

Introduction

We hope that the installation of your new Novak clutch slave retrofit goes smoothly and that you achieve the improved results with your Jeep® that you intend. This guide covers the principles of installing our hydraulic clutch slave cylinder onto most standard shift Chevrolet, Buick, Ford and AMC bellhousings.

Despite your experience with automotive work, we strongly advise you to read these instructions, in which are contained the requirements, tips, hints and tricks of performing these conversions, both in our own facility and information we've gained from discussing this upgrade with our customers. Put this information to good use. Failure to implement the practices and information in these pages may jeopardize the quality of your work, as well as the product warranty.

Note to the Installer

This document and the use of any Novak products assumes a safe and adequate working knowledge of the automotive systems involved. We do not know and there is no way for Novak to determine the skill level of the customer and/or the installer of Novak products, or for Novak to publish all of the foundational information that an individual should know before attempting these advanced automotive upgrade procedures. Vehicular conversion work can be among the most difficult of automotive mechanical and electrical tasks and it is upon the customer to ascertain whether they are working within their expertise or whether they should acquire assistance.

Novak products and procedures are intended and recommended for off-road use only.

Additional Instructions

This instruction set is intended to be used in conjunction with *The Novak Guide to Clutches, Linkages & Bellhousings*, found on the Novak website at: http://www.novak-adapt.com/knowledge/clutches_etc.htm. This document is invaluable and is the greatest compilation of clutch set-up and troubleshooting knowledge available.



JEOP POWERTRAIN SUPERIORITY



Compatibility

This clutch release kit has been designed for the following applications:

- Chevrolet 90 degree pattern “Muncie / Saginaw” style bellhousings
- Buick 90 degree V6 & V8 bellhousings
- AMC / Jeep bellhousings, 1976-1986
- Ford Windsor V8, hydraulic style bellhousings only

Hydraulic Style Linkages

A word is in order here about hydraulic clutches and the misconceptions that surround them. Many individuals believe that it is the interaction of the hydraulic master and slave cylinders through which the force against the clutch pressure plate is multiplied. In fact, the actual multiplication of force occurs in two different areas of the clutch system. First it is in the leverage of the clutch pedal assembly. The master cylinder actuator being closer to the fulcrum of the pedal arm, distance is reduced and force is increased, through that great principle of physics with which all mechanically minded individuals are aware. Secondly, additional force is created through the leverage of the clutch release arm.



With the bearing, as provided by the clutch kit installed, a scale is inserted into the bellhousing window. Because it's a low-hat clutch and the bearing supplied is GM's shortest version, the gap shown is significant at $\sim 3/4$ ".

We consulted the chart below, chose a longer bearing and were back on track with our project.

This is the way any clutch release has been virtually since the inception of the automobile, which is to say taking ~ 8 " of travel at your foot at low force to create $\sim 3/4$ " of travel at the throwout bearing at high force.

Therefore the hydraulic system is simply a method of transferring that leverage - or better said, of transmitting force through the incompressible hydraulic fluid. This is very similar, in principle, as a good old mechanical linkage via pushrods, bellcranks or cables. Essentially no multiplication of force occurs within the hydraulic circuit itself as is common with other hydraulic systems like jacks, rams and presses.

Hydraulic Cylinder Diameters

The above info leads to the next useful principle: Nearly every clutch master cylinder is matched for size to its connected slave cylinder for a largely 1-to-1 relationship. So, a $3/4$ " bore master cylinder should usually connect to a $3/4$ " slave cylinder. A 1" master should have a 1" slave cylinder. A master cylinder that is larger could yield a rather spectacularly blown out slave cylinder and a master cylinder that is smaller will yield a rather disappointing lack of travel for your left foot's efforts. There are occasions where this ratio can vary slightly from this, but rarely more than 15%.

Once the installer understands this, the rest will come together more easily and in accordance with the principles outlined for conventional mechanical clutch systems.

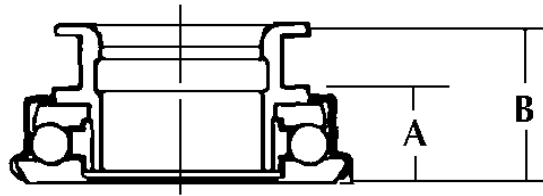
Installation

Measuring For The Correct Release Bearing

No installation of any clutch linkage will be successful if the throwout bearing being used is too long or too short and this is where too many in-

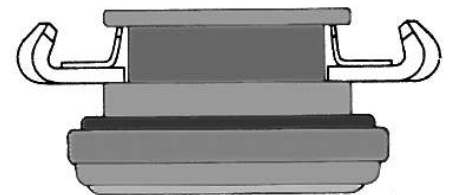


stallers unfortunately fail, and their clutches either don't release because of it, or they slip the disc under power and prematurely burn it up.



-A- Length	-B- Overall Length	Part Numbers
.625"	1.185"	N4008 -or- 614083
.750"	1.216"	N4068 -or- 614038
	1.235"	N4109 -or- 614109
21/32"	1.246"	N3068, N4172-or- 614018
	1.257"	N1488 -or- CC1705C
	1.410"	N1451 -or- G1697C
15/16"	1.609"	1377C
1-1/16"	1.699"	N1466 -or- G1625C
1.196"	1.775"	N1086 -or- 614037
1.310"	1.953"	1697C

This method is described in greatest detail at http://novak-adapt.com/knowledge/clutches_etc.htm, but in short, we recommend you measure the distance between the base of the transmission bearing retainer (where the throwout bearing housing's rear face rests) and the clutch spring fingers. Choose a release bearing (adjacent chart) that leaves between 1/16" to 1/8" gap between the release bearing face and the pressure plate fingers.

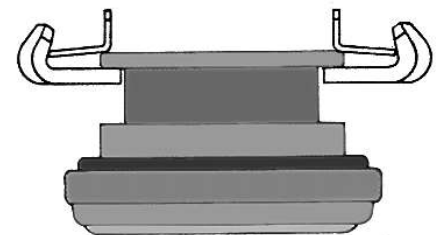


The right method of attaching a GM clutch fork to the release bearing.



The pivot on the left is a standard GM unit. The pivot on the right is an aftermarket adjustable pivot.

Adjustable height pivots are very useful for Chevrolet and Buick bellhousings, allowing for improved fork geometry and more assured clutch release.



The wrong method of attaching a GM clutch fork to the release bearing.

Hydraulic Clutch Line Adapter Fittings

These useful adapter fittings permit the adaptation of our #HCR to 1991-present Jeep master cylinders that use the o-ring style fittings.

These fittings each feature a male 1/4" DOT threaded ends so that the installer can use or make standard hydraulic lines or hoses for the particular situation. The tip inserts into your 1991-1995 Jeep YJ (and 1991-1996 Jeep XJ) or 1997-present Jeep TJ & XJ master cylinder using the factory style o-ring and retaining pin. We recommend that you verify your particular fitting with the image and descriptions below prior to ordering.

Note that 1980-1986 CJ's and 1987-1990 YJ's master & slave cylinders already feature a female inverted flare DOT fitting and do not require these adapter fittings.

Novak # HCA-1

Hydraulic clutch release line adapter, late style, short (typ. TJ)

This adapter fitting (image, upper) is typically for the 1997-2006 Jeep master cylinders.



Novak # HCA-2

Hydraulic clutch release line adapter, early style, long (typ. YJ)

This adapter fitting (image, lower) is typically for 1991-1995 Jeep master cylinders.



A common example of hydraulic hose / line use of these adapters when installing the #HCR kit is to buy or fabricate a line with a female DOT 1/4 fitting for the adapter/master side of the circuit. This line should then feature a male DOT 1/4 inverted flare end for the slave side of the hydraulic release circuit.

Installing Your Particular Slave Assembly

Chevy, Ford, Buick and AMC installations are shown in the following pages. After performing the steps outlined in them, return to this section to complete the installation.

Hydraulic Fluid

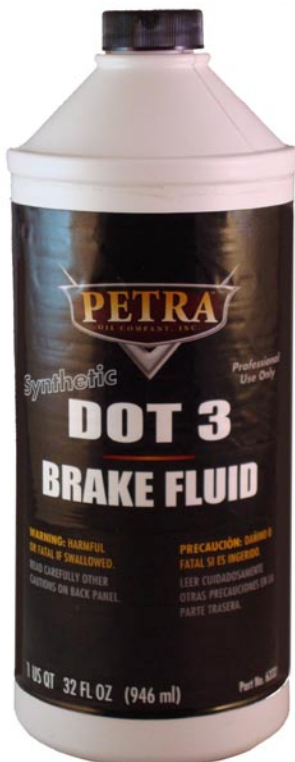
The proper fluid for this slave cylinder and nearly all domestic master cylinders is DOT3 or DOT4 fluid, which are polyethylene-glycol based, the latter having a higher boiling point.

Bleeding

Bleeding the air out of the hydraulic circuit is simple, and typically happens without intervention. If the master cylinder is mounted higher than the slave cylinder, any air bubbles typically guide themselves up the line and up out of the master's reservoir when the pedal is cycled a few times. For this reason, most current OEM hydraulic clutch systems don't even feature bleeder ports anymore.

However, if you have a floor-mounted or frame-mounted master cylinder that is lower than your slave, you will need to provide a bleeding method.

Once completed, fill the master reservoir with the proper fluid and bleed the system as you would a brake circuit by pumping the pedal a few times, holding down and having an assistant release then tighten the bleed screw. Refill the reservoir. Repeat the process until all the air is evacuated.

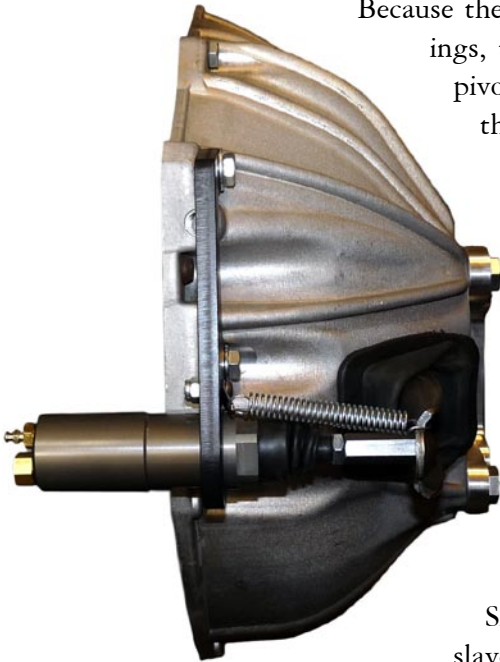


Chevrolet Bellhousings Version

Nearly all Chevrolet engines from 1955-present. It utilizes two of the engine block-to-bellhousing bolts to anchor its mount bracket. Most aluminum bellhousings made by Chevrolet from 1968 - 1988. Aftermarket bellhousings such as Lakewood, McLeod and others are also compatible with this system.

Clutch Arm Installation

Because the clutch arm is too large to insert into the window of most Chevy bellhousings, the clutch arm should be installed into the bellhousing and attached to the pivot prior to installing the slave bracket. However, it is possible to feed the arm through the bellhousing rear bore and through the window, if the transmission is pulled back. Determine which scenario works best for your situation.



Slave Cylinder Installation

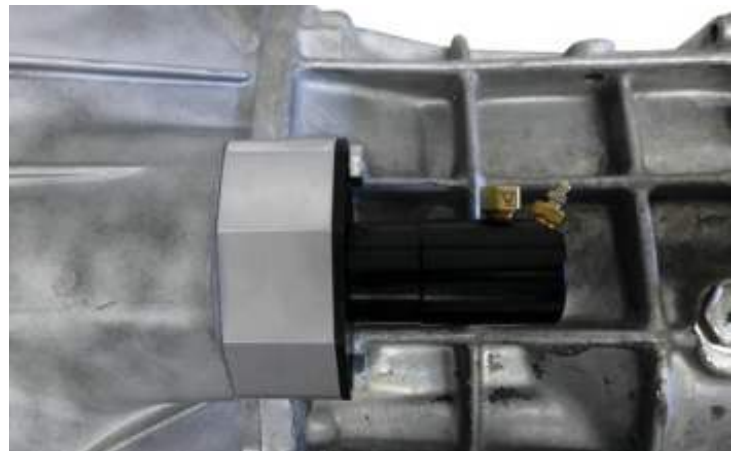
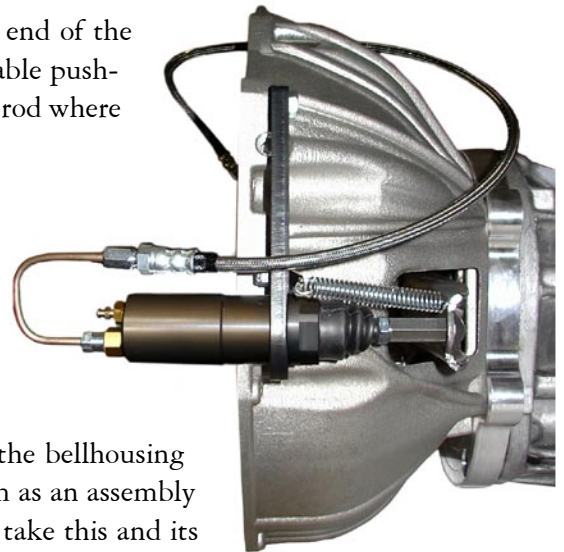
Loosen and remove the two bellhousing-to-block bolts at the ~9 & ~10 o'clock positions. Install the provided slave cylinder bracket tabs in their position. Install the two 3/8" bolts provided through their lockwashers and into the block. Tighten to 35-40 ft. lbs.

Now, install the slave cylinder through the main bore of the bracket and thread the included nut onto the slave cylinder threads and tighten the large nut using a large box wrench, open end wrench or adjustable wrench.

Slip the accordion boot over the end of the slave cylinder and insert the adjustable push-rod, making sure to grease the end of the rod where it will ride in the piston's seat.

Bolt the plated anchor washer to the bracket with the supplied 1/4" button-head bolt and Nylock nut. Now, loop the return spring's end hook through the eye of the anchor washer. You may wish to not fully tighten the anchor washer bolt until you have mocked up the full assembly and determined the optimal angle for it.

Now, note that it is possible and sometimes preferable to assemble the bellhousing to the transmission first, then lifting them as an assembly to the engine. If this is your situation, take this and its sequence into account as you read the directions.



Chevrolet Cast Iron Bellhousings

The classic cast iron bellhousing as found on so many Chevrolet engines from 1955 through the early seventies can be made to be compatible with this kit with two modifications:

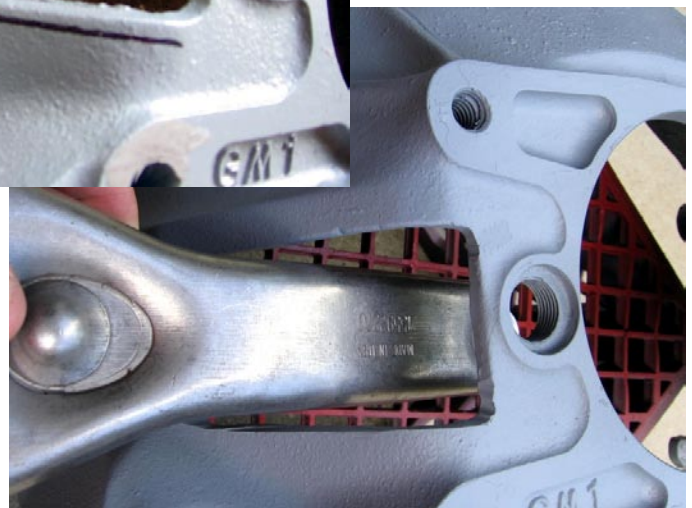
The through-boss at about 9 o'clock (see highlight in image, right) must be milled down to the same height as the through-bosses at 10 o'clock and 11 o'clock. This is a simple machining procedure and we would expect most machine shops to be able to bill it out at around 20 minutes.

Alternatively, one could install a spacer on the boss at 11 o'clock and adjust the pushrod shorter, accordingly. This cylindrical thru-spacer can measure 0.385" - 0.410" ID x 7/8" OD x 0.925" tall.



Once completed, our mounting bracket will sit at the same level as it does on the later aluminum bellhousings.

The clutch fork window is too narrow for the provided, hydraulic style release arm. Widening this window will be required, as shown.



Images and a good example of sanitary modifications are courtesy of customer S. Daily. Thanks also to customer B. Curley.

Ford Bellhousing Version

This version bolts to the popular Ford hydraulic style bell housings - typically Small Block V8 and Big Block V8 engines.

The Kit

Our #HCRF slave cylinder kit has been engineered to work with Ford V8's and their associated pressure plates.

The installer will use their factory Ford release arm and throwout bearing as indicated for use with your application.

Bellhousing Compatibilities

The Novak #HCRF has been proven to work on big clutch & small clutch as well as big bore and small bore Ford bell housings. Your bellhousing *must* have the factory hydraulic slave cylinder mounting bracket, as found with most ~1981-1991 Ford trucks.

Installation

Leave the factory slave cylinder bracket in place. Loosen the large nut on the Novak slave cylinder enough to create a space between the large steel washers, provided. Sandwich these washers over the bracket and orient the slave so that the bleeder is pointing upward. Tighten the large nut using a large box wrench, open end wrench or adjustable wrench.

Adjust the pushrod as required for optimal release. Connect the hydraulic lines as discussed above.

Why do we provide a hydraulic slave cylinder for an application that already featured one?

- Bore size: the factory Ford slave cylinders are typically oversized for many Jeep, car and truck applications, and therefore do not provide enough travel to release the clutch disc

- Hydraulic fittings: the factory Ford fittings are uncommon and problematic to connect to. Our standardized fittings make conversion work much easier

- External size: in tighter spaces, the envelope taken up by the factory Ford cylinder is just too much, considering frame, exhaust, steering and header clearances

- Composition: the plastic Ford slave cylinders are hardly reknown for their longevity. Our hardened and hard anodized billet aluminum cylinder and piston will give longer and more durable service



Buick Bellhousing Version

Our #HCRB clutch kit has been engineered to bolt to most Buick 90 degree style bellhousings. Many Buick, Olds and Pontiac bellhousings work with this assembly. Aftermarket bellhousings such as Lakewood, McLeod and others have thus far proven compatible with this system.

Steering Clearances

The Buick V6 is found in many factory and conversion CJ Jeeps and Commandos. If your Jeep has the original factory Ross bellcrank steering, this kit may not have enough clearance. Please see the pictures of the HCR kit as mounted to a bellhousing, and determine if it will fit into your Jeep.

Early Jeeps (1946-1971) that have had a proper Saginaw steering conversion should have enough clearance.

Clutch Arm Installation

Because the clutch arm is too large to insert into the window of most Buick bellhousings, the clutch arm should be installed into the bellhousing and attached to the pivot prior to installing the slave bracket. However, it is possible to feed the arm through the bellhousing rear bore and through the window, if the transmission is pulled back. Determine which scenario works best for your situation.

Slave Cylinder Installation



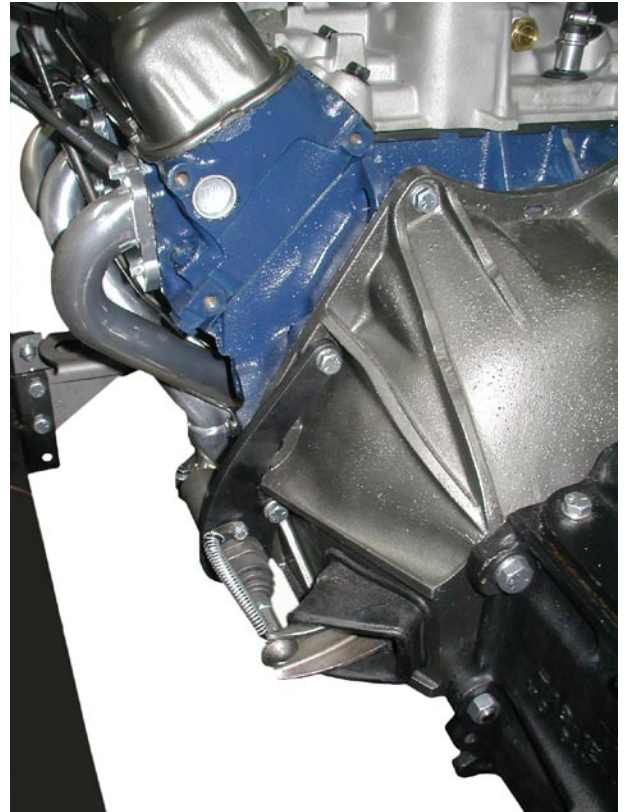
Loosen and remove the two bellhousing-to-block bolts at the ~9 & ~10 o'clock positions. Install the provided slave cylinder bracket tabs in their position. Install the two 3/8" bolts provided through their lockwashers and into the block. Tighten to 35-40 ft. lbs.

Now, install the slave cylinder through the main bore of the bracket and thread the included nut onto the slave cylinder threads and tighten the large nut using a large box wrench, open end wrench or adjustable wrench.

Slip the accordion boot over the end of the slave cylinder and insert the adjustable pushrod, making sure to grease the end of the rod where it will ride in the piston's seat.

Bolt the plated anchor washer to the bracket with the supplied 1/4" button-head bolt and Nylock nut. Now, loop the return spring's end hook through the eye of the anchor washer. You may wish to not fully tighten the anchor washer bolt until you have mocked up the full assembly and determined the optimal angle for it.

Now, note that it is possible and sometimes preferable to assemble the bellhousing to the transmission first, then lifting them as an assembly to the engine. If this is your situation, take this and its sequence into account as you read the directions.



AMC Bellhousing Version

Clutch Arm Installation

Because the clutch arm window on AMC bellhousings is generous, the clutch arm can be installed through it without bellhousing or transmission re-moval.

Slave Cylinder Installation

Loosen and remove the two bellhousing-to-block bolts at the ~9 & ~10 o'clock positions. Install the provided slave cylinder bracket tabs in their po-sition. We suggest using the bolts from your particular application and add the thickness of the bracket for new bolt lengths. Tighten to 35-40 ft. lbs.

Now, install the slave cylinder through the main bore of the bracket and thread the included nut onto the slave cylinder threads and tighten the large nut using a large box wrench, open end wrench or adjustable wrench.

Slip the accordion boot over the end of the slave cylinder and insert the adjustable pushrod, making sure to grease the end of the rod where it will ride in the piston's seat.

Loop the return spring's end hook through the small hole in the bracket and bend it to provide anchoring as necessary.

Now, note that it is possible and sometimes preferable to assemble the bellhousing to the transmission first, then lifting them as an assembly to the engine. If this is your situation, take this and its sequence into account as you read the directions.



Some AMC bellhousings may require that an unused ear of the aluminum flange be removed using a burr or saw, shown in this image. Never a separating disc or grinding wheel as non-ferrous metal may make them explode.



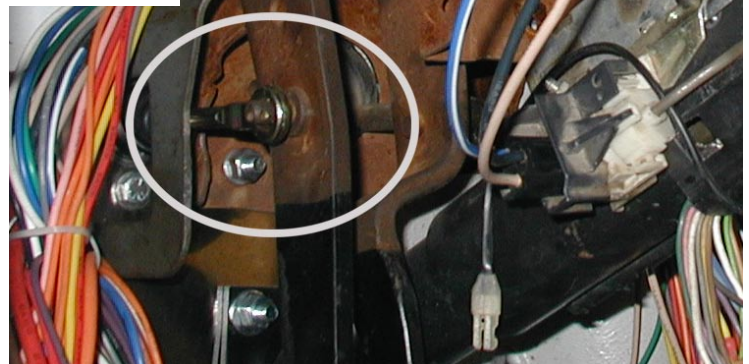
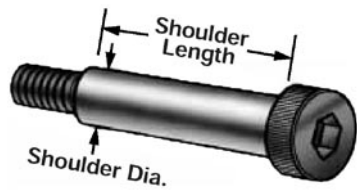
Master Cylinder Installation

Hydraulic slave retrofits are often done in conjunction with the installation of a master cylinder where one was not previously present. Because our HCR kits are used on so many Jeep, truck, car, kit car and muscle car applications, there is no way we could cover even a portion of the feasible scenarios.

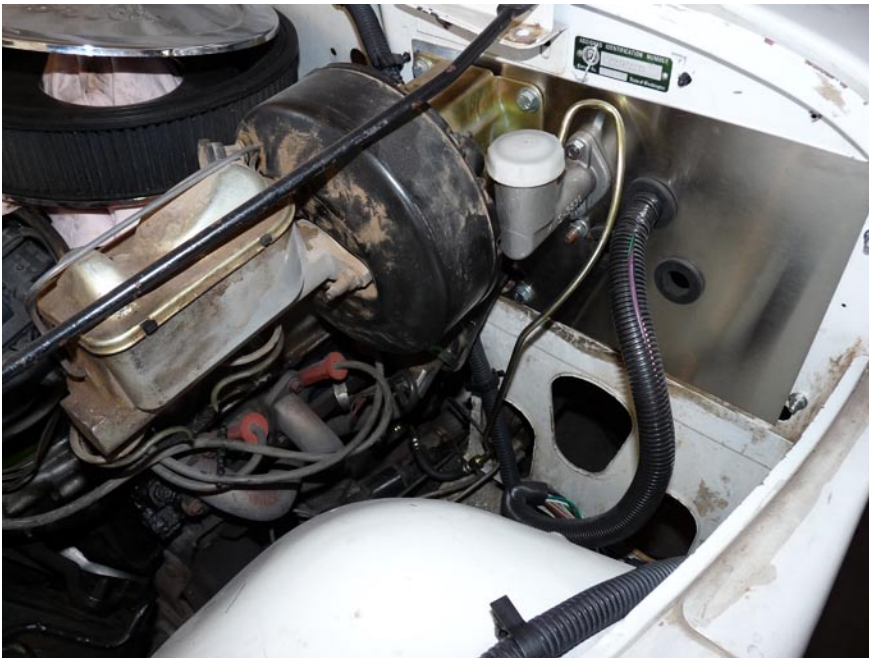


The case for most installations, however, is that there does not exist a firewall marking or clutch pedal pushrod boss to show the installer where to place the master cylinder. Consider these points as you engineer its placement.

- The master cylinder must be installed at the right height for optimal pushrod alignment, e.g., when the clutch pedal is halfway depressed, the pushrod will be parallel to the master cylinder bore centerline, equalizing the pushrod misalignment at the pedal's full rest and fully depressed positions.
- The master cylinder should be installed so that the maximum travel it allows is mostly utilized by the pedal, but leaving an allowance that prevents bottoming the master cylinder, e.g., if the master cylinder allows for 1-3/4" travel, find the point down from the pedal fulcrum that linearly travels 1-5/8" (leaving 1/8" safety margin) and make that your attachment point for the pushrod boss.
- Respect lateral alignment of the pedal attachment point to the centerline of the master cylinder bore. No misalignment here should



Shown here is a 1980's CJ. As Jeep began planning and installing hydraulic clutch systems as early as 1978, there is a die punch in the firewall indicating where one can install a 7/8" CJ master cylinder #5359822, or a 3/4" YJ master cylinder (shown here) #53004466. These units are durable, compact, affordable and have their own integrated reservoir and have standard DOT inverted flare line fittings.



This early Jeep CJ has had a stainless steel lamination attached to its firewall to give the master cylinder a more rigid attachment. It serves a second purpose of giving a clean slate, sealing off the handful of factory and non-factory holes placed in the firewall for various pass-throughs.

occur.

- Shoulder bolts (see adjacent diagram) make excellent clutch pushrod eye pivots. Use of a shoulder bolt through the clutch pedal shank may be possible if it has enough strength and body to permit a hole being drilled into it. If this is not the case, welding or otherwise attaching a cleat plate may be necessary. You may seek expert welding and/or mechanical design assistance here.
- Many firewalls were not originally made rigid enough for the forces placed on clutch master cylinders. It may be required to laminate or otherwise stiffen the firewall for adequate rigidity.

Troubleshooting a Clutch That Won't Release

- Far and away the most common cause of a clutch not fully releasing is the use of too short of a throwout bearing
- The second reason and a perniciously difficult one to diagnose is air ingress and/or internal fluid leak in master cylinder. Change as required
- If leaking fluid is present at line or slave cylinder, leaking line joint or slave hydraulic cup. Change or repair as required

Conclusion

We suggest that you keep these instructions for future reference. For questions concerning your conversion, contact us. We'll be pleased to answer your questions.

There is no final word to our instruction packages. If you have a question you feel this information should have covered and didn't, please let us know about it. You are also welcome to submit your suggestions, ideas and images that you think we should include here which may help future conversion installers. Note our contact information below.

