Borg Warner R10 R11 Overdrive Free Report

Hello:

Thank you for requesting our Borg Warner Overdrive report. This report is meant to assist owners with the operation and maintenance of the Borg Warner R-10 and R-11 Overdrive transmissions.

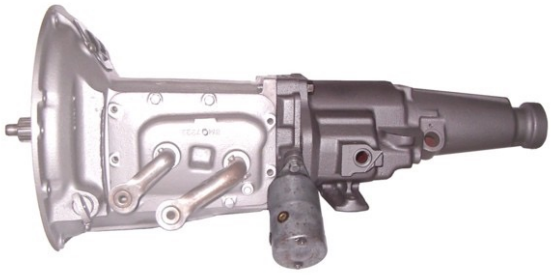
Some history: The original Borg-Warner Corporation was formed in 1928 by the merger of Warner Gear which itself was founded by Thomas Warner in 1901 and Borg & Beck founded by Charles Borg and Marshall Beck in 1903. The company was best known as the supplier of Borg Warner Overdrive units from 1930's to the 1970's and as the developer of the Studebaker three-speed automatic transmission introduced in 1950. Ford took up development of the transmission in Studebaker's place in 1955. The early Ford automatics are derivatives from the early days of Borg Warner. And the world famous Borg Warner Indy 500 trophy has been provided to the annual winner of the Indy 500 by the company since 1936.

As the roads improved and car speeds continued to increase there was a need for a transmission that would allow the engine to turn slower at higher speeds and still have the low end torque for climbing hills. To address these needs, the Borg-Warner overdrive transmission was first introduced in the 1934 Chryslers and DeSoto then used by Ford, GM, Hudson, Kaiser-Frazier, Packard, Studebaker and Willys, all total of 13 auto manufactures used this overdrive transmission. In total, there were 1 million OD transmissions produced.

Ford first installed the Borg-Warner overdrive's in the Lincoln Zephyr in 1941. Then became optional on Ford and Mercury cars from 1949 and then

faded from use in cars in the ‘60s. Ford pickups continued to offer overdrive into the ‘70s.

Borg-Warner R10 and R11 use a planetary gear set that fit in between the transmission and the tail shaft housing and offered a .70:1 ratio on the R10 and .72:1 on the R-11. Overdrive was available in second and third gear, essentially offering five forward speeds.



The overdrive transmission are electro- mechanical devices and require several electrical and mechanical components to operate: Solenoid, Governor, Kick Down Switch, Manual Push Pull Cable, Relay and wired together using a wiring harness.

The R-10 has a three pinion planetary gear set and adequate for street applications, the R-11 utilize four pinion planetary gear set and overall a stronger transmission and was mostly found on heavier trucks.

Operating the overdrive is simple. There is a manual control cable mounted under the dash and used by the driver to manually engage or disengage the transmission. Pulling the handle out takes the transmission out of overdrive and then operates like a conventional three speed. Pushing the handle in allows the engagement of the overdrive and then the operation is essentially automatic.

Driving a car with overdrive requires the driver to understand the operation and may require some adjustment in driving style. With the overdrive engaged (handle in), the transmission will freewheel below 20-30 mph depending on the car’s rear end gearing, which means the engine will drive the wheels, when lifting off the throttle the wheels won’t spin the engine and

the car will coast as there is no engine braking. However, once the car is up to the required speed will say 28 MPH the governor closes the electrical circuit, then when the driver momentarily releases the throttle the solenoid is activated via a relay and locks the sun gear in the planetary set and the transmission shifts into overdrive which also means there will be compression braking when lifting off the gas. Remember this happens when speed is above governor speed (28 MPH).

Shifting out of overdrive happens in two ways. Slowing down under the governor cut-off speed (28 MPH) causes the solenoid to release. Or, if the throttle is floored the kick-down switch is depressed. This does two things, it interrupts power to the OD solenoid and also grounds the ignition coil momentarily, this grounding stops the engine for a brief moment and takes the torque off the transmission similar to depressing the clutch and allows the solenoid shaft to retract and disengage. Internally the solenoid shaft is trapped and can not be released, by shutting off the ignition system briefly releases the load on the transmission and the solenoid shaft and allows the solenoid to release the sun gear (which means the transmission is in direct drive) and the ignition system is back on. All this happens very fast. The flyweight governor located on the tail shaft activates around 28 MPH, this means the overdrive can not be activated below this speed.

Around town in traffic using overdrive say in second gear is like having an automatic, as the transmission will shift back and forth between direct and overdrive as the speed varies above and below governor speed.

On the highway and cruising in third gear the transmission is in overdrive mode. When you want to pass another car or jump on the freeway the driver simply depresses the gas pedal and this will activate the kick down

switch and causes a downshift taking the overdrive out for passing. Then once letting off the gas the overdrive will be back engaged.

When parking and leaving the vehicle in overdrive there is danger the car can roll away. Best practice is to pull out the OD handle, this ensures that the OD is not engaged and not free wheeling, then put the shift lever in 1st or 2nd gear and set the park break. This will ensure that the compression of the engine is acting on the rear wheels and in a manner to stop the car from rolling.

Never reverse the vehicle with OD engage, if all the electrical and mechanical devices are connected as designed originally this will never happen. However over the years car owners have removed manufacture safety features and installed switches on the dash to activate the solenoid along with maybe an indicator light. This will work until someone else drives the car and does not realize what the dash light means, then puts the car in reverse with OD engages and CRUNCH!! Goes the gears and bearings and a very expensive repair. therefore **It is never recommended to bypass the electrical circuits that were designed to prevent this from happening.**

Now that we covered overdrive basics, we will dig further into some specifics around the OD electrical system. We mentioned earlier that 13 car manufactures installed the Borg Warner R10-R11 transmissions and essentially all electrical operation is the same. However, all companies used different colored wires making it difficult to troubleshoot and change parts. For this reason we have developed a simple to follow wiring diagram. Click here

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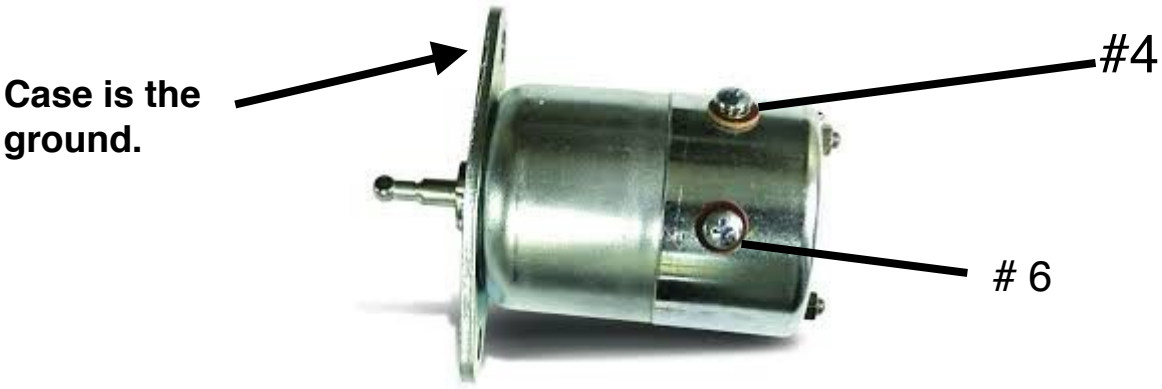


The solenoid; this device tends to be the most replaced item because it does the most amount work and wares out the quickest.

The purpose of the solenoid is to engage and disengage the OD itself by extending a shaft that is attached to a pawl inside the transmission to lock and un-lock the sun gear rotation.

The Solenoid shaft when at rest and outside the transmission will measure about 1” in length from the centering ring to the tip. There are a few exceptions, station wagons and convertibles used a longer shaft solenoid about 1 1/2 inch long. The longer shaft was due to an adapter that extend the solenoid mounting out and beyond a cross member that is present on convertibles and wagons. Some Chevrolet pickups from the mid to late 1960's had a 2” long shafts.

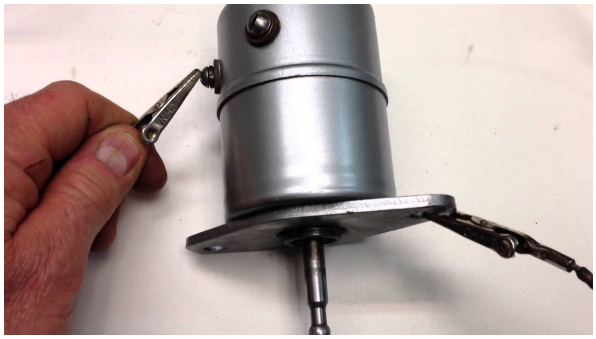
The solenoid image shows solenoid with 1” shaft length.

Solenoid wire terminal locations: locating the terminal on the solenoid as follows: With the solenoid in hand and the shaft facing away from you, the right hand terminal is #4 and will connect to the relay. The left hand terminal

#6 connects to the kick down switch. A few solenoids had a third terminal or wire which is a ground, in most solenoids the case itself is the ground. A few solenoids had internal connections with wires coming out of the solenoid. Wiring connections for both are the same, you will just need to check which wire is the #4 by activating the solenoid with voltage and grounding the case.

There were two solenoid manufactures besides Borg Warner which were Autolite and Delco. Both of these will interchange as long as the shaft length matches and the operating voltage is correct for your vehicle.

Checking Solenoids for operation: The best way to test a solenoid is to apply battery power directly to the #4 terminal and grounding the case with a set of jumper cables or test leads. When touching the ground and #4 terminal the solenoid shaft should snap out. You can do this while the solenoid is in the vehicle or on the bench. Either way should make the solenoid work.



Checking to see if you have a 6 or 12 volt solenoid.

A 6 volt solenoid will operate on 12 volts, but this does not mean you have a 12 volt solenoid as the 6 volt coils will indeed work on 12 volts for a while anyway. But a 12 volt solenoid will not operate on 6 volts. So be careful when buying used solenoids in the open market, you may not be buying a 12 volt solenoid because it worked on 12 volts and you may get a 6 volt solenoid and find that it fails after a short time on 12 volts.

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You can buy new re-production solenoids with 1” shafts in both 6 and 12 volts

Seal click here

12 volt solenoid

6 volt solenoid

Solenoid Installation: first, always replace the seal in the transmission housing, if your seal is bad, oil will leak into the solenoid and damage the solenoid.
The special seal can be installed either way, there is no right or wrong way to install this seal. There is also a shaft seal in the solenoid itself, this is replaced when rebuilding and is not typically replaced in the field.

When you get ready to install the solenoid you want to line up the solenoid shaft so the flat spot is at 12 o’clock. Next apply battery power to the number #4 terminal on the solenoid and ground the case of the solenoid which will extend the shaft out. Next, carefully slide the solenoid shaft past the seal, you should apply a little white grease or Vaseline in the center of the seal and on the end of the solenoid shaft, this allows the shaft to slide in easier. Slide shaft in until the shaft engages into the pawl in the transmission. Once it is engaged turn the solenoid CW or CCW to secure the solenoid in the pawl and align the bolt holes. Next start the bolts loosely to align to housing, now release the power and the solenoid shaft should retract and suck in the solenoid. By using this practice will always ensure the solenoid shaft is connected correctly in the transmission pawl.

Now tighten the bolts on the solenoid, Note, there is no gasket between the solenoid flange and transmission, it is metal to metal contract.
This procedure will also works if the flat spot on the solenoid shaft is clocked at a different location than the original. The rule is you want the flat spot on the shaft to be at 12 'clock position when you insert the shaft into the transmission. Once the pawl is in the groove rotate the solenoid as necessary to line up the mounting holes.

When the solenoid is out and on the bench, never press down on the solenoid shaft to test the spring, this will damage the contract inside the solenoid and will need to be repaired. Also never try and rotate the shaft to another clocking position this will also damage the solenoid.
Every solenoid will install correctly regardless of the shaft flat spot location just follow the above steps.

Wiring your overdrive: go to the link below to see simple to understand wire diagram click this link.
New wiring harness link

Overdrive relay: The relay of choice is a newer and much improved relay that is easier to connect, has self re-setting internal circuit breaker that eliminates the old glass fuse and enclosed in a water tight case. These relays come in both 6 and 12 volts. **12 volt relay**

6 volt relay

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Governors: The governor is mounted on the tail shaft and connects to the same worm gear as the speedometer gear. This is a simple flyweight device, when the speed is around 28 MPH the flyweights engage a contact that goes to ground and tells the relay ok to engage the solenoid. There are **no** new governors produced, if you have one that is not operating correctly, simply remove and bench test with a power drill motor and ohm meter or trouble light to test. If not operating, remove the cover clean and adjust the contacts. Usually this is all needed to repair. There is a **rubber boot** that you can install over the end of the governor to protect the wiring.The old original boot is usually missing.

Kick down switch: This switch is mounted under the gas pedal or on the accelerator linkage, either way it allows the driver to press down hard on the gas pedal and activate the switch. This switch is a simple slide switch that closes the contacts and activates the relay and kicks the OD out of operation.

link to **kickdown switch**

Push pull cable: Mounts under the dash and allows the driver to activate and deactivate the overdrive. Normal operation the handle is pushed in and stays in unless parking the car to prevent rolling away. **Link to cable**

Converting from 6 to12 volts: The vehicles with OD's installed prior to 1955 or 1956 we be 6 volt systems, some positive and some negative grounds. When converting to 12 volts, the relay and solenoid need to be replaced with 12 volt devices. The kick down, governor and wiring will operate on both 6 and 12 volts. When converting to 12 volts you want to

wire the vehicle with negative grounds. The OD system works on both positive and negative grounds systems. **Conversion parts**

When converting to 12 volts: You can either order new 12 volt 1" solenoid and relay or you can order a reducer relay. Many folks will say there is no such reducer to operate these solenoids. That is generally true because a simple resistor will not work due to the high solenoid current draw. The solenoid also has dual coils, one to extend the shaft and another the hold it extended. Vintage Auto Garage has developed a single box that contains the 12 volt relay and 12 to 6 volt reducer/driver. This product is not a simple resistor, rather an electrical device that rapidly stores and releases electrical energy and will operate 6 volt solenoids on 12 volt systems. If the 6 volt solenoid is good or perhaps a long shaft solenoid which are not available, this product is a perfect set up. **Click here**

When doing a complete 12 volt conversion there are kits you can order that have the the needed parts. 12 volt conversion parts

Servicing and cleaning the overdrive: If the OD has not been service recently and has 50 year old lubricant, here is a simple way to clean without tearing the OD apart. Drain the fluid in the OD and the transmission

replace the plugs and fill with kerosene. Start the engine and run the transmission with wheels rotating for about 5-10 minutes, drain the dirty kerosene and refill with the correct overdrive and transmission fluid. Use only API rated GL-1 oil

You may need to repeat this process several times until the kerosene is clean. Dirty OD transmissions are a primary cause of operational problems and sticky solenoids.

Do not use synthetic gear oils.The sulfur and related additives in modern lubricants will destroy the bronze parts inside of the overdrive. Most all overdrive transmissions require four pints of lubricant. The OD and transmission share common fluid, there is a passageway between the two. You do need to drain and refill both the transmission and the OD itself.

Here is a link to the complete Borg Warner OD service manual, this is an on-line version that you can open and turn the pages.

Click here for original service manual

Click this link for all OD parts.

We hope this report answered your questions.

You can always call us 800-516-4461

Thank you!

Vintage Auto Garage