



## J Type Overdrive, Part IV - Testing & Troubleshooting

### Testing

**Measuring the hydraulic Pressure:** The first and most important test to of the OD is to measure the hydraulic pressure. I use a liquid (glycerin) filled gauge purchased from McMaster Carr via the internet ([www.mcmaster.com/](http://www.mcmaster.com/)). The gauge was what they call Grade A that is calibrated to within 1% around the middle of the scale. It has a 2 1/2 inch dial, 0 to 1000 psi range, part number 49053K79 that cost about \$25. A 0 to 600 scale would have been better but as I recall the next lower scale they stocked was 0 to 500 that is a little too close to the expected pressure.

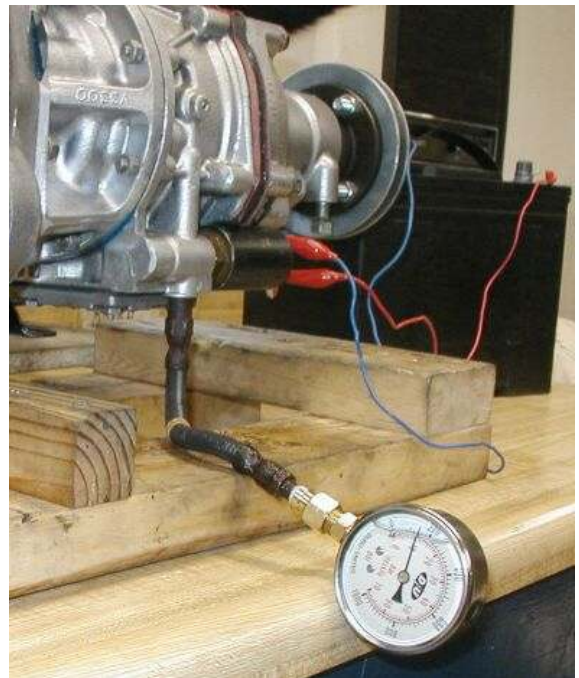
The pressure is measured by removing a plug on the bottom of the main casting in front of the solenoid. Churchill Adaptor L188-2 is used to connect gauge L188 to the access hole. I found that an old brake hose that connected from the tee on the frame to the line on the rear suspension arm was a great L188-2 substitute. This was an early hose that was threaded 3/8-24 on each end. The plug is threaded 3/8-16. The coarser threads are much deeper than the fine threads so I just ran a 3/8-16 die over the 3/8-24 threads on the end that had the shorter threaded part and square end. The gauge is threaded 1/4 pipe thread. I first used a brass reducing coupling from 1/4 inch to 1/8 inch pipe threads. The 1/8 pipe thread seems to be 24 TPI and very slightly larger then the 3/8-24. I used a little Teflon tape around the metal end of the hose and screwed it into the coupling --- it leaked a little. I then purchased a brass flare to 1/4 inch pipe half union, cut off the flare end and threaded the inside 3/8-24 --- essentially making a 1/4 inch pipe thread to 3/8-24 bushing. Copper washers were used on each end of the hose. These parts are shown below. The gauge is liquid filled, but not 100% filled, probably to accommodate temperature changes --- hence the air bubble.



The gauge is shown connected to the OD in photo on right. The gauge reads a little less than 200 psi. I must have had the unit spinning and up to full pressure and then stopped the spinning but left the solenoid operated --- the pressure then must have bled down to the pressure noted. (Yes, if you look carefully, you see the clip leads from the battery are still connected to the solenoid.)

The full test setup is shown below. The motor is 1.5 HP at ~ 3450 rpm and rotates counter clockwise. The OD output shaft spins at about 1300 RPM, which corresponds to about 34 mph.

The residual pressure in direct drive should be about 20 psi and the pressure with OD engaged should be 430 to 460 psi. On this unit I measured an engaged pressure about 465 psi. However, the residual pressure dropped to zero a few seconds after the solenoid released.



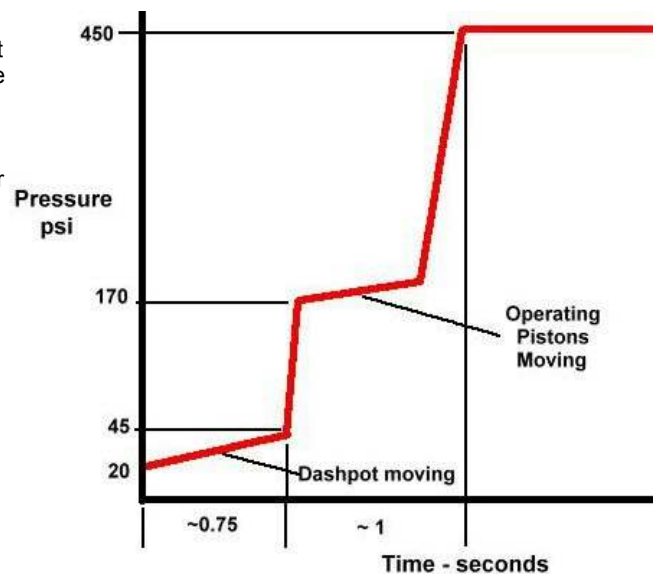


At this point there were two reactions. First, this was the quietest and smoothest gearbox I've ever observed on the test stand. The second reaction was that the reading of zero residual pressure was unacceptable --- something must be wrong!

After I thought about it a while I realized that the dashpot wouldn't work if there was no residual pressure. Also, the pressure gauge had no marking for the first 20 psi indicating that maybe they didn't think it should be used to measure very low pressures. I found a 0 to 160 psi gauge on an air regulator that I wasn't using at the moment so I screwed it on the adaptor hose. Turned the motor on and watched the pressure build right up to about 45 psi and then drop back to about 30 psi. As the unit warmed up further the pressure continued to drop until it read just over 20 psi when hot. So --- the problem was the gauge.

I put the high pressure gauge back on after the unit had run for about an hour and found the pressure when engaged had dropped from a little over 460 psi when cold to about 445 psi when hot. This is a phenomena I observed earlier on the A type ODs. The pressure drop is not due to the heat reducing the oil viscosity because increasing the RPM (and hence the pump output) has little effect on the pressure. Recall that increased RPM gives higher oil pressure in the car engine. My conclusion was (and still is) the spring force on the relief valve decreases a little as the spring heats up.

**Detailed Pressure Plot:** After turning the solenoid off and on several times I realized the pressure didn't build uniformly but went in steps. It goes a little fast--- now wish I had purchased a two-speed motor or one than ran at 1700 rpm so I could slow everything down. Have the smallest drive pulley I can find and the bigger load pulleys cost too much. Anyway, came up with the graph on right after considerable observation using several gauges --- one for the low end and the other for the remainder. The chart is only approximate but I think contains some valuable indicators on how the system operates.



The first thing that happened when the solenoid operated was nothing --- or practically nothing. The pressure built slowly (for about 3/4 second) from the 20 psi residual pressure to about 45 psi. I think this is the period where all the pump output is being used to move the dashpot piston. As that piston moved the relief valve pressure setting was being adjusted upward and no fluid escaped from the valve. Once the dashpot piston reached the high pressure position, there was no place for the fluid to go so pressure built rapidly. Once the pressure reached about 170 psi the operating pistons started to move and took all pump output. After about another second the operating pistons had moved as far as far as they could go and engaged the OD. At that point there was no place for the pump output to go so the pressure built rapidly till the relief valve operated at about 450 psi.

**Solenoid release:** When the solenoid released the pressure dropped very quickly, to about 170 psi in less than half second at which point the OD switched to direct drive. The pressure continued to drop, but more slowly to the residual pressure 20 psi in about 10 seconds.

**Stop pump with solenoid operated:** Another test was to shut off the drive motor with the solenoid operated. The pressure dropped quickly at first and then more slowly until it reached a stable pressure after about 30 seconds. This seemed like an exponential decay. The stable pressure varied from about 170 psi to about 210 psi with no apparent relationship to other parameters such as temperature. The OD stayed engaged (test by trying to turn backwards). I could rotate it three or four revolutions by hand and the pressure would build back to the 450 psi area and then usually decay to a slightly different stable pressure.

I then rotated it by hand to build up the pressure and loosened the fitting between the hose and gauge so that the pressure would bleed down lower. I rotated the shaft back and forth slightly as the pressure bled down so that I could sense when the OD shifted down. It sifted out of OD at about 160 psi.

**Caution:** I've included the above data so that one can get a feel for the operation. The time measurements are rough estimates, not by stopwatch or precision instrument. The pressure readings are dependent on the accuracy of the gauges and the ability of the operator to read the gauge on the fly. If your unit operates similarly but the times or pressures are different, it's likely you have better instrumentation.

## Troubleshooting

**Strange noises:** If your gearbox and/or OD is making grinding, clanging, clacking, wheezing, whining or any other new and different mechanical noises, that's likely bad news. Best stop using it at once or it'll likely be worse news shortly. I'd verify that the noise is actually coming from the gearbox/OD and not differential, engine, spouse, animal locked in trunk, etc. If in gearbox/OD, suggest you face the fact that the thing has to be pulled.

**Stuck in OD:** I'd never heard a J type sticking with OD engaged until I published this note. John Korsak then sent an email describing his J Type that stuck in OD due to a faulty operating valve (solenoid valve). John's description of his experience is included at the end. If you suspect your OD is stuck operated, **don't attempt to drive it in reverse as damage might result.** I'd use the tachometer and speedometer to see if it's really in OD. When in 4th, the tachometer should read 482 rpm per each 10 mph ---- 2410 @ 50 mph. When in 4th and J Type OD engaged, the tachometer should read 383 rpm per each 10 mph or 1915 at 50 mph. Failure modes that might cause the unit to be stuck in OD are:

- Electrical resulting in the solenoid staying operated.
- Hydraulic such as a stuck relief valve or a failure in the operating valve (solenoid valve) such that fluid is always applied to the dashpot.
- Mechanical such as the sliding clutch sticking in the brake ring. This happens sometimes in the A type -- usually after driving an extended period with OD engaged. It is probably aggravated by weak release springs. (An improper operating valve adjustment can also cause this problem in the A type but is not a problem in the J type) The stuck clutch in the brake ring usually comes loose when it cools or with a sharp rap of a hammer on the side of the brake ring.

If electrical or hydraulic problems are suspected, the same procedures as to diagnose an OD that won't engage discussed below should be used.

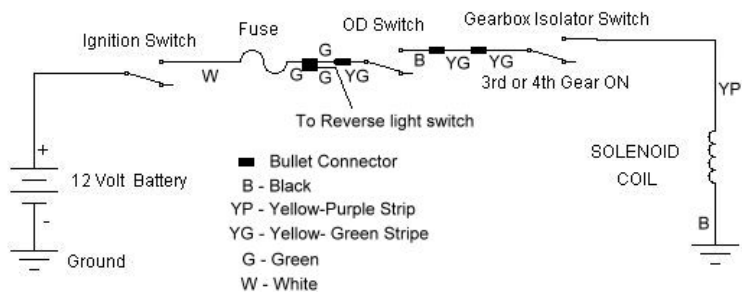
**Won't engage in overdrive:** This is the most common OD problem and usually electrical related. With a statement like that most think: Oh **Lucas, the Prince of Darkness.** The real situation is that the mechanical and hydraulic components are safely sealed away in the castings while the electrical stuff is hanging out ready to be disturbed during some unrelated maintenance procedure. (One of my friends claims that 95% of all carb problems are electrical ---- similar concept).

The first test to run is to turn on the ignition (don't start the car), put the gearbox in 3rd or 4th gear and operate the OD switch on the steering column. Go get a cup of coffee, stop to get rid of the last one, etc. for about 5 minutes and then slide under the car and feel the solenoid. If electrical power is supplied, it should be hot ---- so hot you can barely hold it. If it's hot, then electrical power is making it to the solenoid. If that is the case, then the I'd check the gearbox fluid level. Recall that the gearbox oil is also the OD hydraulic fluid and the OD won't operate if the fluid level is too low. So how does one add fluid through the hole in the side of the gearbox ----- roll the car on its side? Most auto parts stores sell plastic pumps with hoses that make the job of transferring fluid from the bottle to the gearbox a snap ----- or at least increase the probability that at least half the fluid dispensed actually makes it into the gearbox.

**Troubleshooting Electrical Problems:** I'd strongly recommend that one purchase the [Triumph TR250 - TR6 Electrical Maintenance Handbook](#) by Dan Masters. Dan provides an **accurate** foldout schematic for each model year. Every TR250 and TR6 I've examined closely had some (usually detrimental) wiring modification. Also, most manuals and references I've seen have inaccurate schematics. See <http://members.aol.com/danmas6/> for ordering information. (A neat idea is to print out a page from the website, make a note on it about how much you'd love to have one and then leave it where the wife will find it --- maybe beside a box of sweets you bought her.)

The schematic of the OD electrical circuit is below. This is the same schematic as in Part I except that the color of the wires has been added.

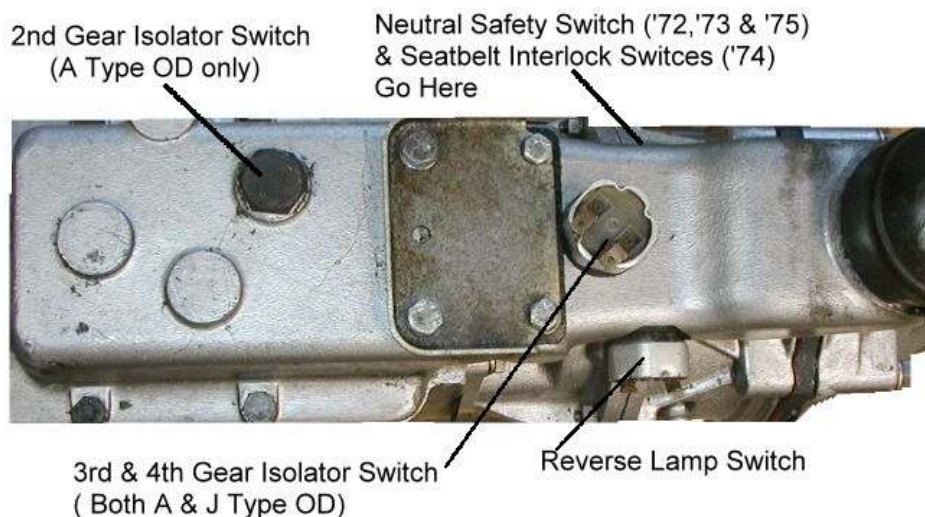
## J Type Overdrive Part IV



The OD electrical is powered from the **White** ignition wire, the same wire that goes to the ignition coil. After the fuse it becomes the **Green** circuit that powers the wipers, instrument voltage stabilizer (temperature & fuel gauges) heater fan and turn signals. The physical wiring configuration is:

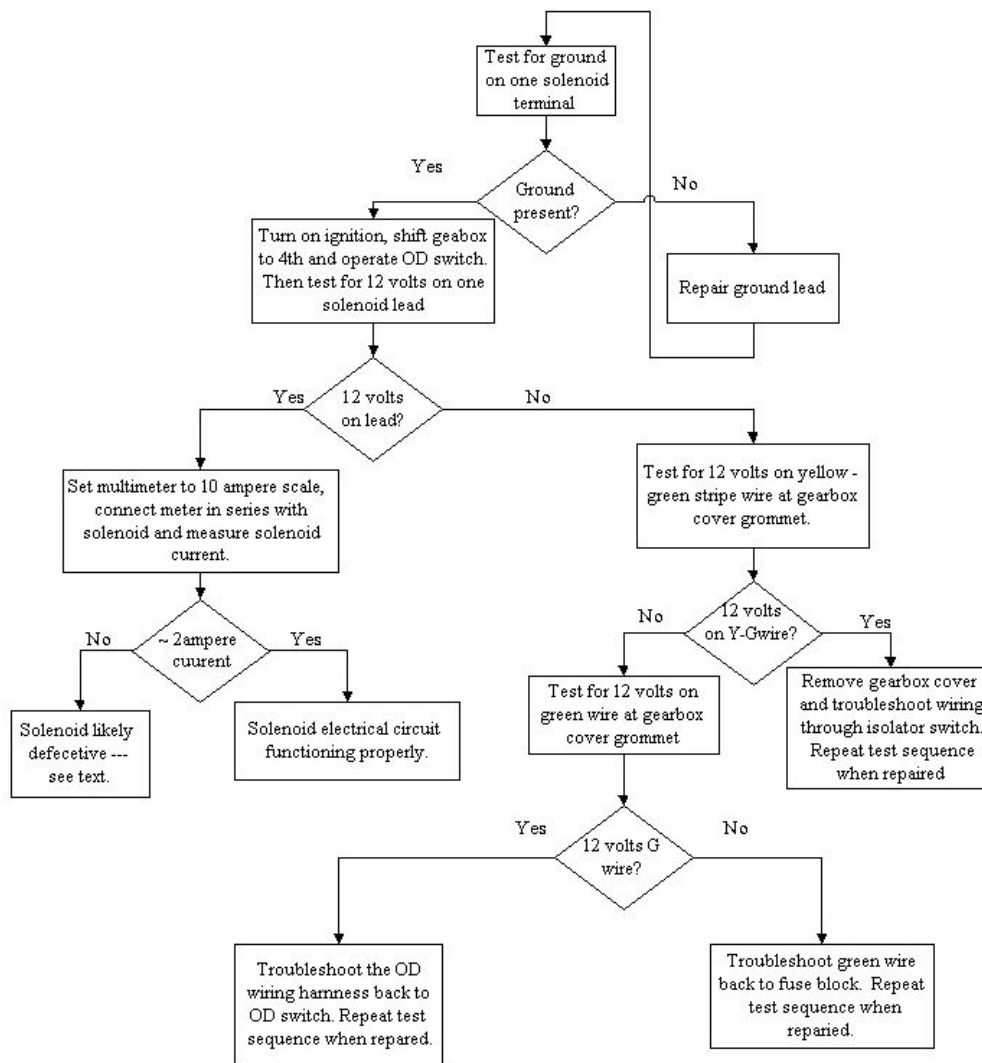
- The green wire between the fuse and first bullet connector actually runs from the fuse block to the grommet near the right front of the gearbox cover. Note there are a total of three wires on that connector, a green one that comes from the fuse block, a green one that goes through the cover to the reverse lamp switch and a green one that goes in the two-wire OD harness back up to the steering column switch.
- The other end of the OD wiring harness terminates under the dash near the steering column where the green wire in the harness connects to the yellow- green stripe wire from the OD Switch and the yellow- green stripe wire in the OD harness connects to the black wire from the switch. (Note: there is no problem if the two harness wires connect to the opposite switch wires.)
- The gearbox end of the yellow - green strip wire in the OD wiring harness connects to another yellow - green strip wire near the grommet in the gearbox cover. That second yellow - green stripe wire goes through the grommet and to the OD isolator switch in the top of the gearbox top cover.
- There is a single yellow - purple stripe wire that runs from the other side of the isolator switch to the solenoid.
- There is a short block wire that runs for the second solenoid terminal to ground at one of the studs connecting the main and rear OD castings.

The '76 TR6 gearbox switches are shown in the next photo. The reverse lamp switch is on the side and the 3rd/4th gear isolator switch for the OD is on the top. The late covers are also provided with a place to install the 2nd gear isolator switch should someone want to use the cover with an A type OD. Gearbox covers from '72 through '75 also have a switch opposite the reverse lamp switch to sense when the gearbox is in neutral for the neutral safety and seatbelt interlock features. The top cover wiring associated with the J type OD consists of the yellow - green stripe wire from the isolator switch through the grommet in the cover and the yellow - purple stripe wire from the isolator switch to the solenoid. Unfortunately this gearbox came without the wiring so you'll have to use your imagination.



If electrical problems are suspected I use the flow chart below to troubleshoot the problem. The use of the multimeter to make these kind of measurements is discussed in Part V on the A type OD note.

## J Type Overdrive Part IV



If the circuit passes the test in the flowchart I would then verify that the voltage on the solenoid goes to zero when either the ignition or OD switch is turned off or when the gearbox is shifted to neutral or any gear other than 3rd or 4th. If this doesn't happen, then the switch that doesn't affect the voltage should be examined.

If the system passes all the voltage tests but the current reads other than about 2 amperes, there is likely something wrong with the solenoid coil. If the current is zero, the winding is open and the solenoid must be replaced. If the current is excess, like 3 amperes or more, there is likely an internal short in the coil and the solenoid will probably overheat in the near future and fail.

**Troubleshooting Hydraulics:** If the electrical circuits are in order, the oil is at the proper level, then there must be something wrong with the hydraulics. Fortunately, essentially all the hydraulic components are accessible without pulling the OD. The first thing I'd do is measure the hydraulic pressure as described at the beginning of this part. This requires that the engine be running and the transmission be engaged in 3rd or 4th gear. That brings a scary image of the car falling off jack stands in gear with tires spinning and the soon to be DPO underneath reading the hydraulic pressure. **Please be careful. I vote for disconnecting the front end of the propeller shaft (drive shaft) from the OD before messing with the vehicle in gear with the engine running.**

The first measurement is of the residual pressure. It should be about 20 psi as noted earlier but I suspect the system will work at 10 psi or less. If there is no pressure and the gauge is known to be accurate at low pressure, then there is something wrong with the pump or the filters are plugged. The sump cover must be removed to inspect the suspicious components.

If there is residual pressure I'd then operate the OD switch and observe the pressure. It should follow the pattern as noted in graph above. If the pressure fails to increase, then there is probably a problem with the operating valve. I'd first remove the solenoid and apply power to the solenoid to see if the valve stem actually moves. If it doesn't, then it is stuck or the coil is not energized. I'd disassemble the valve and inspect all the components. The photo near the end of Part I shows the valve details.

If the pressure increases when the OD switch is operated but fails to reach full pressure, then the problem can be in the relief valve not adjusting to the proper pressure or the pump being incapable of supplying sufficient pressure possible due to a defect non return valve or damaged pump piston/cylinder. The sump cover must be removed to access the relief valve or non-return valve.

If I have to removed the sump cover, I clean all the filters and inspect all the components that can be accessed through the sump. The fault will likely be found through this inspection.

**War stories:** The following are some problems encountered by others as well as one I had myself. Anyone who has interesting problems (and solutions) please pass them on for inclusion here.

- The article by Erik Quackenbush in the Illinois Sports Owners Association newsletter was mentioned earlier in reference to the O-Rings. Erik measured the normal 20 psi residual pressure but no increase in pressure when the solenoid operated. He found the problem was that the nut worked off the bolt that held the spring and thimble to the dashpot piston. Everything worked fine after he screwed the nut back on (with a drop of thread lock) and reassembled everything.
- A story on one of the email lists a year or so back described an OD that failed to engage. The owner later reported that the brake ring had fractured and ruined the sliding clutch too.
- I mentioned earlier that my J type OD failed after debris got into the pump. The lower part of the pump piston was heavily scarred indicating something made it into the pump cylinder. This probably made the pump piston hard to move. The pump cam (steel) wore the inside surface of the cam follower (aluminum) so much that there was essentially no pump piston motion. There was also a crack in the cam follower.
- John Korsak wrote: *I purchased my '74 TR6 June 2001. PO had not done anything to the car for years. Soon after my purchase I noticed that the clutch seemed to be slipping in 1st and 2nd, but not very much in 3rd or 4th. Of course that seemed to be just the opposite of what a slipping clutch should be doing. After researching the problem in the 6-PACK archives, I concluded that my overdrive (J Type) was stuck in the ON position. I checked the electricals and they seem to be working properly. With the help of my friendly mechanic (and transmission specialist) we removed the solenoid and discovered that corrosion had caused the piston to be stuck in the ON position. Cleaning the piston and honing out the bore of the solenoid solved the problem. So I know from first hand experience that a J type solenoid can get stuck in the on position.*