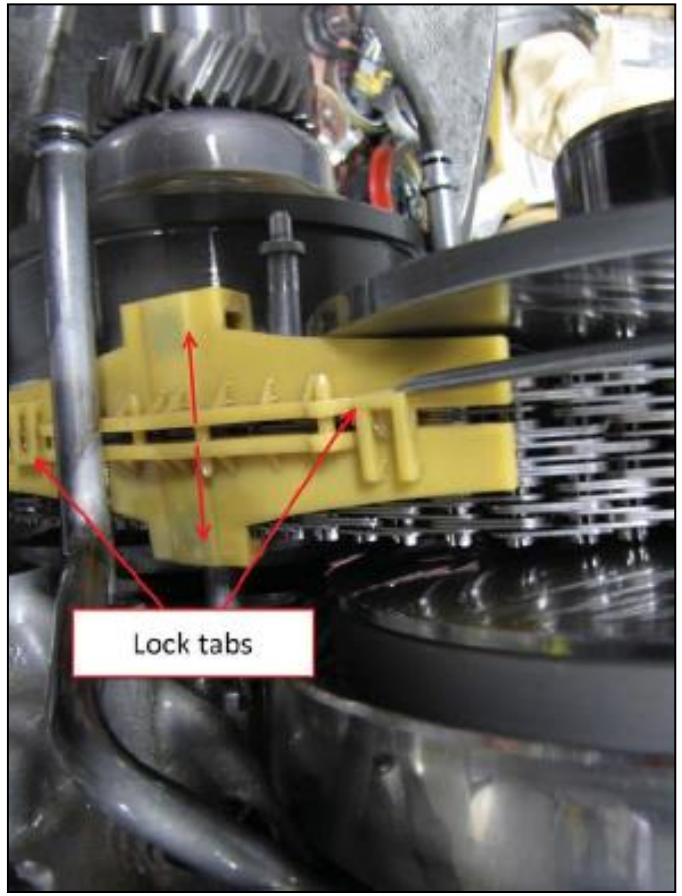
Also available at
Napa, Carquest
Sears online &
Amazon.com
approx. $342.00 List

Tool #11054

Chain Removal

With the tension off the chain, remove the two aluminum chain guide shafts. Then pull out the two locking tabs and separate the chain guides.

Now the chain is ready to come off the pulleys. This is a very important process, if the puller slips off the pulley the spring is going to slam the pulley halves together. If your fingers are between them, it may do some serious damage. Simply slide the chain over the pulley and remove it.



The front of each pulley is retained with a bracket and two bolts. The primary pulley retaining bolts have seals on the heads of the bolts, so keep track of them.

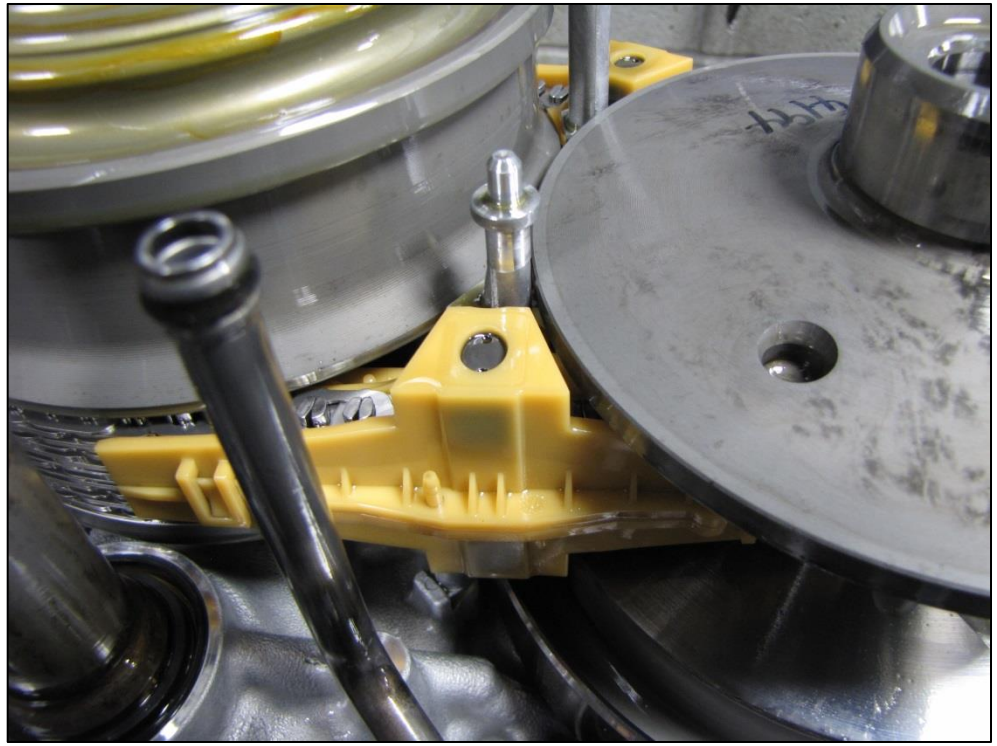
Remove the pulleys, pulling straight up on them, one at a time.

Chain Guides

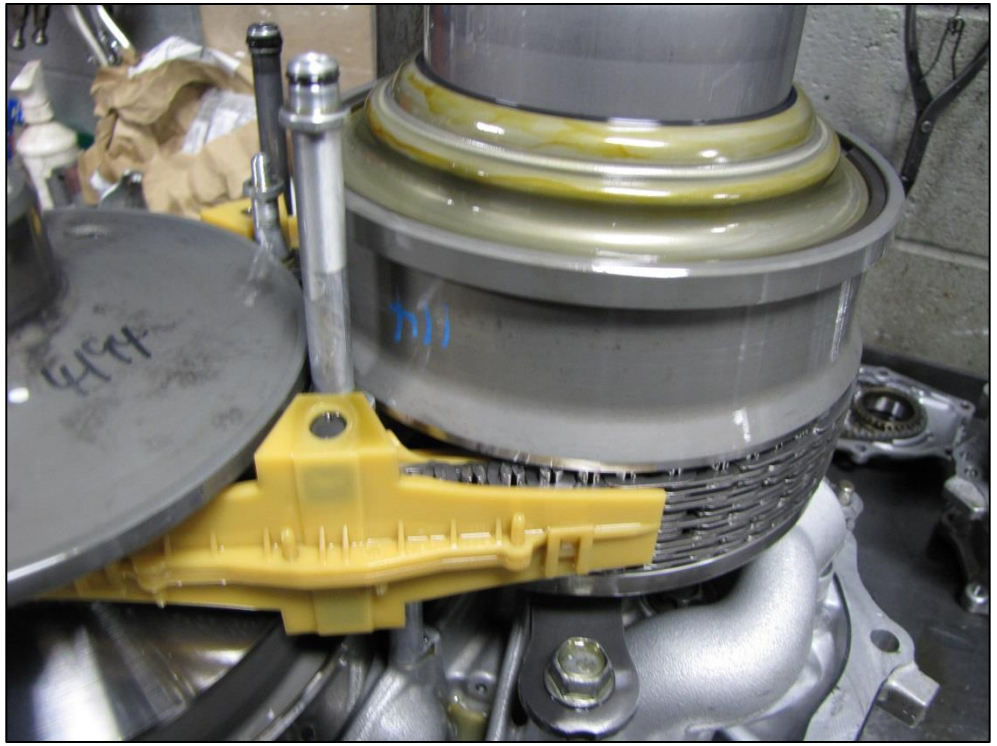
The plastic chain guides (2) are the same so you can't mix them up.

There is one plastic chain guide on each side.

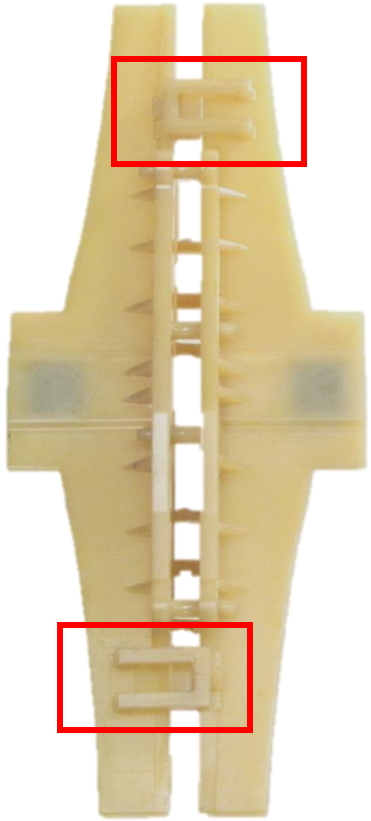
Guide Pin

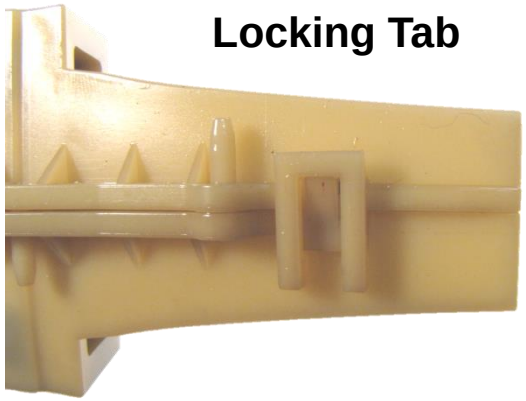


Guide Feed Tube



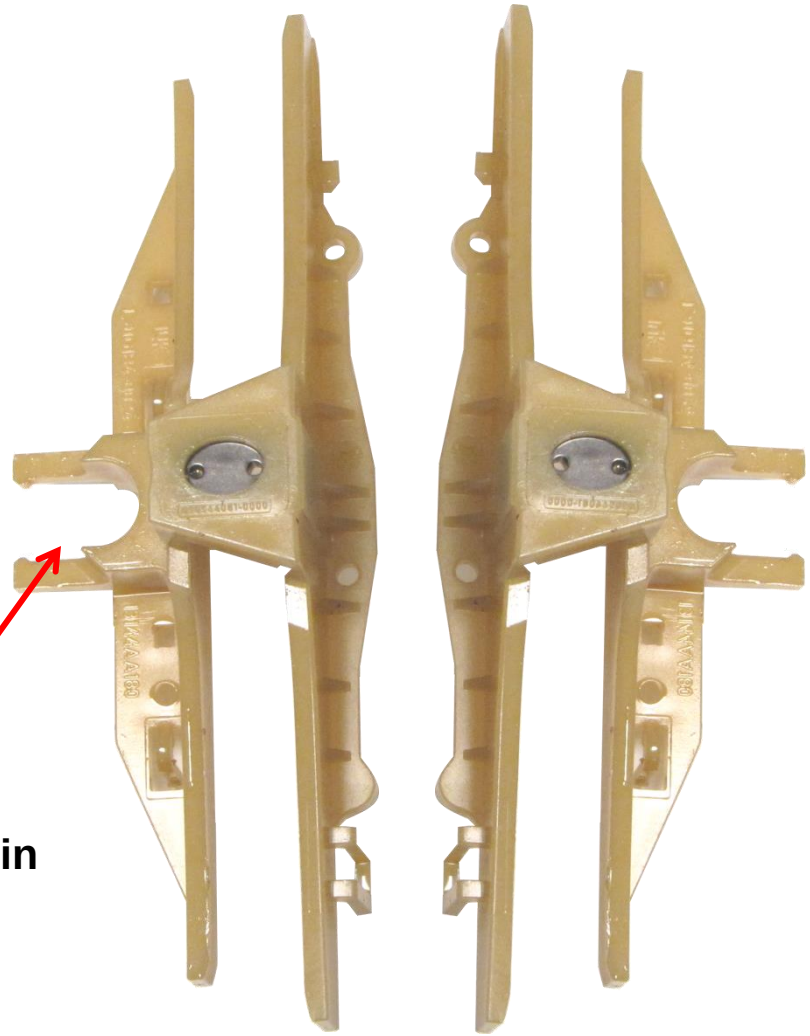
Chain Guide





Locking Tab

Tube or Guide Pin

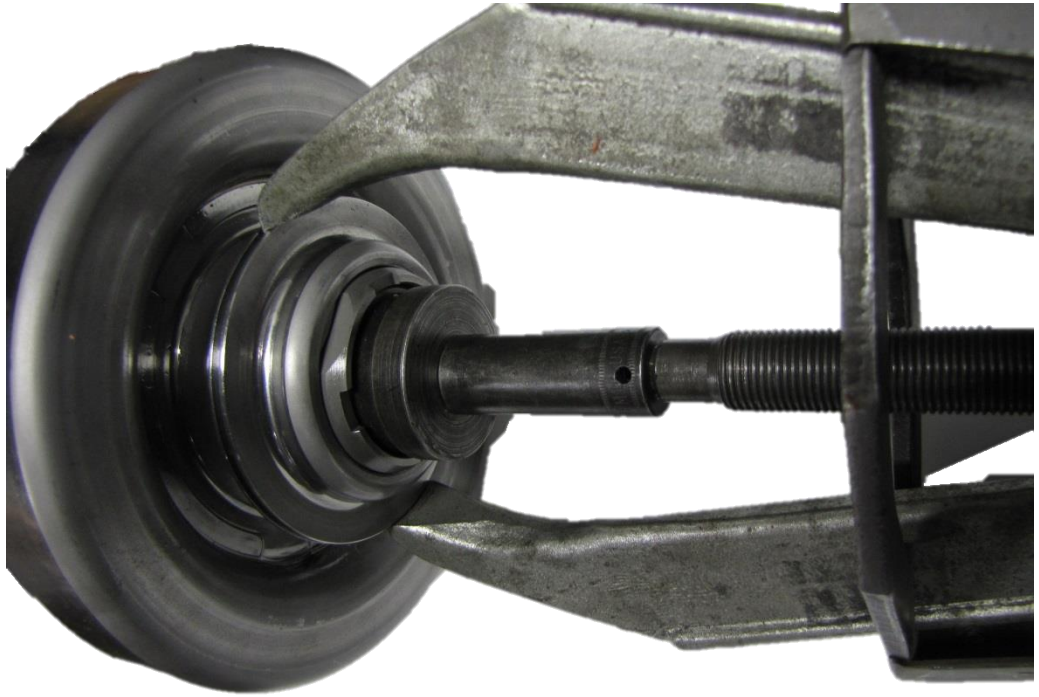


Primary Pulley Disassembly

Place the puller tool on the sealing ring groove. If the ring retainer is too tight use a gear puller under the retainer assembly.

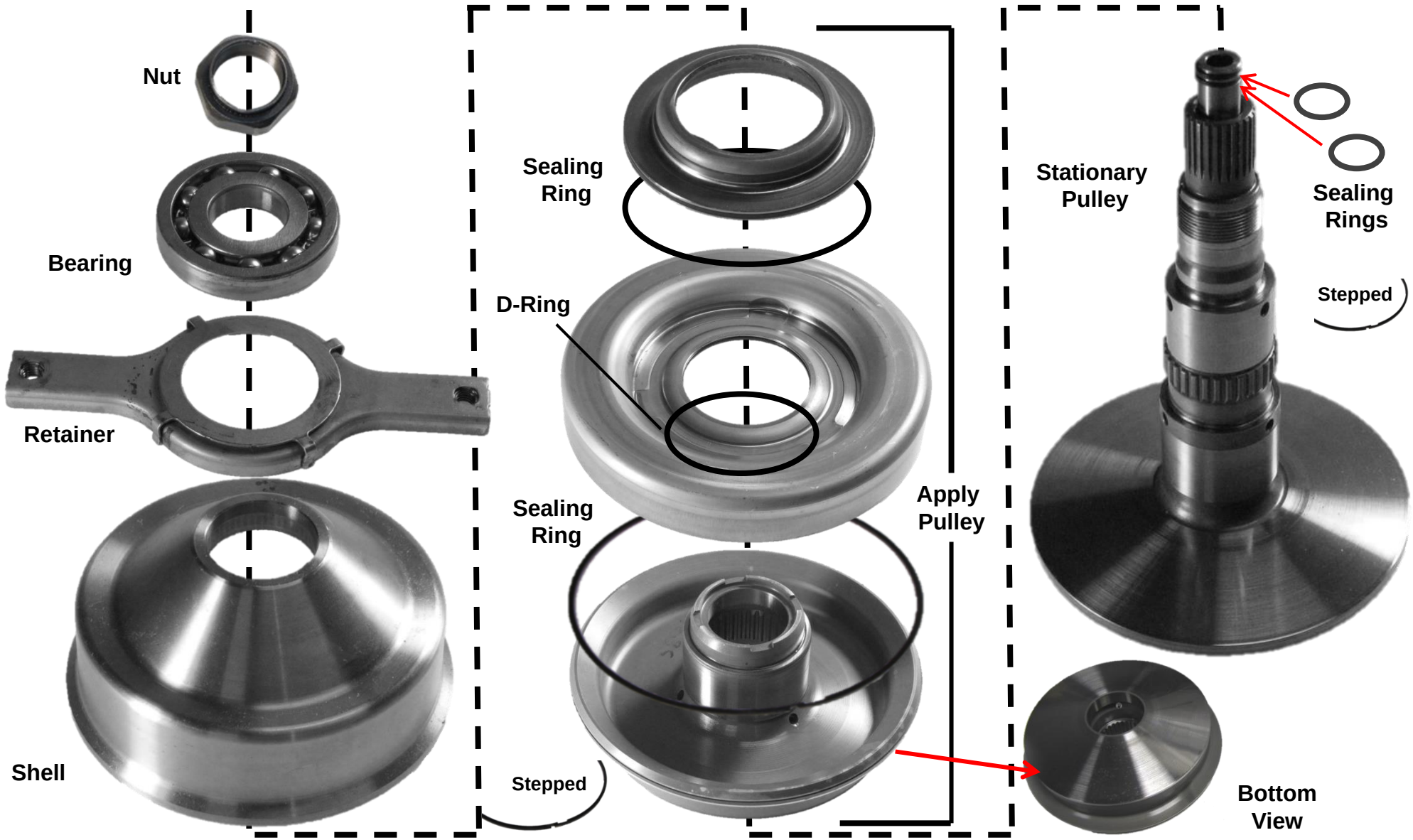
There is no spring inside this pulley assembly.

The aftermarket has not released a rebuild kit at this point in time, but the pulleys can be disassembled to see if there is damage to the seals and clean the inside of the pulleys.



Seal Aftermarket Products is in the process of creating a rebuild kit at the present time.

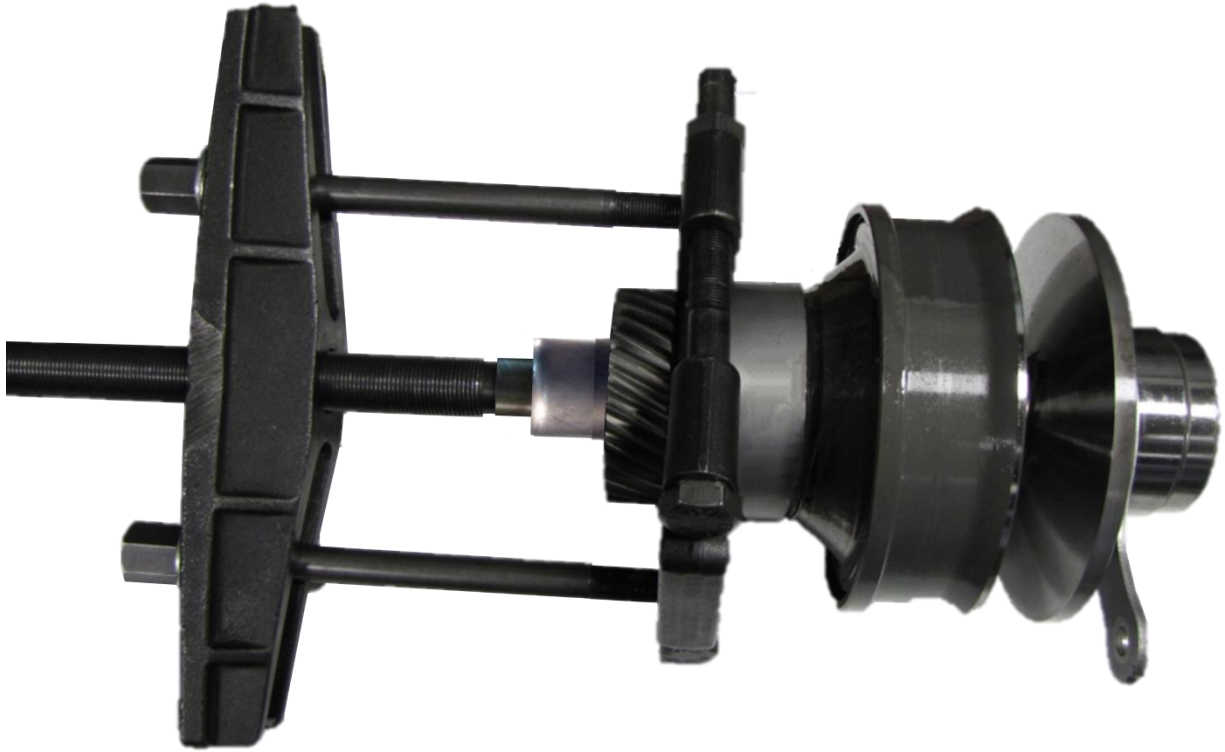
Primary Pulley Disassembly



Secondary Pulley Disassembly

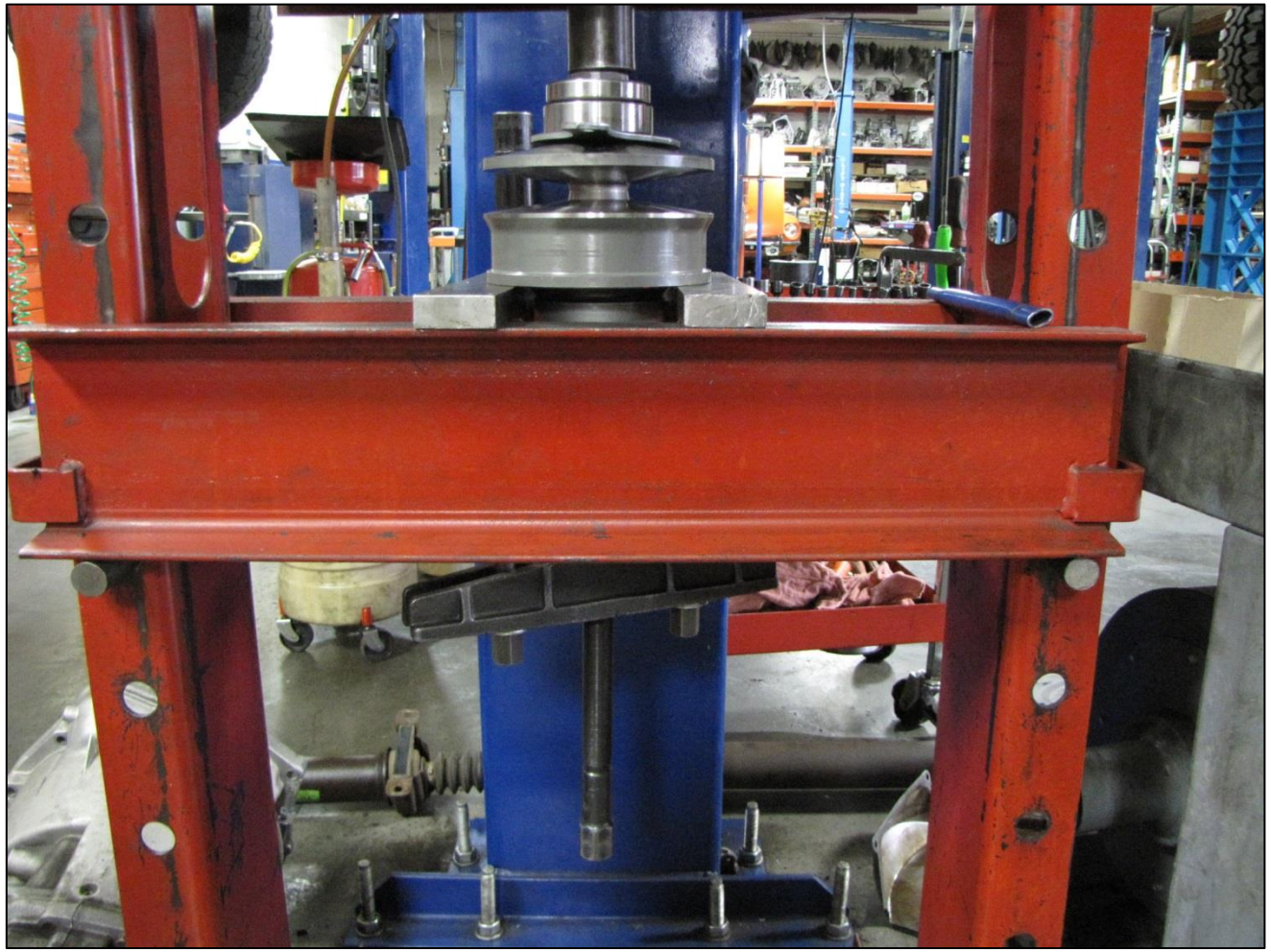
Remove the retaining nut. Install a gear pulling tool.

Care should be taken when the gear assembly comes off, the spring is extremely strong and parts will go flying.

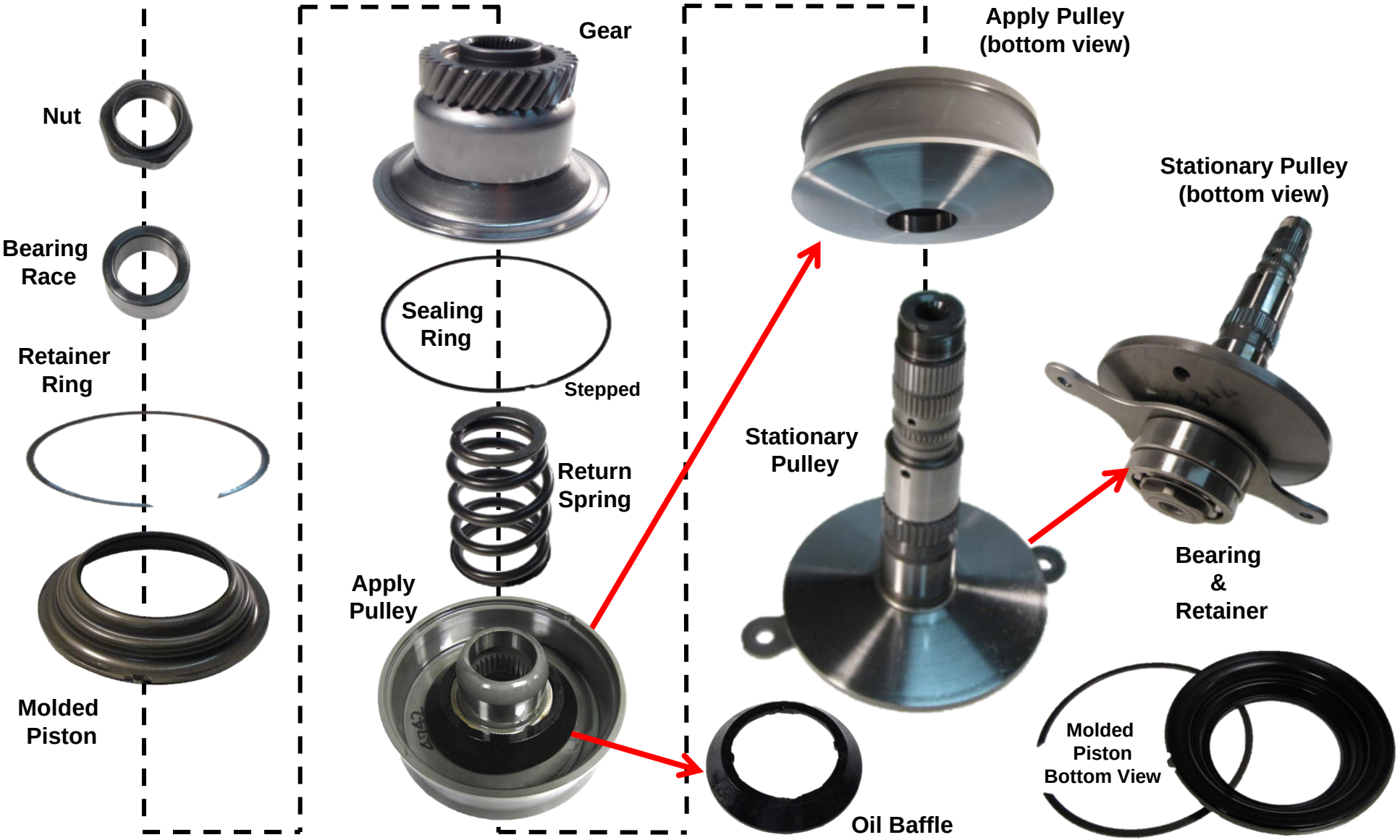


Secondary Pulley Disassembly

With the pulling tool installed; turn the assembly over and place in a press (pump the press all the way down to start with) to safely remove the gear while releasing the press to prevent the parts flying out. The press will hold the assembly together.

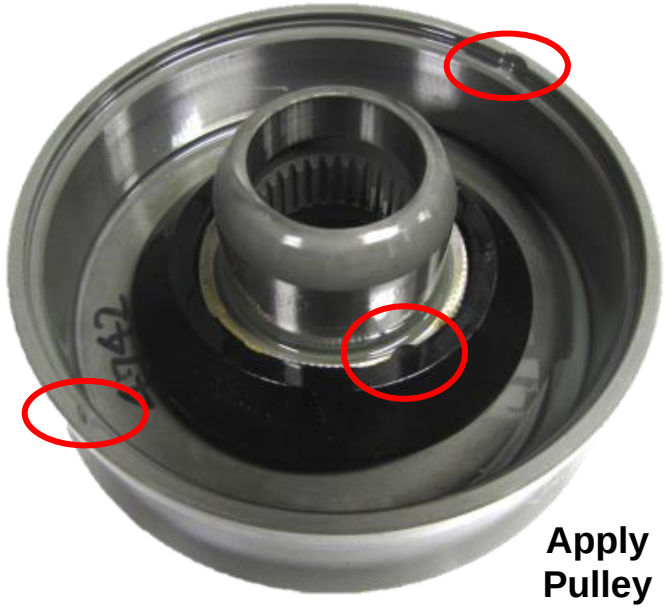


Secondary Pulley Disassembly



Secondary Pulley Assembly

Molded Piston

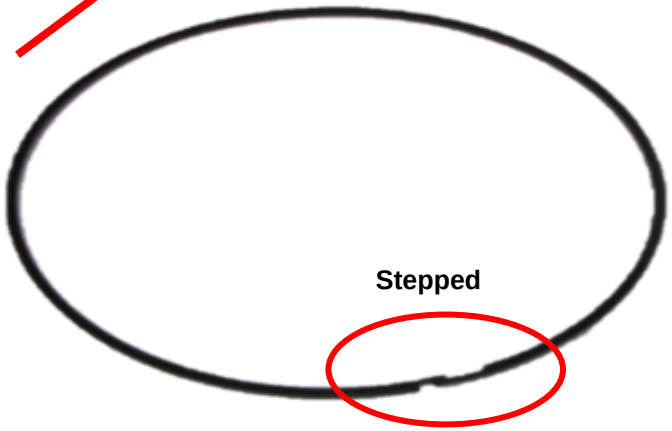


Apply Pulley

Oil Baffle

Gear

Sealing Ring

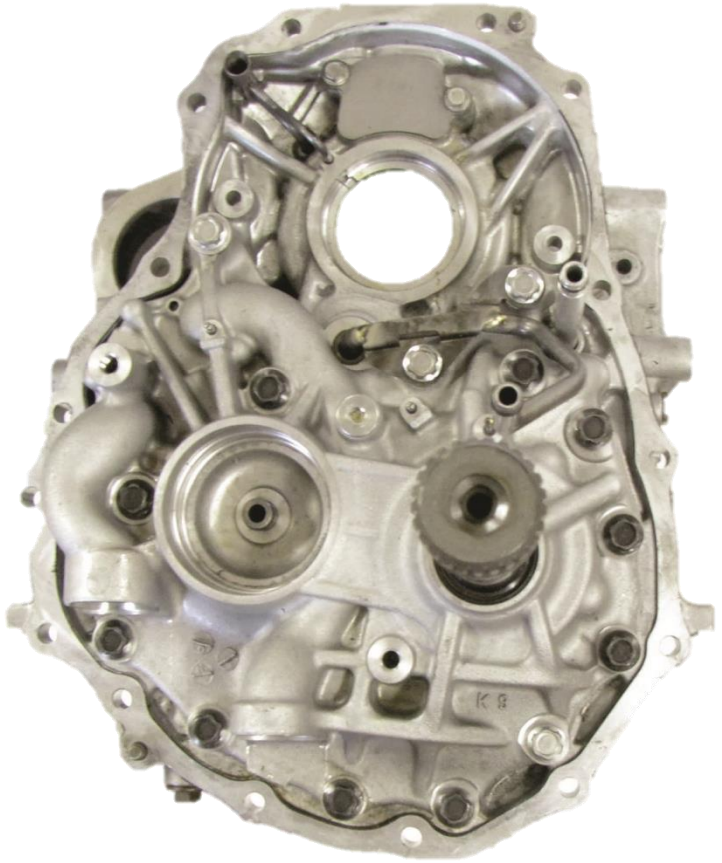


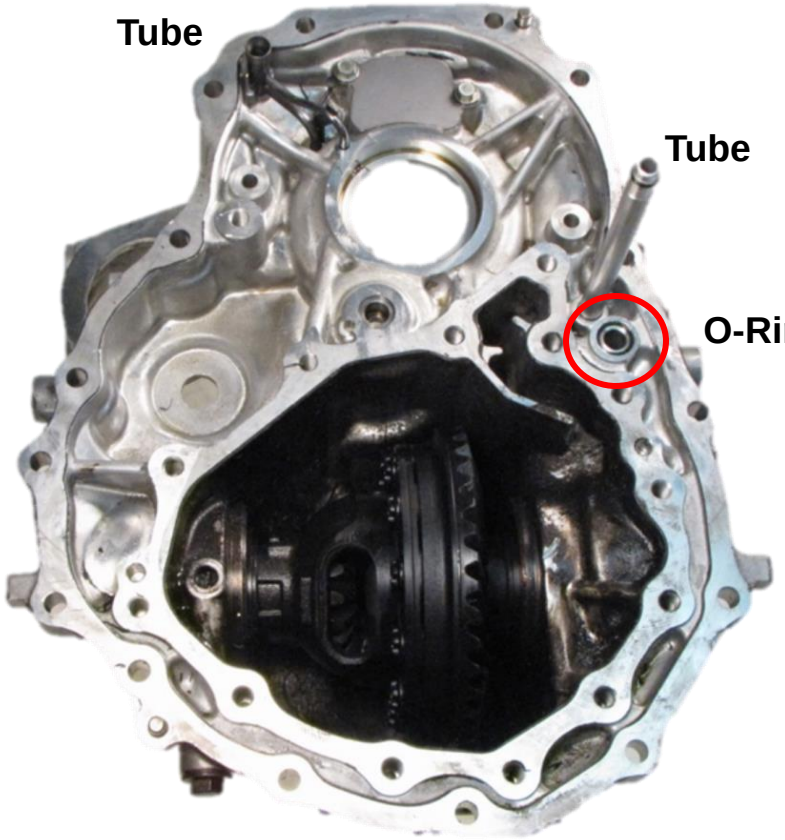
Stepped

Pinion Support

With Pulleys removed, remove the pinion support bolts and remove the support to reach the front differential for inspection.

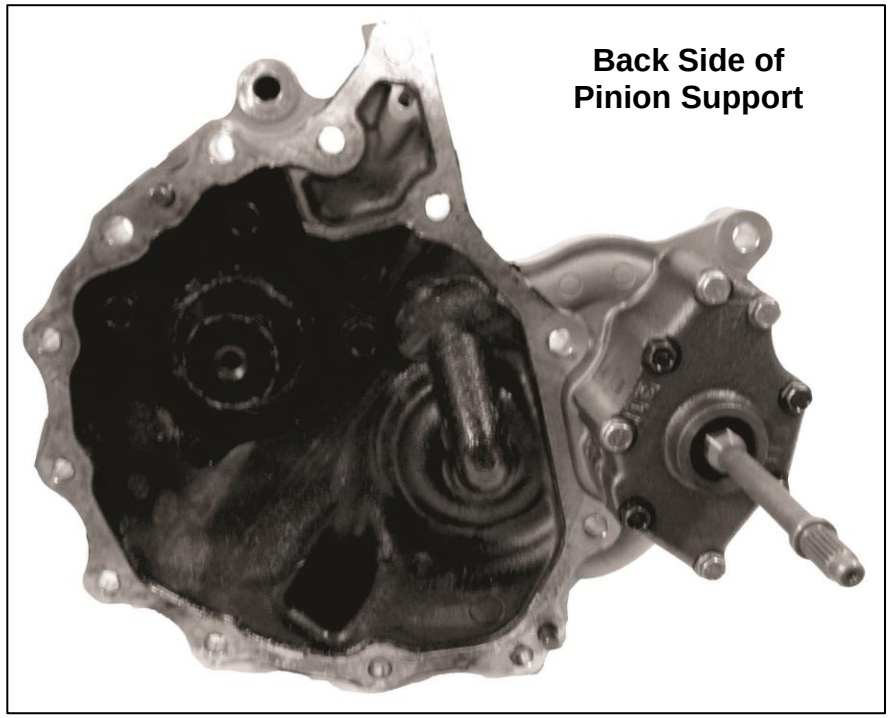
The differential is set up just like other Subaru transmissions. One thing that's different is the pump is attached to the support and there are oil passages for the oil pump.

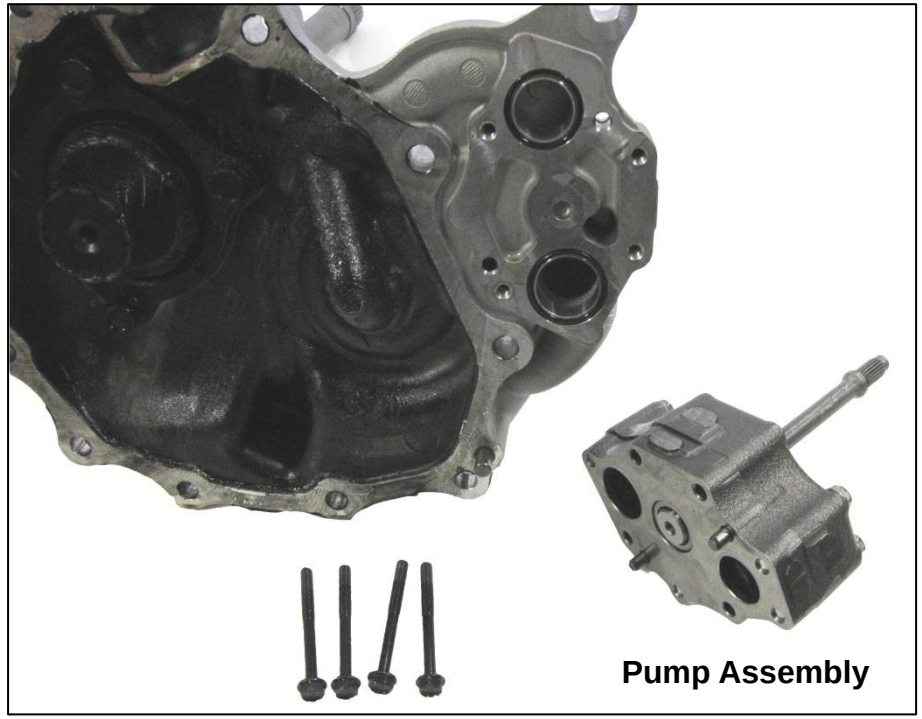




Pump Assembly

To remove the pump from housing and inspect it for wear or damage, just the 4 dark colored bolts need to be removed.

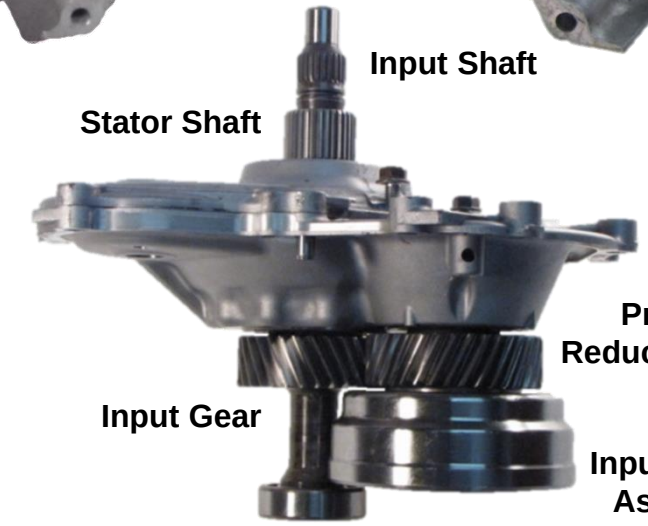




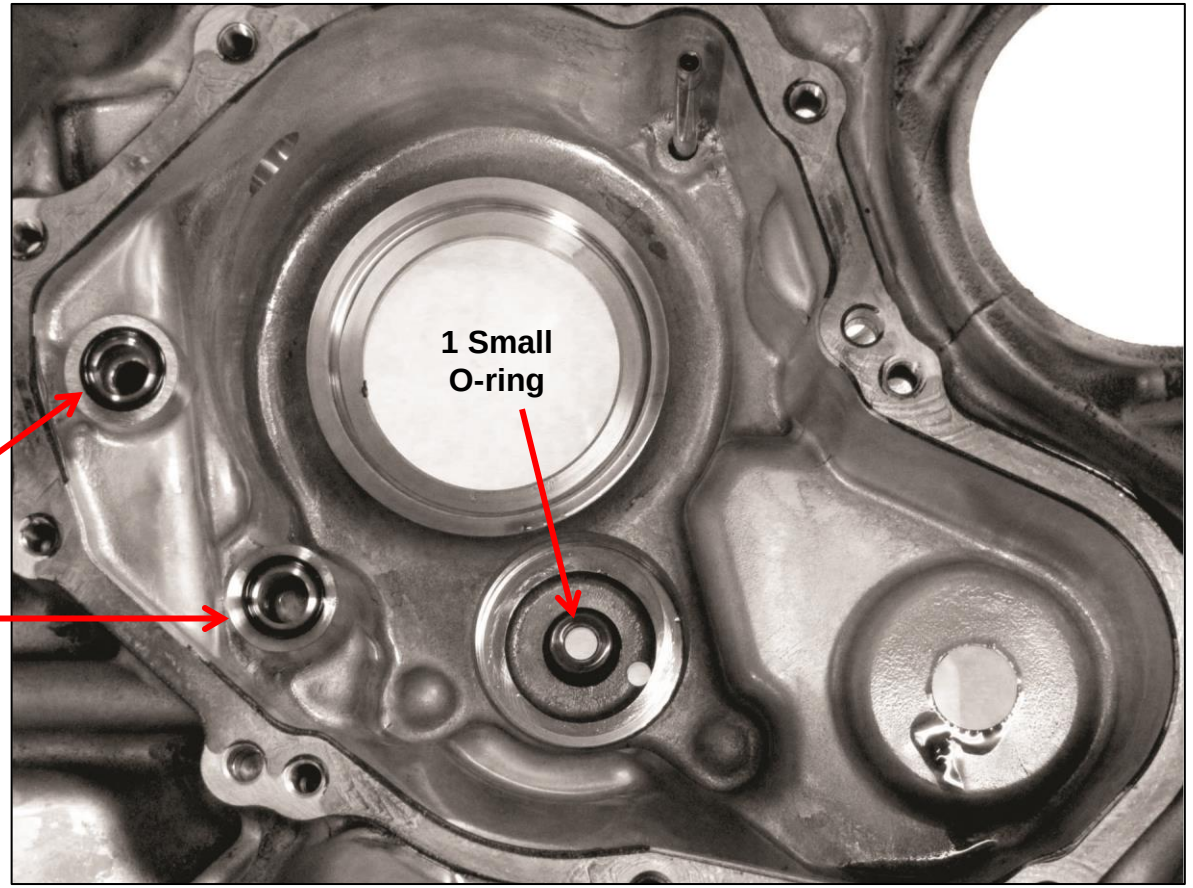
Pump Assembly

Bellhousing Disassembly

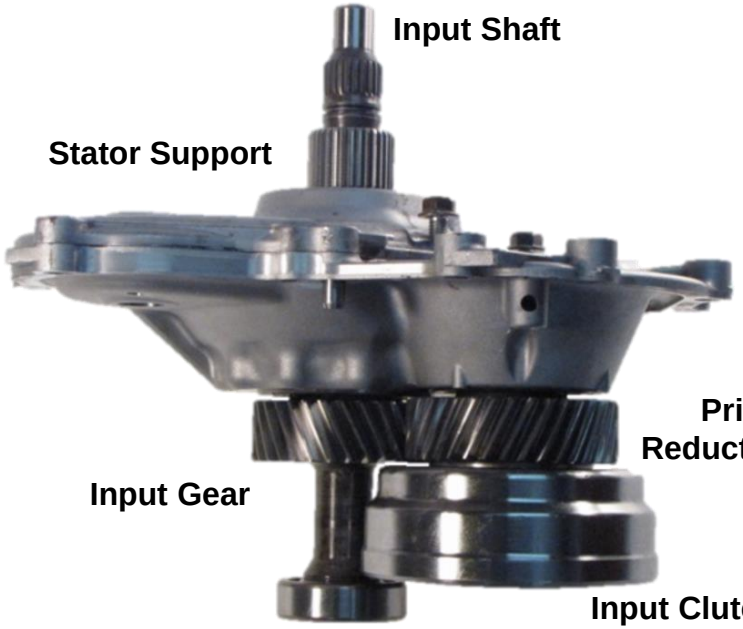
Put the bellhousing on its side and tap the input clutch assembly out of the hole that the primary pulley was splined into. It should come out the front as one assembly.

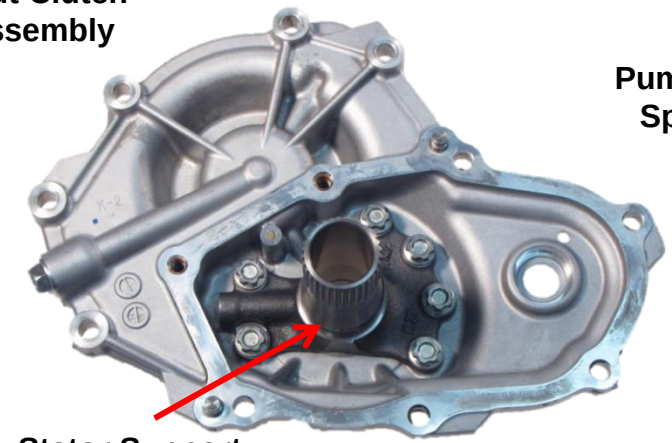


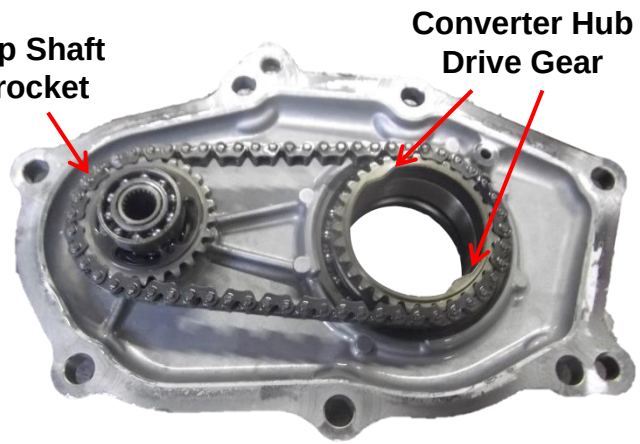
Bellhousing Disassembly



Input Clutch Disassembly







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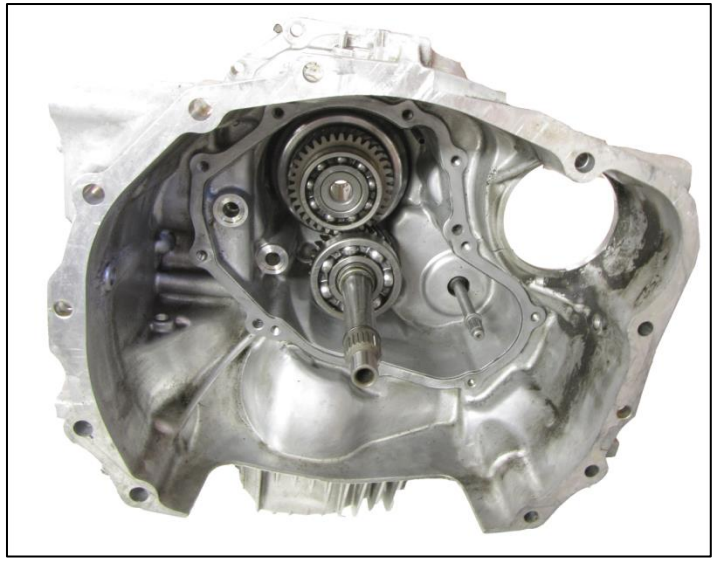
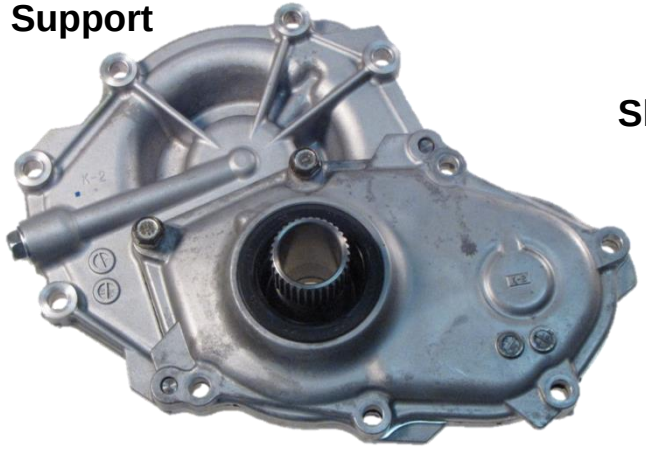
Input Clutch Disassembly

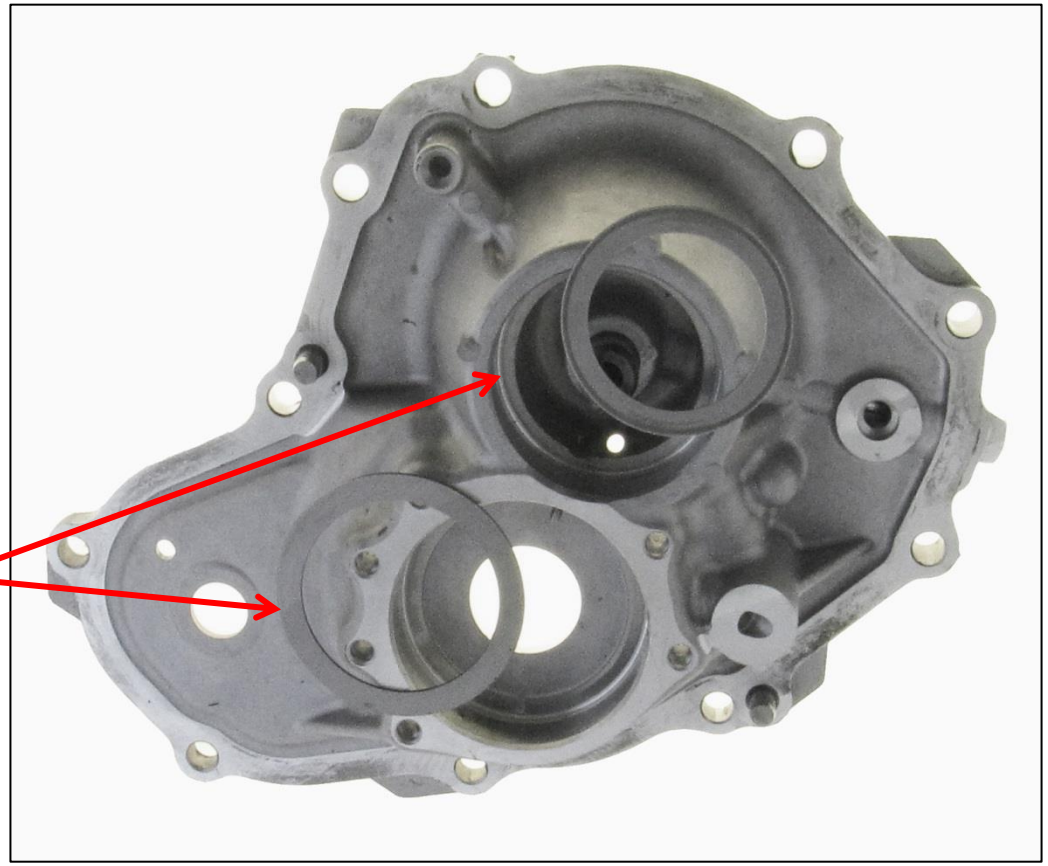


Stator Support

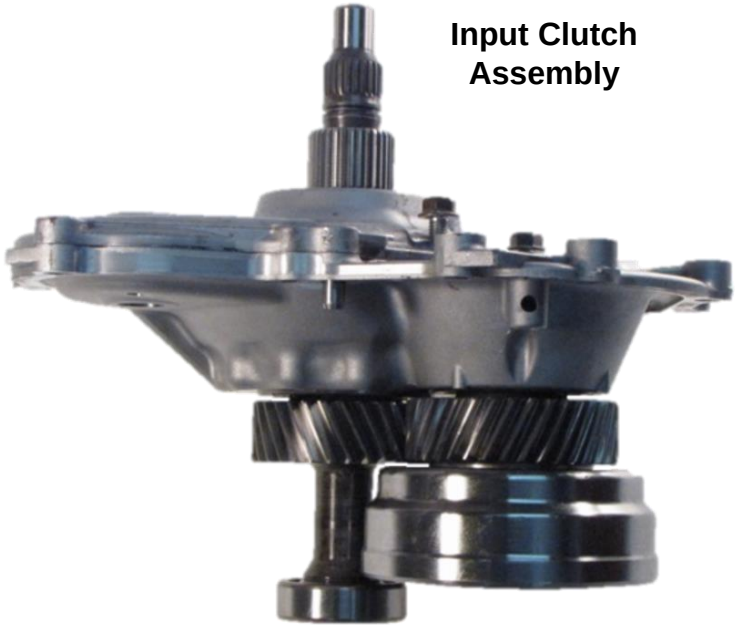


Back Side of Stator Support

Shims



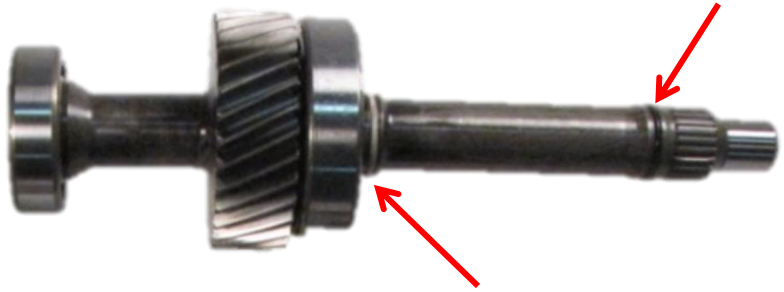
Input Clutch Assembly



Input Clutch Assembly

Input Shaft

O-Ring



Sealing Ring (white)

Input Clutch Drum

Primary Reduction Gear

Turns Free Until Clutch Is Applied

Bearing

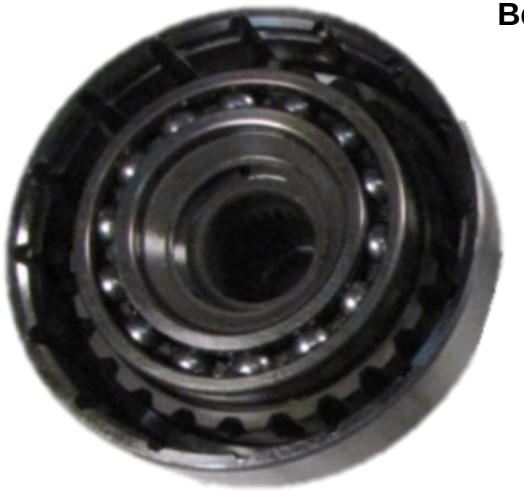
Input Clutch Hub

Input Clutch Assembly

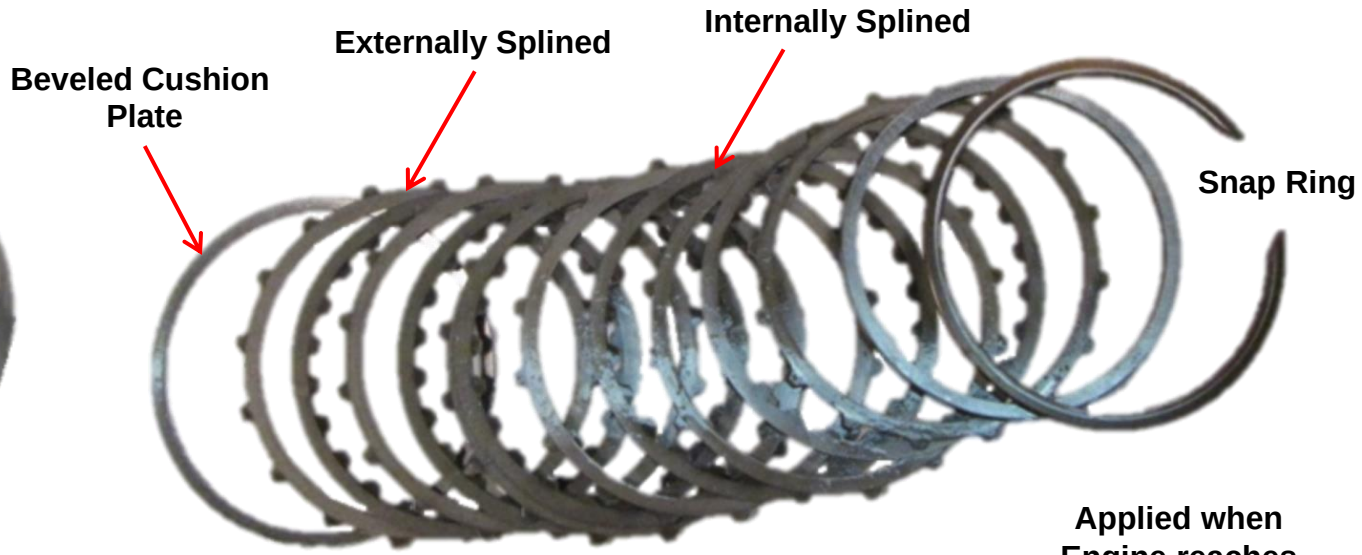
To inspect the input clutch, remove the snap ring and pull the clutch plates out. To remove the pistons from the drum, pull the bearing off the front of the drum and remove the clutch hub.

The input clutch is different because the plates are all steel. There's no clutch material on the steels. This clutch is applied whenever the engine reaches 400 RPM.

The input clutch stack up starts with the small diameter of the beveled cushion plate against the piston. Next install an externally splined steel plate, then an internally splined steel plate; keep alternating until you've installed six externally splined plates and five internally splined plates. Top it off with a pressure plate and snap ring. The input clutch clearance should be 0.094" - 0.110" (2.4 - 2.8 mm).



Input Drum



Input Clutch
(No Friction Material)

Applied when Engine reaches 400 RPM

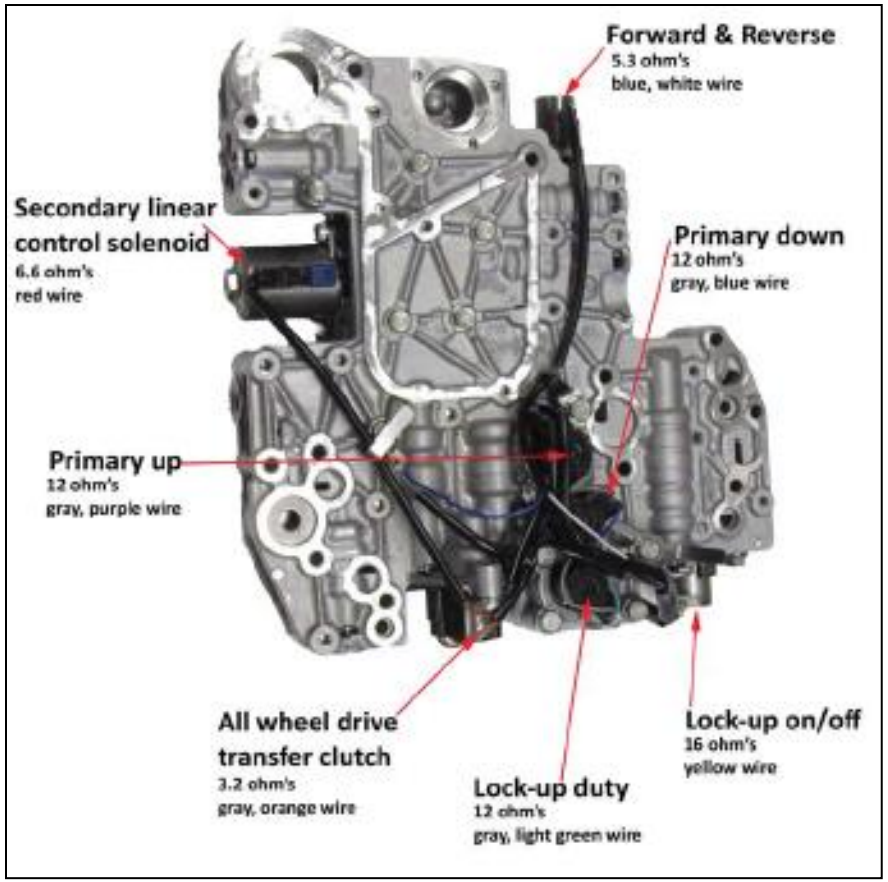
Solenoid Identification

The Subaru Lineartronic uses seven solenoids to control its operation:

- **Secondary Linear Control 6.6 Ohms**
- **Lockup On/Off 16 Ohms**
- **Lockup Duty 12 Ohms**
- **Primary-Up 12 Ohms**
- **Primary-Down 12 Ohms**
- **Forward/Reverse Linear 5.3 Ohms**
- **AWD Transfer Case Clutch 3.2 Ohms**

All of the solenoids are feed-controlled by the TCM and grounded at the valve body. The secondary linear control solenoid and forward/reverse solenoid are linear-style solenoids. The lockup duty, primary-up, primary- down and all wheel drive transfer clutch solenoids are PWM-controlled solenoids. The Primary Up, Down & LU Duty solenoids are normally closed and are fully interchangeable. The lockup on/off solenoid is the only on/off style solenoid in the unit, it's normally closed.

When disassembling the valve body, pay close attention to the solenoid wires, including the solenoid grounds attached to the valve body bolts. If these wires are loose or have bad connections, the TCM will set solenoid codes.



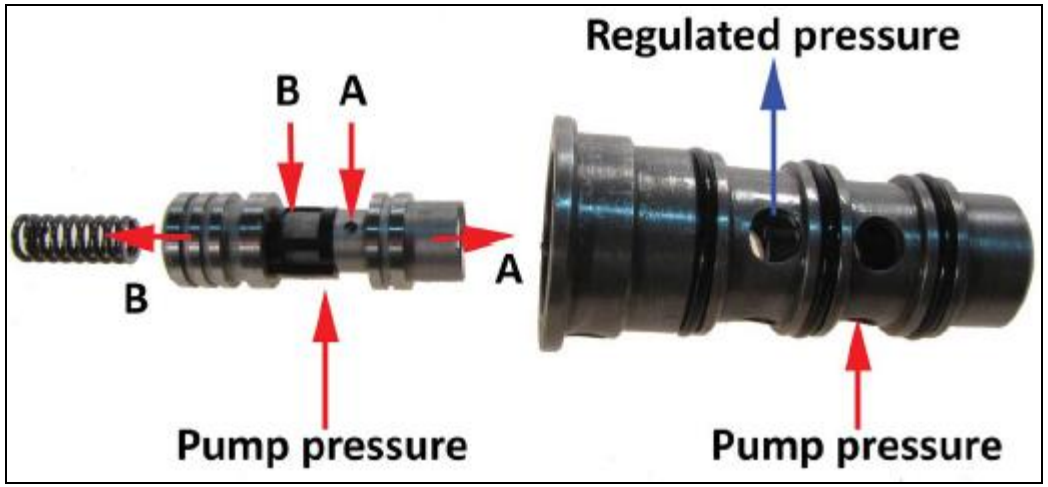
Solenoid Function

Secondary Linear Control; controls pressure to the pulleys to keep the chain tight enough that it doesn't slip. Secondary pressure can be as high as 900 PSI. The main regulator for this transmission is built into the snout of this solenoid.

Pump pressure enters the end port of the solenoid snout. We've removed the valve from the snout to show orifices A and B. Orifice B is behind the screen on the valve. The pressure regulation spring controls base line pressure. There are two balance orifices built into the valve. Orifice A is the balance orifice for main regulation, and keeps the valve balanced, much like most normal pressure regulator valves.

Orifice B is controlled by the solenoid. The solenoid acts on a needle and seat that opens or seals this orifice to control the position of the pressure regulator valve. The secondary linear control solenoid operates at 2000 Hz. This is very fast, which keeps the control pressure smooth.

If a problem occurs with the secondary linear solenoid, the TCM will shut the signal off and the transmission line pressure will rise to maximum. This will cause harsh forward and reverse engagements and no lockup. The transmission will continue to adjust gear ratios normally.



Solenoid Function

Lockup On/Off
This solenoid controls the TCC control valve and the direction of oil through the torque converter. A problem with this solenoid or its control signal will inhibit lockup. The transmission will continue to adjust gear ratios normally.

Lockup Duty
This solenoid controls the lockup boost valve and regulator valve as it controls the pressure in the torque converter clutch circuit. The lockup on/off solenoid has to be commanded on before this solenoid will operate. A fault with this solenoid or its control signal will inhibit lockup. The transmission will continue to adjust gear ratios normally.

Primary-Up
This solenoid controls the primary-up control valve, which increases primary pressure in the ratio chamber of the primary pulley. The increased pressure in ratio chamber squeezes the pulley together and forces the chain to ride higher in the pulley. That increases the ratio {toward overdrive) of the transmission. A fault in this solenoid or circuit will prevent the transmission from changing ratios.

Primary-Down
This solenoid controls the primary-down control valve, which releases primary pressure in the ratio chamber of the primary pulley. That opens the primary pulley, which allows the chain to ride deeper in the pulley. This lowers the transmission ratio. A fault in this solenoid or circuit will keep transmission ratio high.

Solenoid Function

Forward/Reverse Linear
This solenoid controls the forward/reverse control valves and engagement feel. If this solenoid or circuit fails, pressure will rise to maximum levels, which will cause harsh engagements. The transmission will continue to adjust gear ratios normally.

All Wheel Drive Transfer Case Clutch
This is a linear solenoid that controls the AWD control valve, which operates the transfer case clutch. This clutch powers the rear differential when the TCM identifies wheel slip in the front wheels. The TCM identifies wheel slip by monitoring wheel speed and transmission output speed. If this solenoid or circuit fails, all torque to drive the vehicle will come from the front wheels; the rear differential won't operate. The transmission will continue to adjust gear ratios normally.

If any solenoid or solenoid circuit fails, the AT Temp light will flash and store a code in the system. The system will reset and test the system again on next key cycle. If the system cuts power to the transmission, it'll take off in a higher gear. It'll feel like the transmission is slipping and there'll be no power on takeoff.

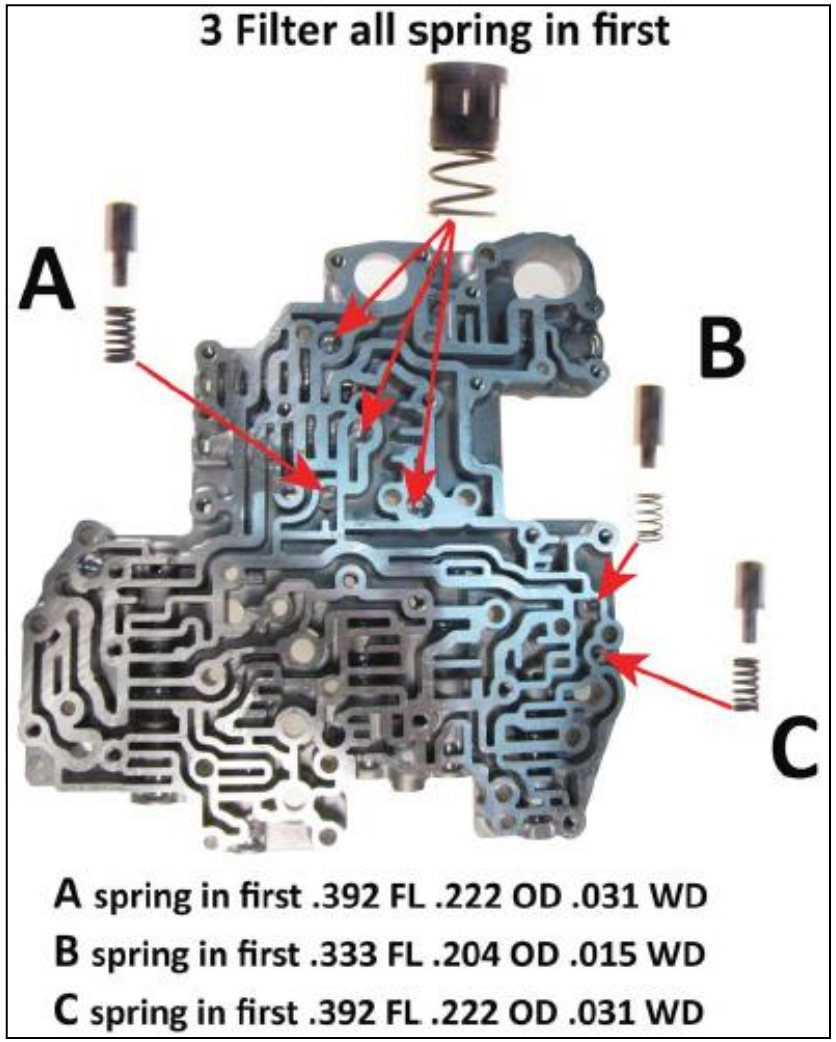
Valve Body

Remove the solenoids and separate the valve body. Keep the separator plate against the upper valve body, because all of the small parts are in the upper half.

In the upper half of the valve body you'll see three check valves, each with its own spring. There are also three (3) filters with springs.

One of the springs is different from the others, so pay attention to which spring went where. The springs go into the valve body first, then the check valve.

<u>There are no check balls in this valve body.</u>

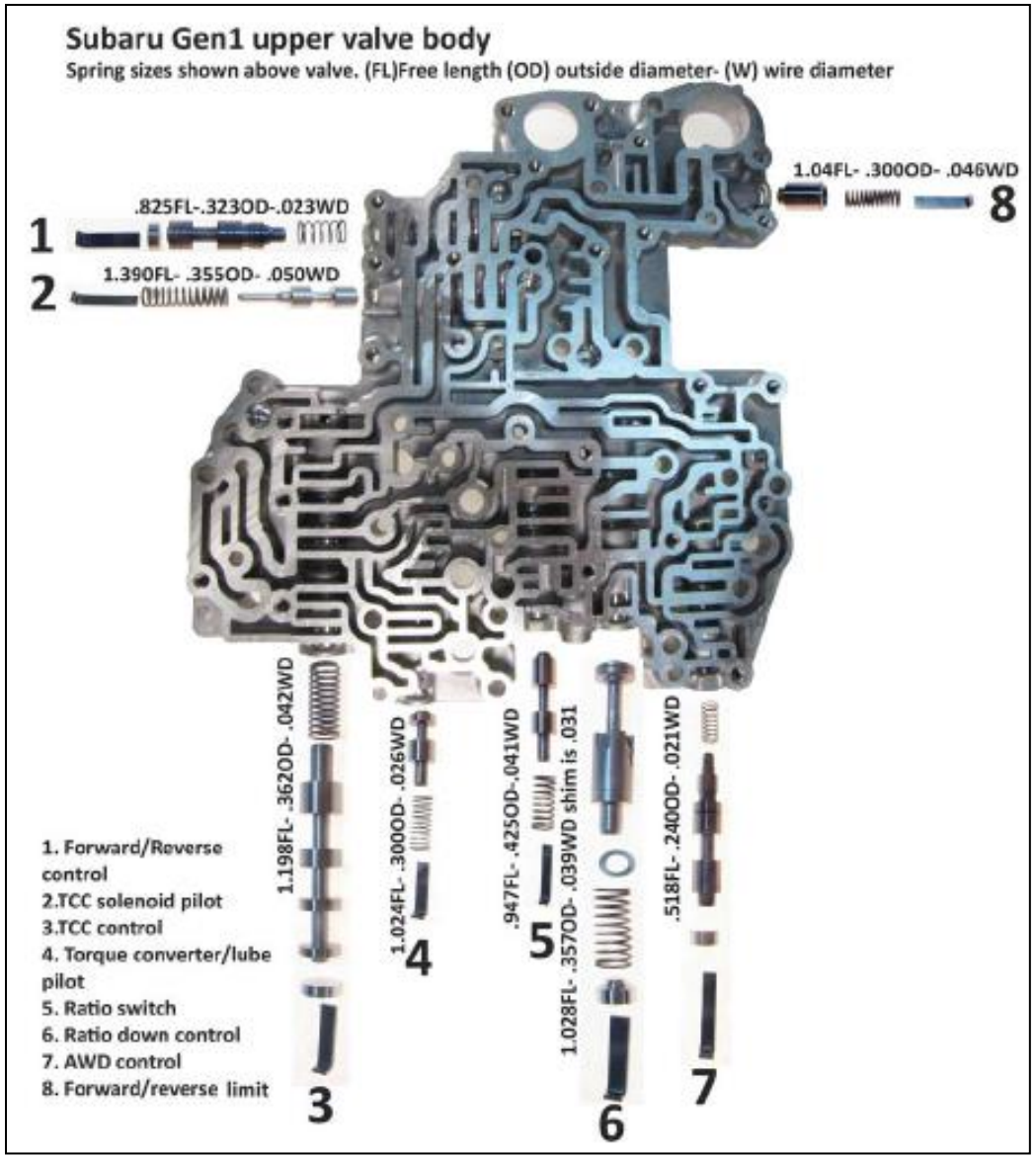


Valve Body

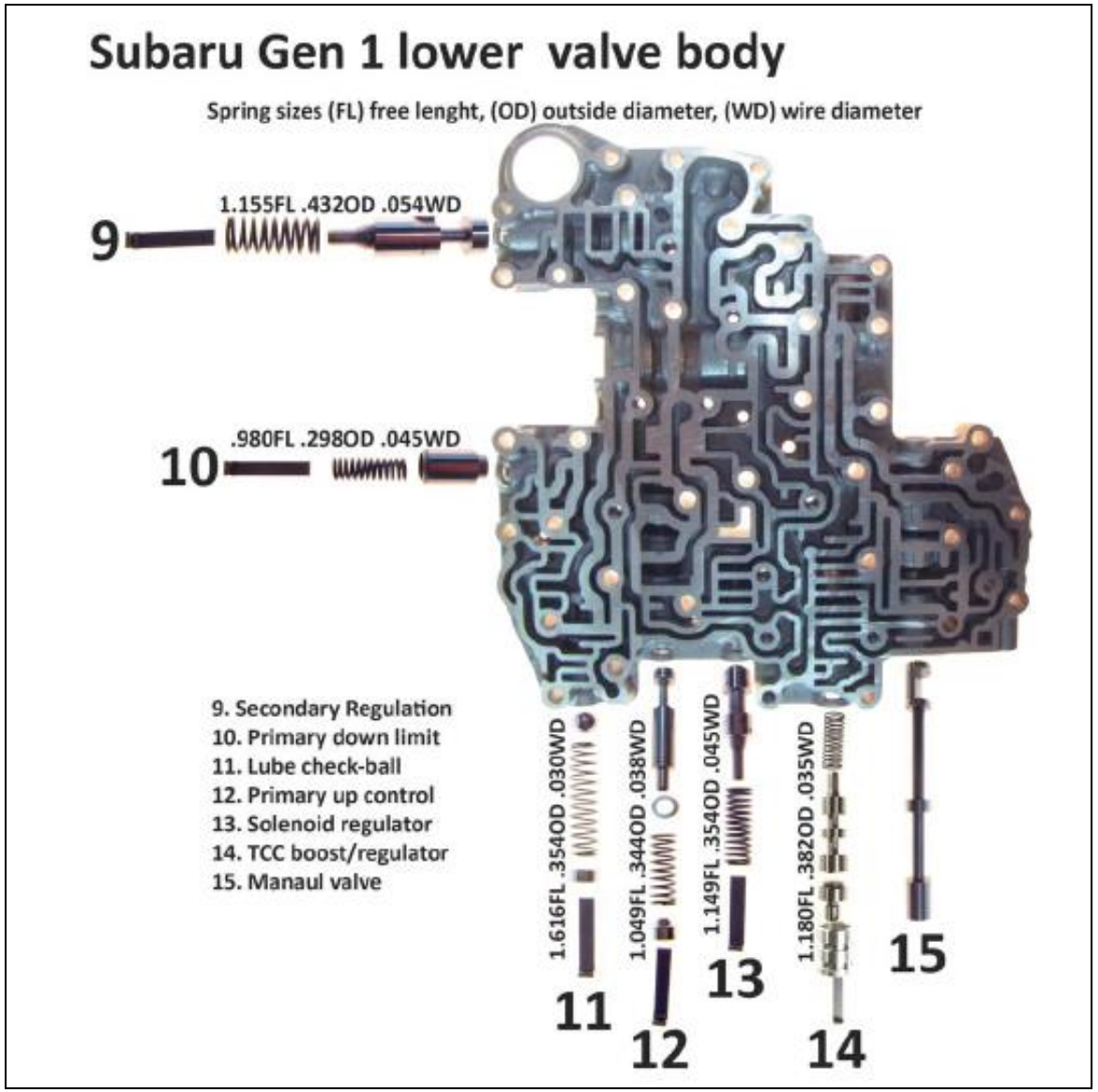
Subaru doesn't provide valve body information on valve names or the layout.

The valve body is sold as one piece with solenoids.

The valves are identified by what they control or their function.



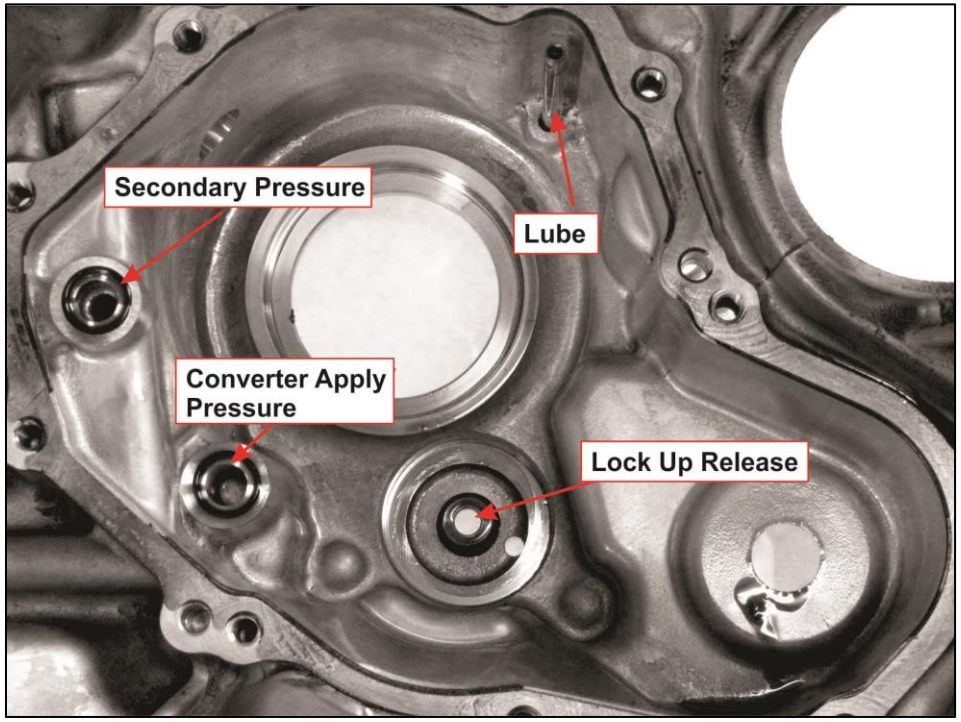
Valve Body



Hydraulic Passage Identification

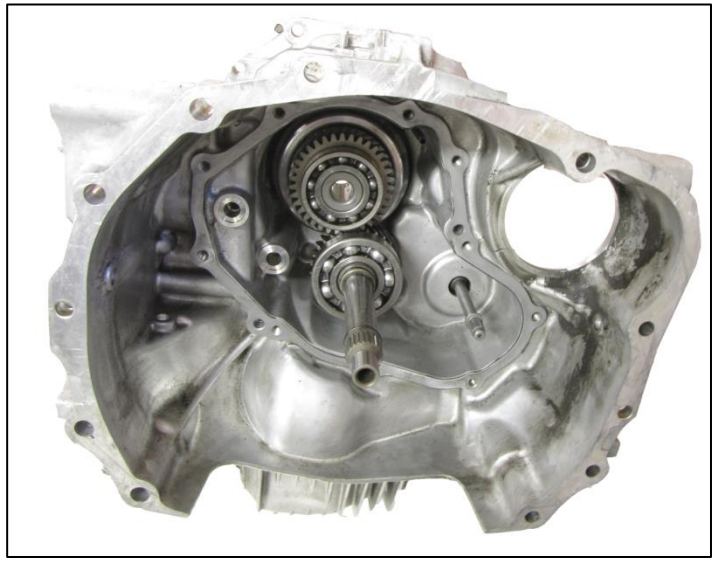
Front of Bellhousing

Stator Support Removed

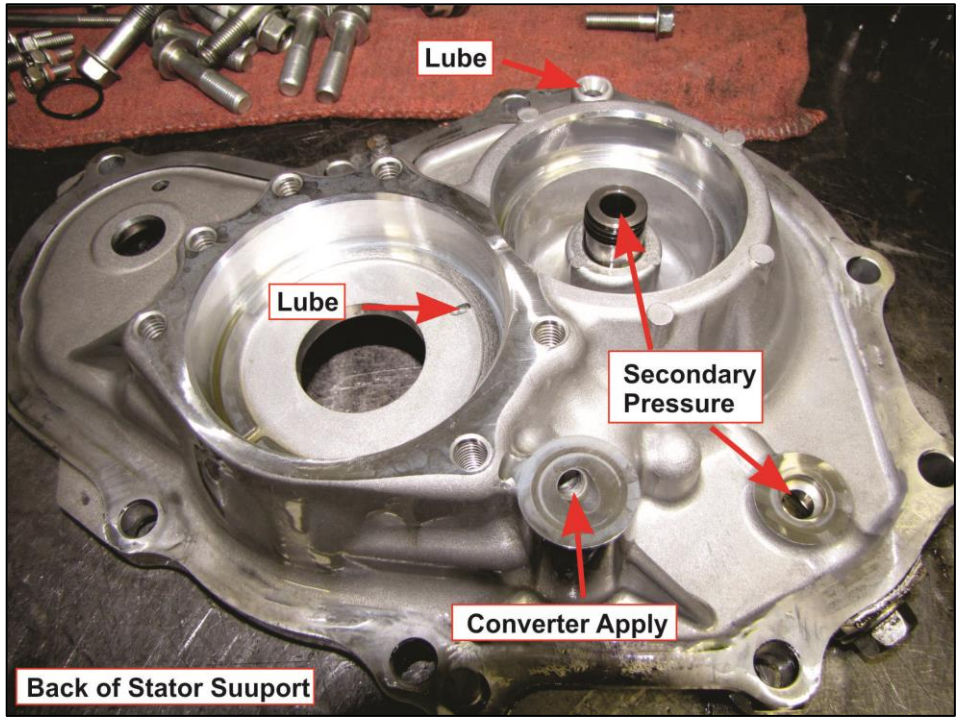


Hydraulic Passage Identification

Front of Bellhousing

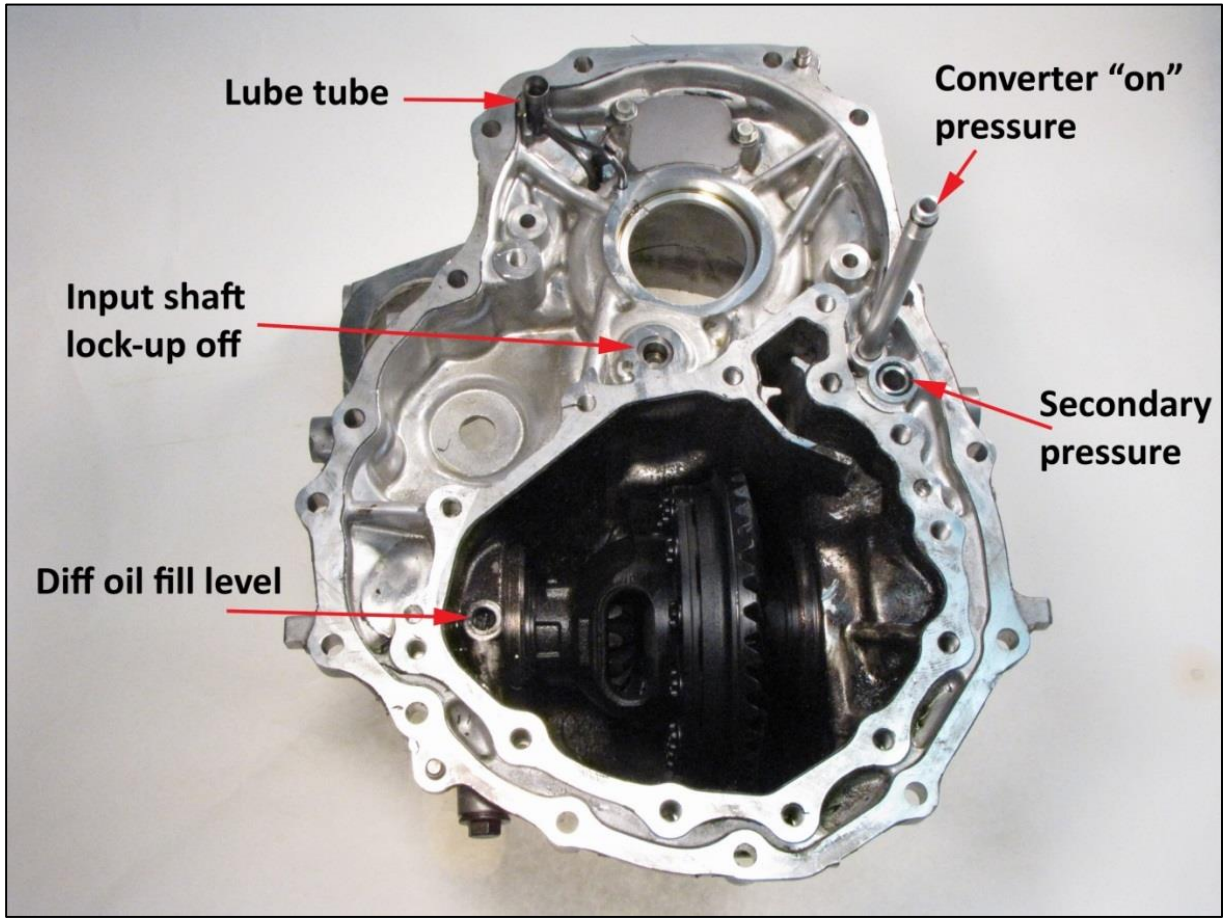


Back of Stator Support

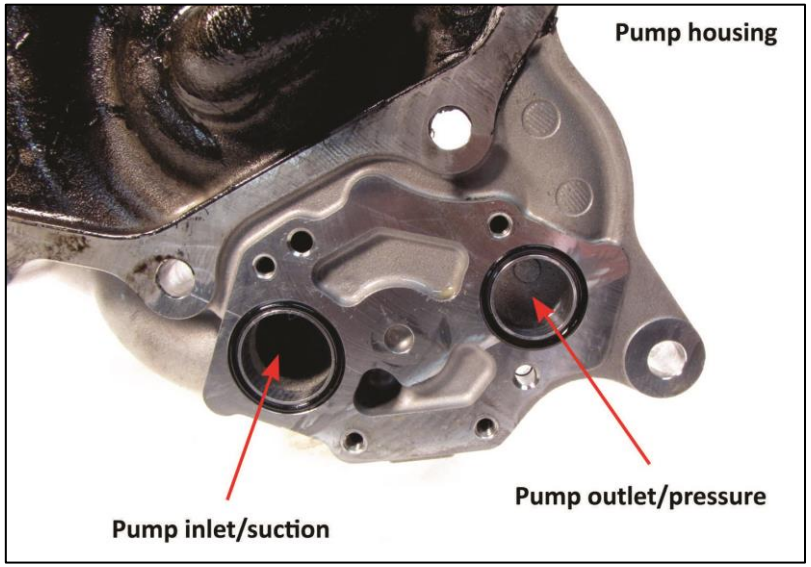


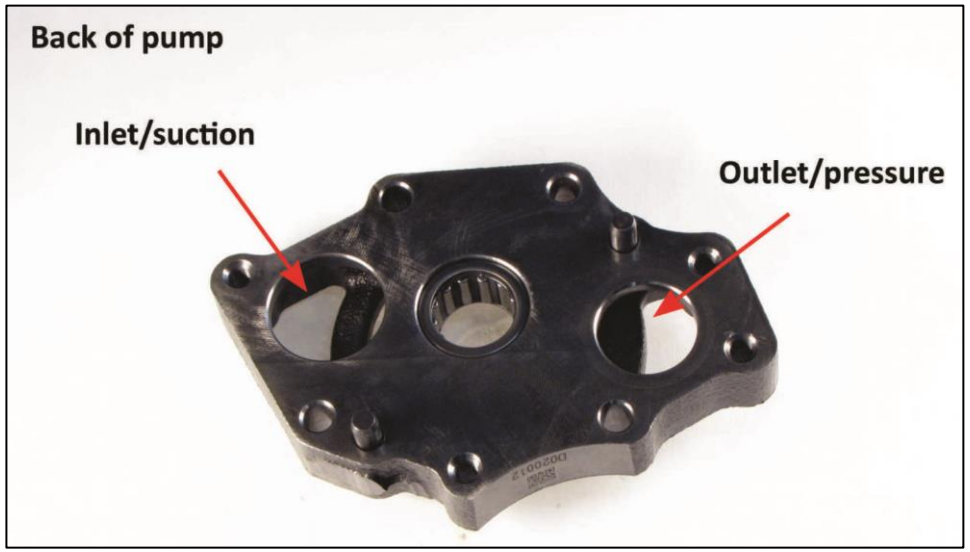
Hydraulic Passage Identification

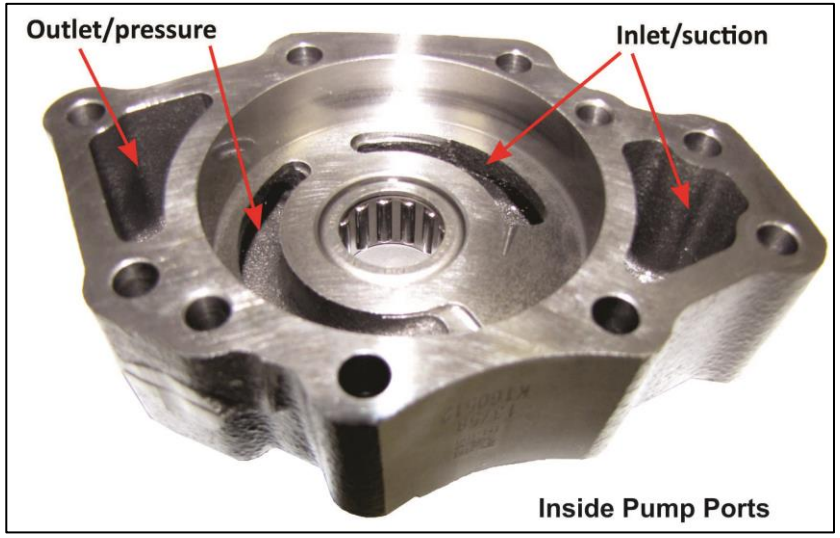
Back of Bellhousing



Hydraulic Passage Identification Pump

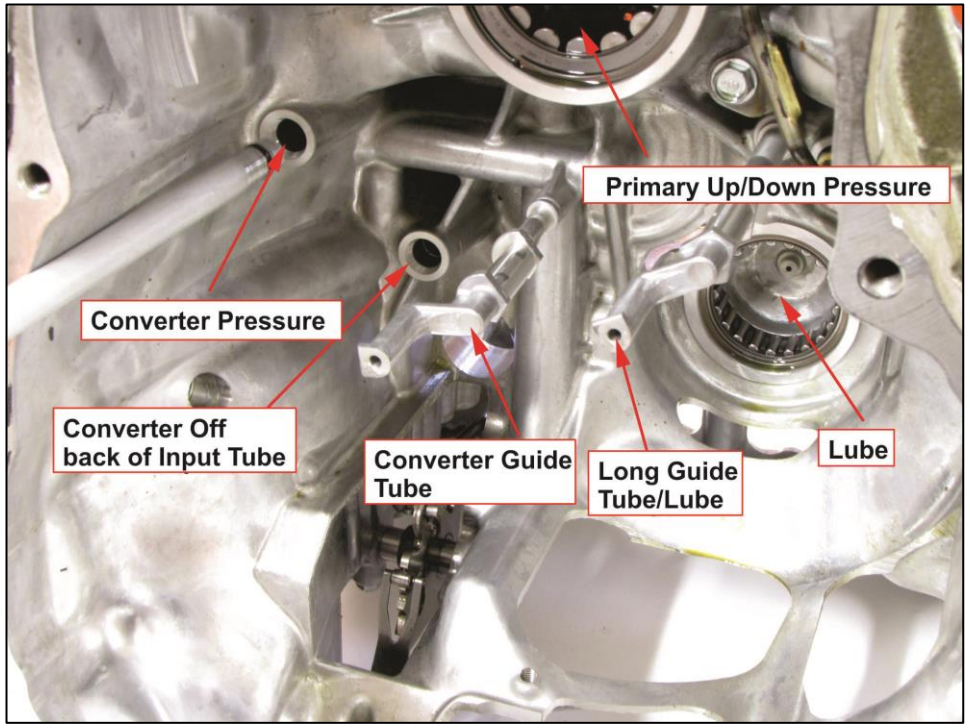




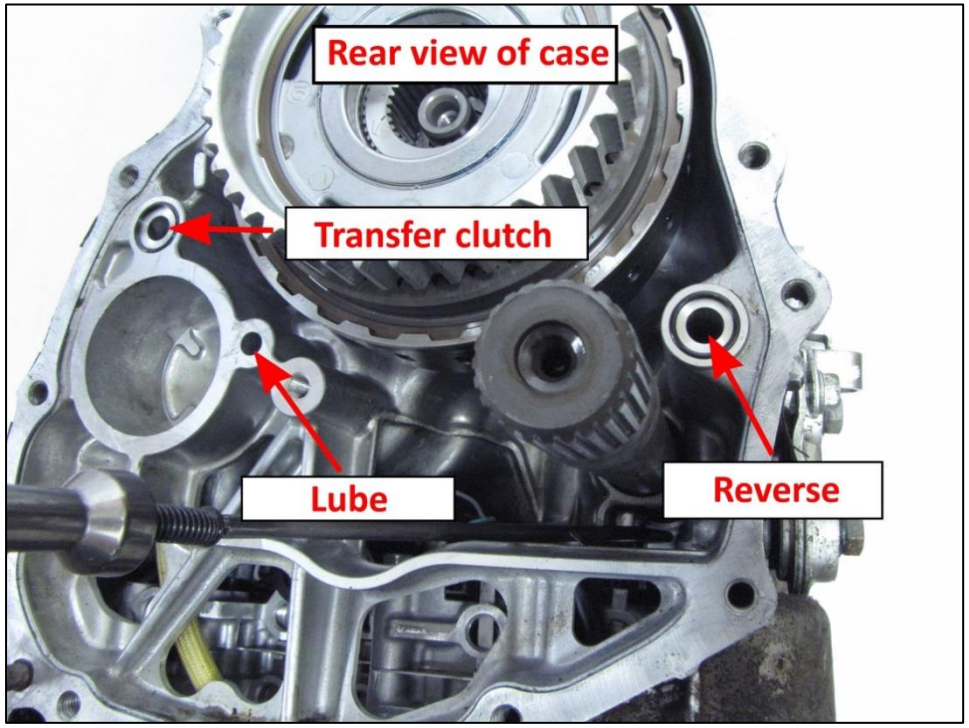


Hydraulic Passage Identification

Front of Main Case

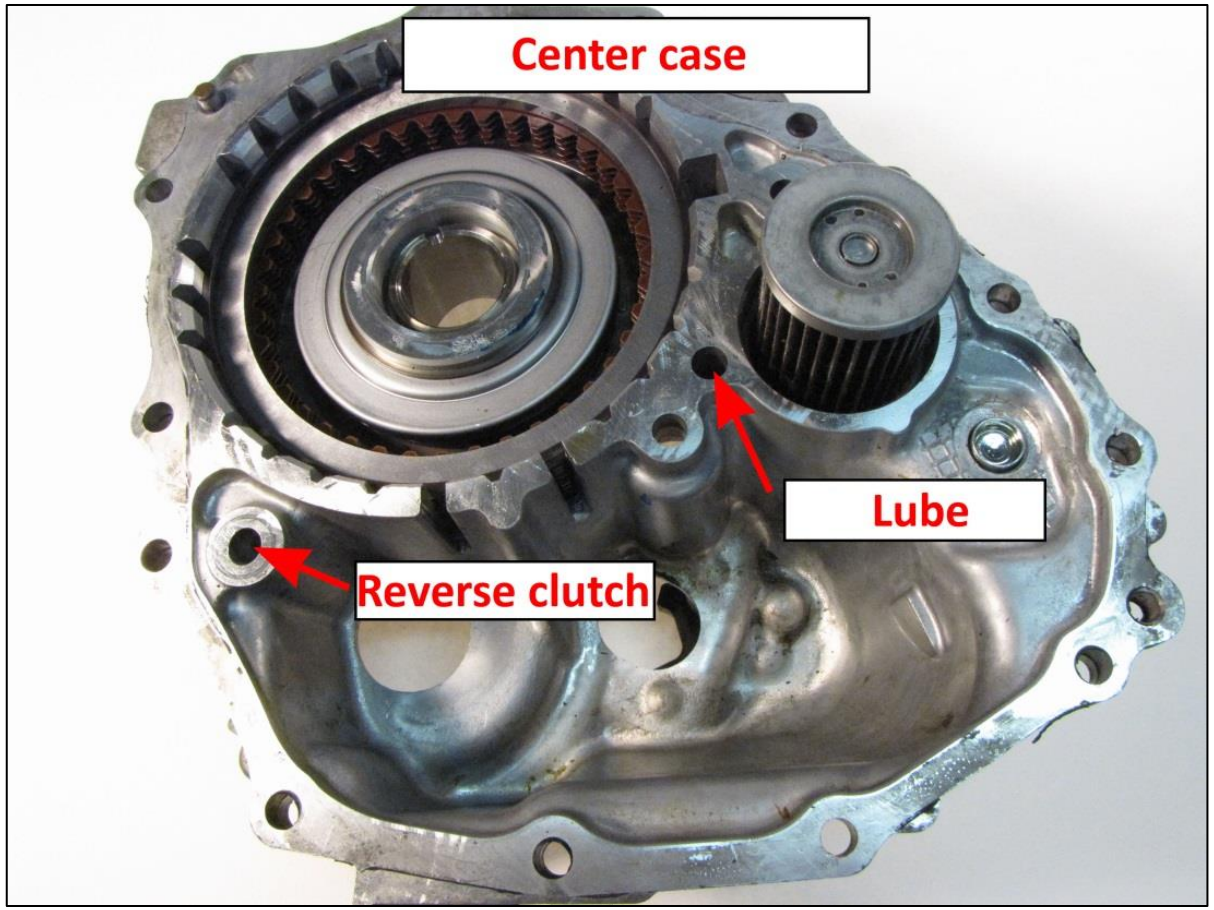


Rear of Main Case



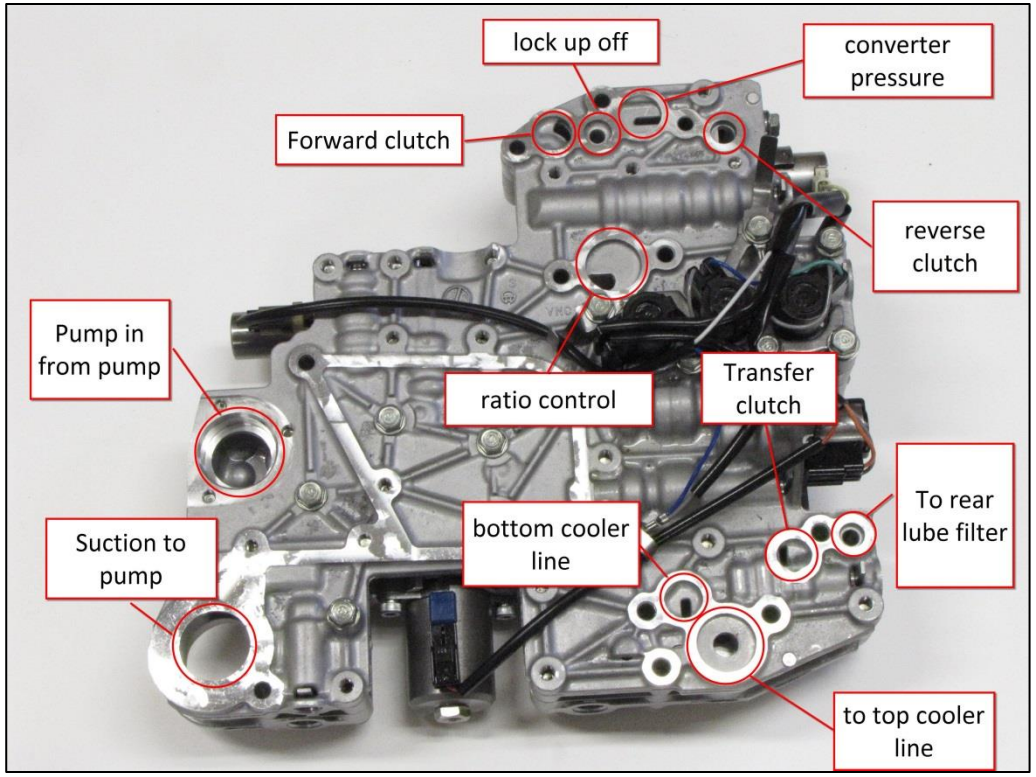
Hydraulic Passage Identification

Front of Intermediate Case

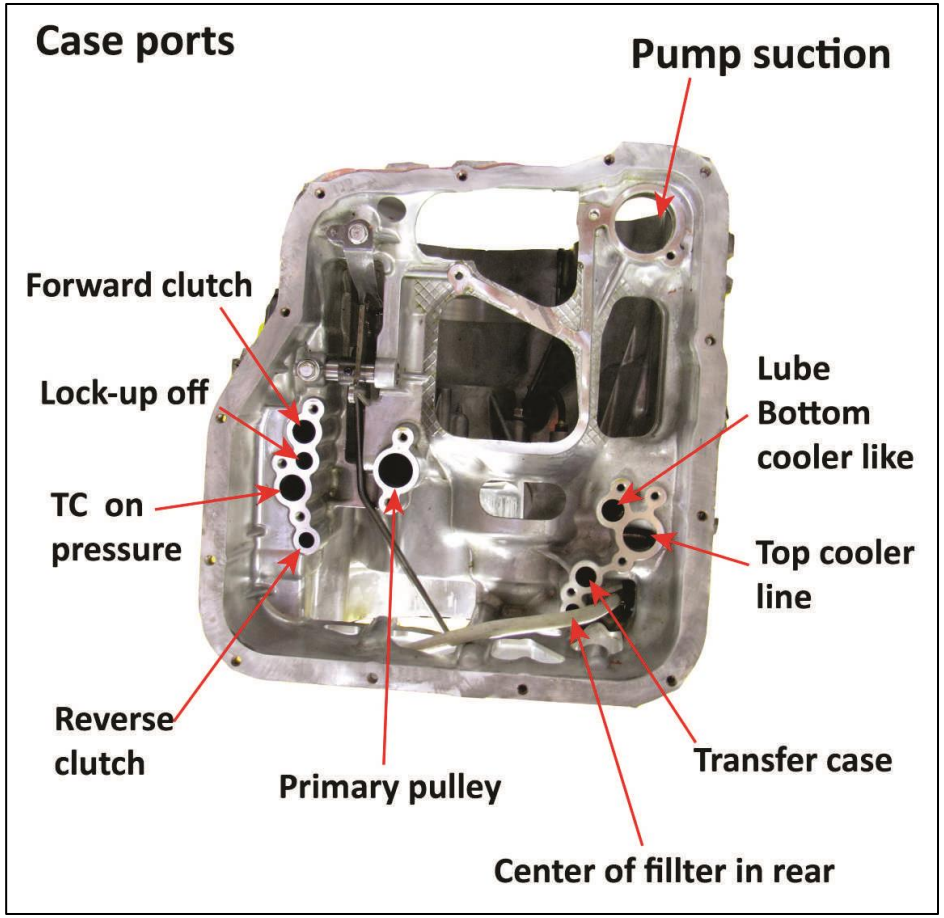


Hydraulic Passage Identification

Valve Body

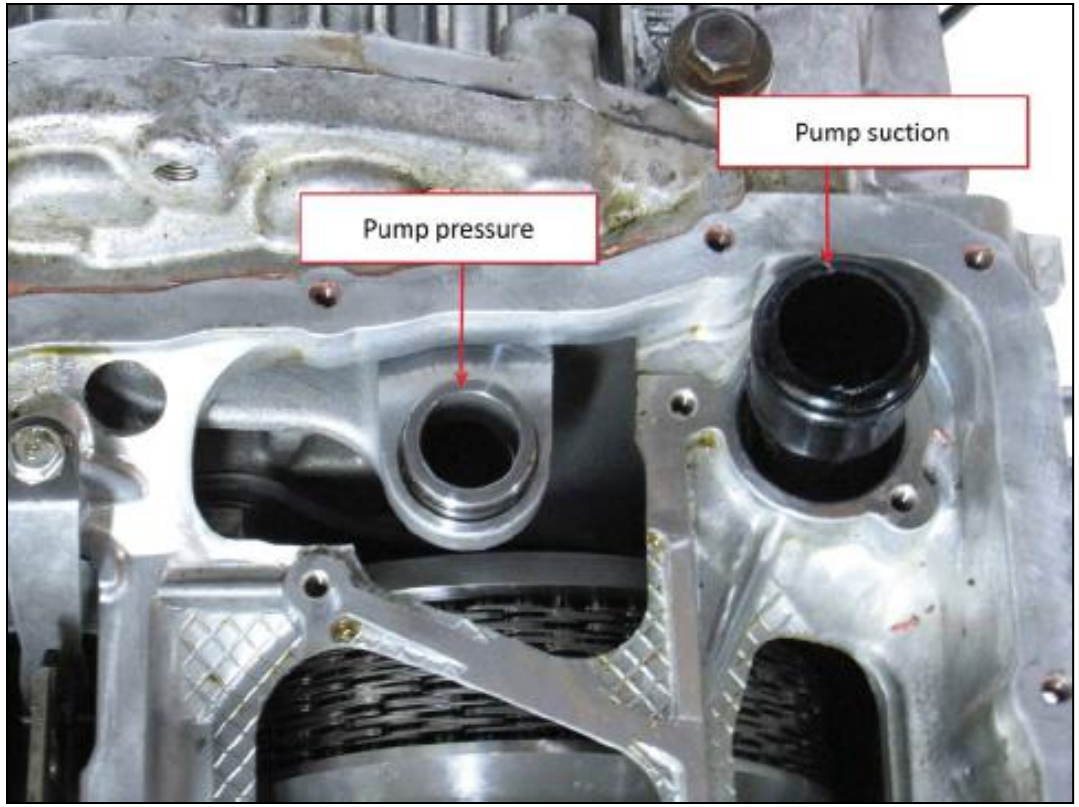


Bottom of Main Case

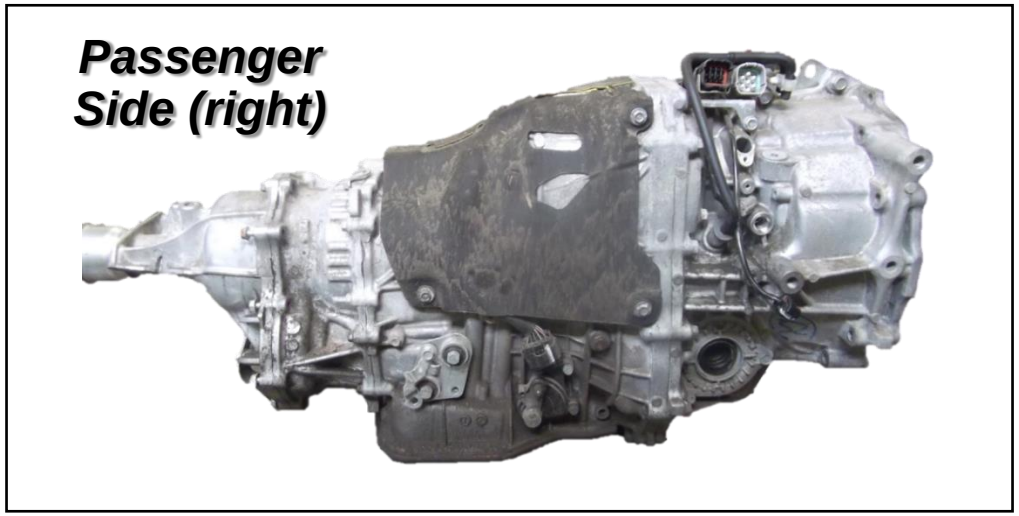


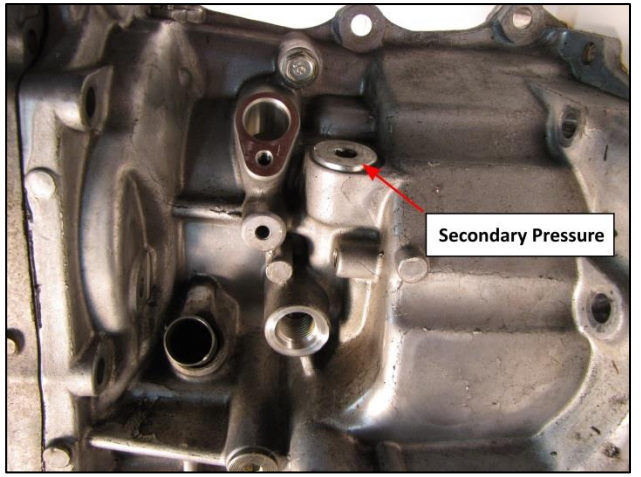
Hydraulic Passage Identification

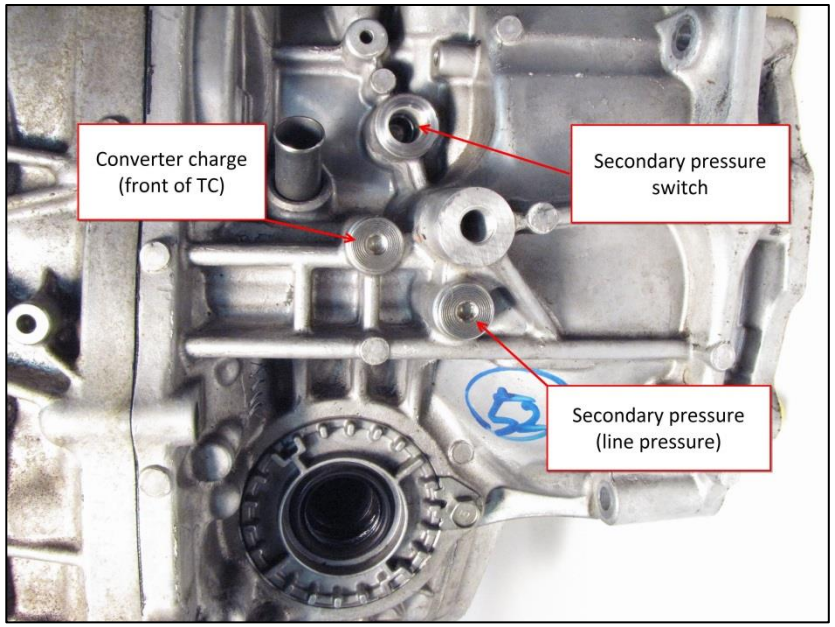
Bottom of Main Case with Bellhousing

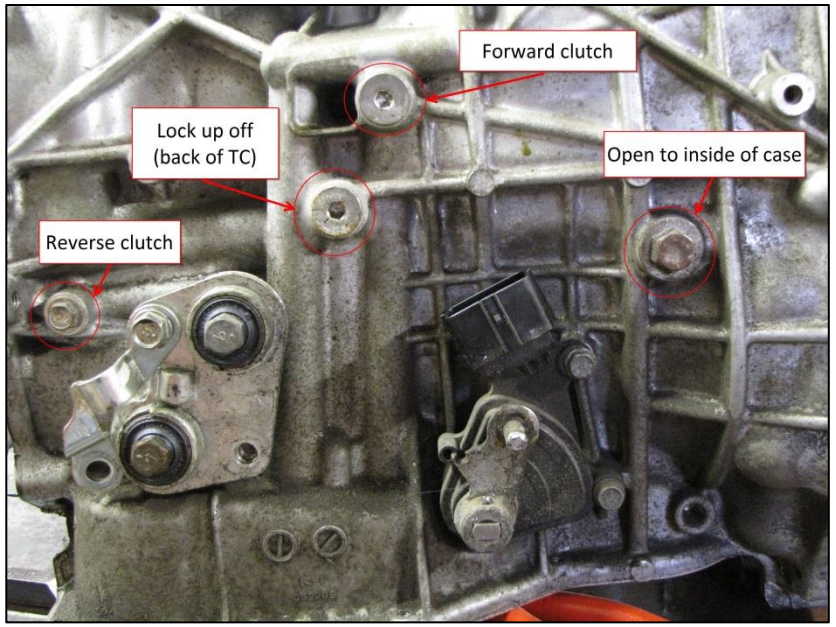


External Pressure Ports



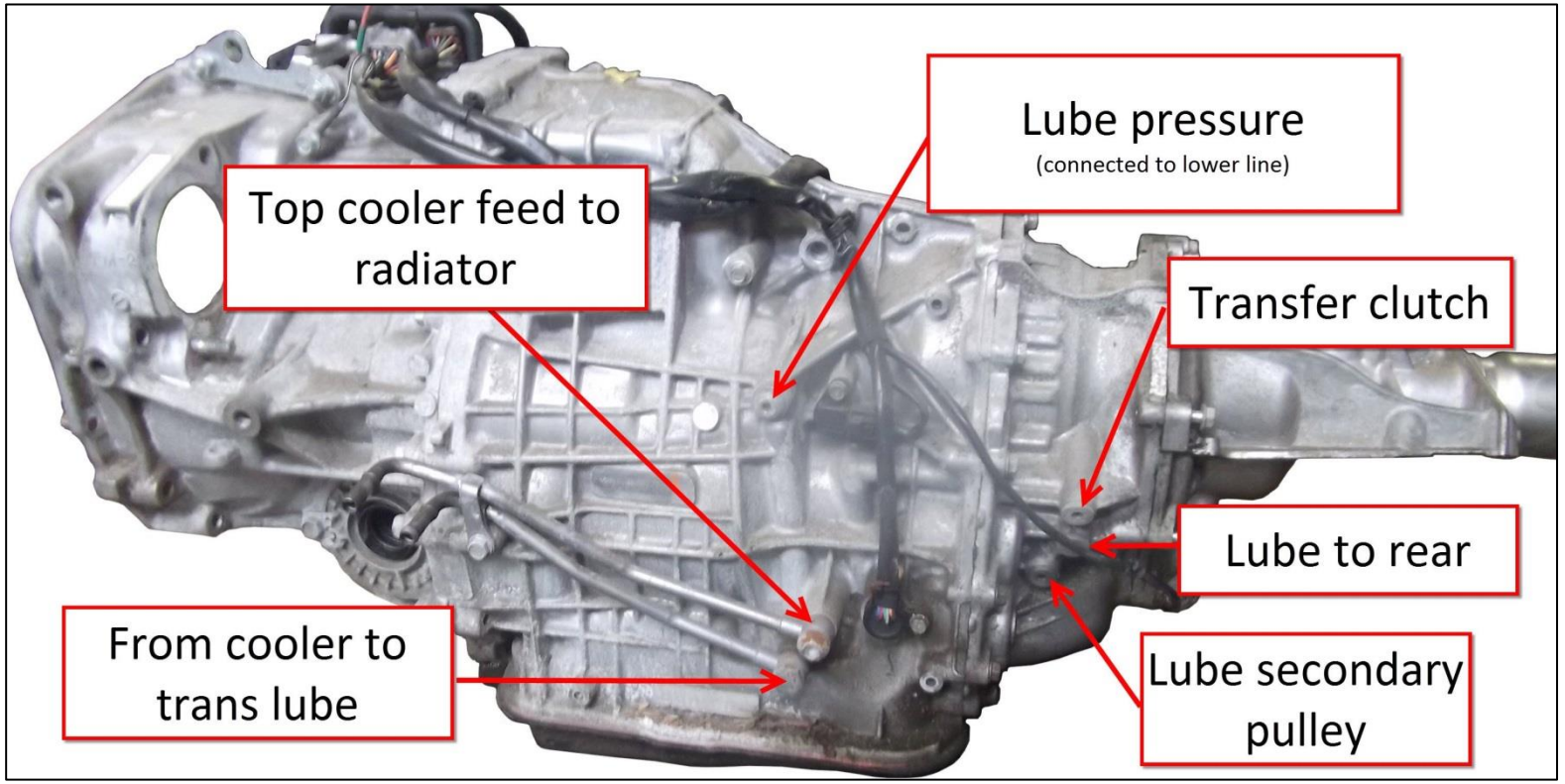






External Pressure Ports

Driver's Side (left)



Pressure Specifications

Secondary Line Pressure

	Range	Throttle	Brake	Secondary line pressure PSI		
Stall	Drive, reverse	Full open	On	652-870 PSI		
Idling	Park, Neutral	Full close	Off	72-218 PSI		

Transfer Case Clutch Pressure

RANGE	DUTY CYCLE %	TPS %	AWD mode	FWD mode
Park, Neutral	0	0	0	0
Manual 2nd	95-100%	100%	145-174 PSI	0
Manual 2nd	60%	««««	58-102 PSI	0
Manual 2nd	0	0	N/A	0

«««« = Adjust throttle percent to achive 60% duty cycle on scan tool at the transfer case duty cycle PID.

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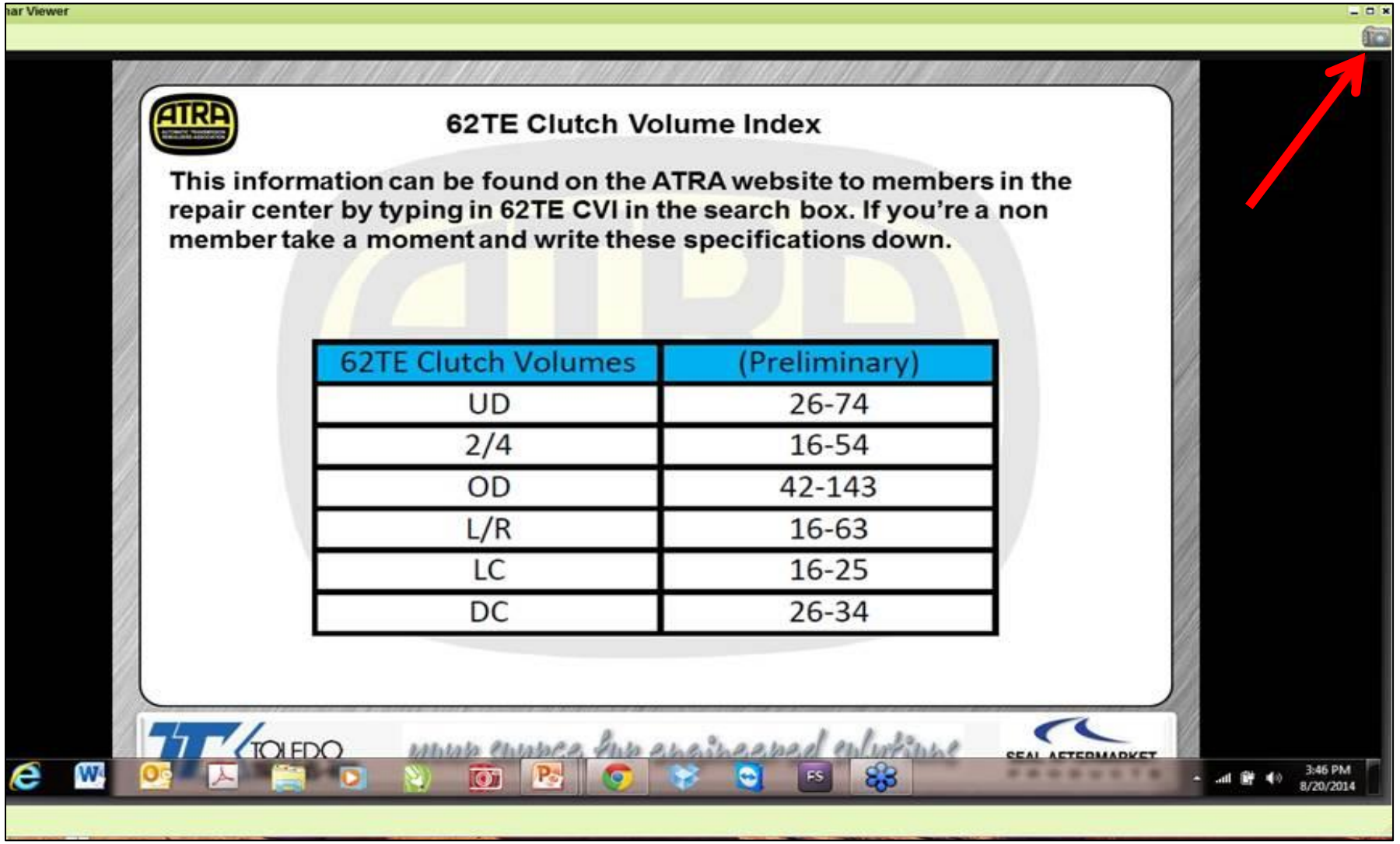

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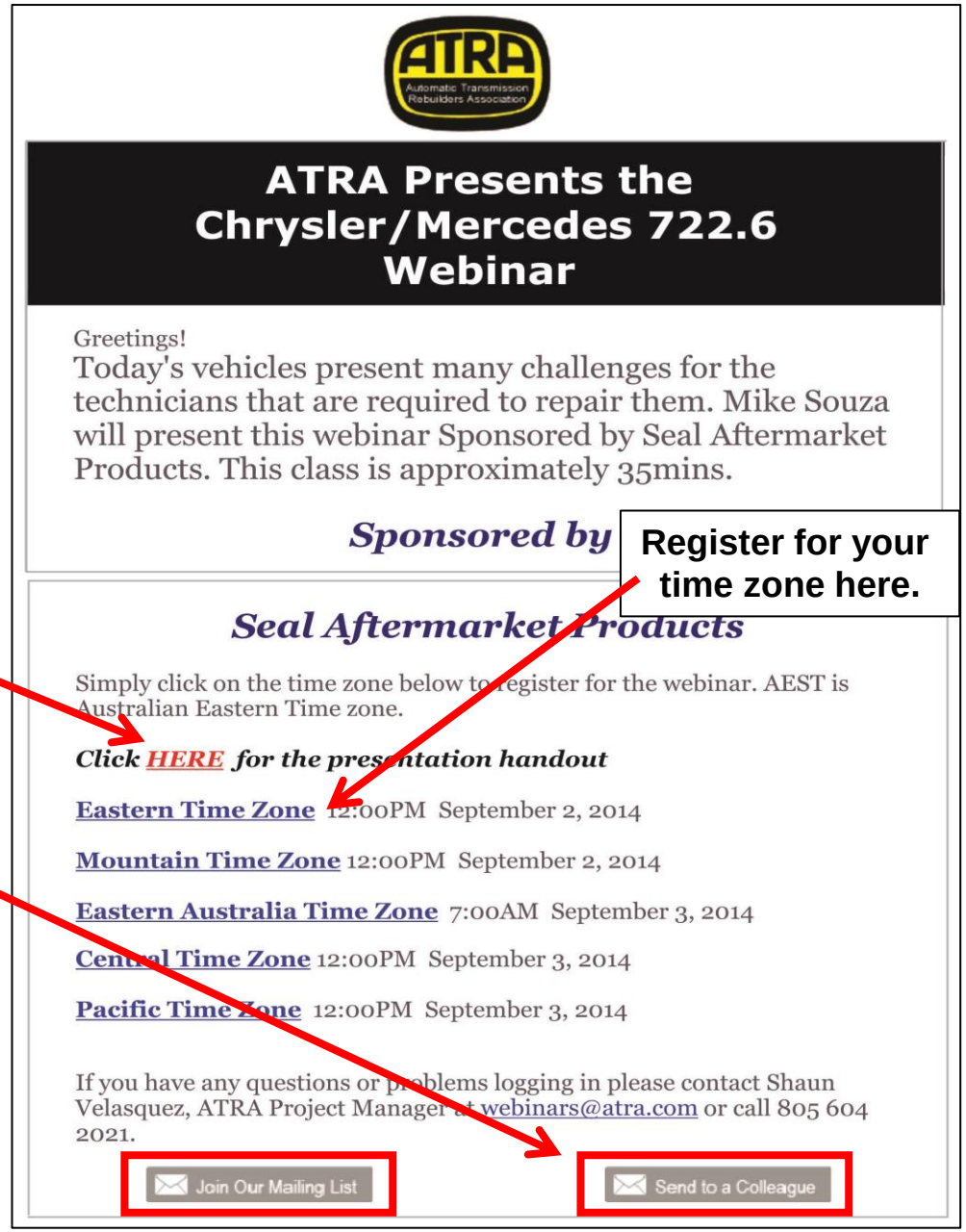

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