



1997-2006 Jeep Wrangler LS/LT Engine Swap Technical Guide

Overview

The Hooker Blackheart LS/LT engine swap system for 1997-2006 Jeep Wranglers has been comprehensively designed to provide the user with the highest level of component compatibility available for this vehicle application. The components designed as part of this engine swap system include:

Fabricated steel engine mounting brackets

LS OE-type clamshell engine mounts and polyurethane mount inserts

304SS 1-3/4" LS and LT engine swap headers

304SS Y-pipe assembly (2.5" primary legs into 3" outlet collector)

304SS 3" exhaust system

Using this system of components to install a GM LS or LT engine into a Jeep Wrangler will provide the user with benefits that are unique to the Hooker Blackheart LS/LT swap system.

These benefits are:

- **Maximum parts compatibility-** all system parts co-developed simultaneously
- **Maximum engine performance-** headers, Y-pipe and exhaust system are designed and sized specifically for LS and LT swaps in the Jeep TJ chassis
- **Maximum vehicle functionality-** engine mounting brackets, headers and Y-pipe provide the greatest amount of front suspension up-travel clearance available
- **Reduced installation time-** the stock 4.0L 6 cyl. engine mounting frame brackets are not required to be cut/ground off of the frame (some trimming required to their ends only)
- **Reduced total cost of installation-** body and/or suspensions lifts not required to execute the engine swap
- **Adaptability-** LS or LT engine can be installed interchangeably by swapping out only the engine mount cages and the headers.

The foundational design geometry of this swap system replicates the stock nominal passenger side crankshaft centerline offset position of the Jeep 4.0L engine to provide maximum front driveshaft clearance and maintain compatibility with the stock Jeep Wrangler skid plate without having to relocate the lateral (side to side) position of the transfer case mounting holes in it.

The crankshaft centerline is elevated higher than the stock 4.0L position to compensate for the lower underside clearance profile of the LS/LT engines compared to the stock 4.0L engine, and the engine/transmission mating plane is moved forward by approximately 2-7/8" from the stock 4.0L engine position. This mounting position places the Jeep Wrangler 231J transfer case in the stock OE position when the swap is executed using an LS-application 4L60e transmission and a 3" long aftermarket transfer case adapter. This engine swap system is optimized for installing a stock GM LS/LT engine (Gen III, IV or V) and a TH350, TH400, 4L60E, 4L80E or 6L80



transmission into the Jeep TJ chassis and mating them to the stock Jeep Wrangler NP231J transfer case with aftermarket transfer case adapters. Fitment validation of all of these transmissions was carried out using transfer case adapters from Novak Conversions and the stock 1997-2002 and 2003-2006 stock Jeep Wrangler skid plates. If you are using a manual transmission, different brand transfer case adapter, or a different skid plate/crossmember, you will need to be able to determine the correct mounting height for your transmission/transfer case combination and be able to fabricate a suitable rear mount for it. Manual transmission and alternative transfer case applications will quite possibly require the use of a body lift, so the user should be prepared to carry out the extra work required for such installations.

All parts within the Hooker Blackheart 1997-2006 Jeep Wrangler LS/LT engine swap system are compatible with both TJ and LJ models, except for the BH13212 exhaust system, which fits TJ models only in a bolt-in fashion.

Component Specific Design/Compatibility Information

Use of this Hooker Blackheart GM LS/LT engine swap system of components will provide the user with unrivaled vehicle and inter-component compatibility. The information provided hereafter is intended as a guide to assist the user in carrying out this swap in the timeliest and most cost efficient manner possible, according to their individual needs.

Jeep Wrangler body, chassis and drivetrain modifications

Those wanting to use the Hooker Blackheart LS/LT swap engine mounting brackets as the basis for building an emissions-legal engine swapped Jeep Wrangler YJ may do so by installing an engine and its complete emissions system (i.e. ECU/wiring, fuel tank/evaporative emissions system, exhaust manifolds and catalytic converters) from a qualified donor vehicle. Stock Chevy OE 5.3L/6.0L Trailblazer (EXT and SS models included) exhaust manifolds have been verified to be compatible with the Hooker Blackheart engine mounting brackets for LS installations, but a suspension and body lift will be required to use them and be able to obtain a desirable amount of front driveshaft clearance with the exhaust system. Check with your local/state government authorities to determine what specific equipment is required to keep the Jeep Wrangler being swapped emissions legal.

Jeep Wranglers being built for off-road/racing use that are using the Hooker Blackheart Jeep Wrangler LS/LT swap engine mounting brackets, headers and Y-pipe, do not require a body lift to install an LS/LT engine, 4L60E transmission and NP231J transfer case drivetrain combination into a them. This is applicable as long as the powertrain is mounted in a stock 4.0L-like inclination angle (approximately 6.5 degrees down relative to the bottom of the frame rails) on a stock Jeep Wrangler skid plate.

In all instances, the lower firewall pinch seam will need to be trimmed slightly on the driver side to clear the transmission case bellhousing. A 1" body lift will be required to install the drivetrain



in a belly-tuck configuration, or to install transmission or transfer case other than a 4L60E, TH350, NP231J or NP241C.

Although not required in this Hooker Blackheart engine swap application, a suspension lift may be of benefit to the user, depending on the type of terrain the vehicle is intended to be operated on and/or the amount of suspension up-travel that is desired in the front suspension.

New front and rear drive shafts may need to be made and will provide the opportunity to have the rear driveshaft built in a slip-yoke-eliminator/double cardan joint configuration for those in the position to rework their transfer case output shaft and rear axle/suspension to be able to work with this type of upgraded driveshaft. The stock Jeep Wrangler transfer case shift linkage will have to be modified/replaced in order to provide correct shifting of the transfer case. There are aftermarket components/kits available to carry out this task.

Engine Mounting Brackets and Engine Mounts

The Hooker Blackheart BHS513 LS/LT engine mounting brackets were designed specifically for use on 1997-2006 Jeep Wrangler 4.0L 6-cylinder engine frames and cannot be installed on Jeep Wranglers equipped with a 4-cylinder frame. The unique geometry of these engine mounting brackets eliminates the need to cut and grind the stock 4.0L engine stands off of the frame, and leaves the majority of their geometry in place to provide faster/easier installation, maximum strength engine mounting and no reduction in front suspension upper control arm clearance compared to the stock 4.0L engine mounting brackets. The stock steering shaft frame support bracket is also left undisturbed in the installation of these engine mounting brackets.

These engine mounting brackets are designed to use a specific type of engine mount to properly mount the engine. The engine mount clamshells required for this task are Hooker Blackheart part number 71221018HKR for LS engines and part number 71221019HKR for LT engines. Both of these engine mount clamshells requires the use of Hooker Blackheart 71221016HKR (black), or 71221017HKR (red) polyurethane engine mount inserts to complete the mounting of the engine.

For users wanting to install their engine using rubber engine mounts, stock replacement motor mounts for an LS1 equipped 1998-2002 Camaro can be substituted for the above listed Hooker Blackheart engine mount clamshells and polyurethane inserts. Do not attempt to use other brand aftermarket polyurethane inserts in this application as their dimensions have been confirmed to deviate considerably from GM factory specifications and will cause fitment issues when mounting the engine.

Use of these engine mounting components will produce a nominal 1/2" wide clearance gap between the firewall and the passenger side cylinder head, when the drivetrain is installed at a stock inclination angle configuration. If an engine/transmission belly tuck configuration is being used, the firewall-to-cylinder head clearance gap will be slightly larger due to the fulcrum position of the engine mounts.



Headers

The Hooker Blackheart BH13209 (LS) and BH13210 (LT) 1-3/4" 304SS engine swap headers were specifically designed to provide optimized fitment and function on the Jeep Wrangler chassis/body. They include the hardware needed to connect them to the Hooker Blackheart BH13212 Y-pipe and also an extra pair of V-band flanges to allow them to be connected to a user-built Y-pipe also.

There are no O2 sensor bungs included on these headers as they have been located in the Hooker Blackheart BH13212 Y-pipe for optimum packaging of the complete header/exhaust system.

The BH13209 LS headers will permit the A/C accumulator to be installed next to the firewall or be mounted remotely; the BH13210 LT headers will permit the A/C accumulator to be mounted remotely only.

These headers are designed to provide maximum front axle up-travel clearance and provide the ability to install the engine/transmission in a transfer-case-drop, or belly-tuck configuration without experiencing interference issues with the vehicle frame or body tub floor. They are also fitment compatible with many different transmissions.

The geometry of these headers has been optimized for use on engines that have been installed using the related Hooker Blackheart engine/transmission mounting components, attempts to use them with other engine mounting brackets that shift the crankshaft centerline closer towards the driver side of the vehicle may result in interference between the driver side header assembly and the steering shaft.

Exhaust manifolds

The following exhaust manifolds have been verified to be installation compatible with the Hooker Blackheart LS and LT swap systems for this vehicle application:

LS installations-

Hooker cast iron LS exhaust manifolds (all except turbo manifold set); not recommended for use without a suspension lift.

Stock 1999-2007 OE 5.3L/6.0L Silverado truck manifolds; not recommended for use without a suspension and body lift, right side manifold heat shield must be removed/notched to clear engine mounting bracket.

Stock 2003-2009 OE 5.3L/6.0L Trailblazer (EXT and SS models included) exhaust manifolds, not recommended for use without a suspension lift.

LT installations-

Hooker cast iron LT exhaust manifolds, not recommended for use without a suspension lift.
Stock OE truck manifolds- none have been validated at this time.



Exhaust Y-pipe

The Hooker Blackheart BH13211 304SS Y-pipe assembly has been designed to provide bolt-in compatibility with the Hooker Blackheart BH13209 and BH13210 headers and also maximum flexibility to work with multiple types of front suspension systems.

It can be used with drivetrains installed in both transfer-case-drop and belly-tuck configurations and connects directly to the Hooker Blackheart BH13212 3" exhaust system in both instances.

The bend geometry of this Y-pipe is designed to clear the sumps of the stock truck and Holley 302-2, or 302-3 oil pans in LS applications and the Holley 302-20 oil pan in LT applications. The Holley 302-2 and 302-3 oil pans provide an increase in front axle up-travel over the stock LS truck pan. Those using the stock LS truck oil pan will need to remove the oil level sending unit from the pan and plug it as it is not usable with this Y-pipe.

Exhaust System

The Hooker Blackheart BH13212 (3") exhaust system is designed to be compatible with the stock rear suspension system, aftermarket rear control arms, increased size rear wheel/tire assemblies and/or bolt-on lift kits on TJ model Jeep Wranglers. Fitment and compatibility of this exhaust system on the longer wheelbase LJ models has not been ascertained.

This exhaust system includes two different inlet tubes to ensure the system is compatible with the Hooker Blackheart BH13211 Y-pipe, whether the drivetrain is installed in a transfer-case-drop, or a belly-tuck configuration.

For greater vehicle off-road functionality, the turned-down tip of the tailpipe assembly is positioned so as to not extend rearward of, or lower than, the stock fuel tank protective skid cover. Bolt-on compatibility of this systems with altered-configuration rear suspension systems should not be expected due to the many design variables involved.

Transmission and Transfer Case

This system is optimized for the combined installation of a GM TH350, TH400, 4L60E, 4L80E or 6L80 transmission and the stock Jeep Wrangler NP231J transfer case behind an LS or LT engine. These engine/transmission combinations can be installed into the vehicle at a stock engine/transmission inclination angle, or in a transfer-case-drop configuration, without requiring the use of a body lift kit.

Installing these same engine/transmission combinations in a belly-tuck configuration, or a manual transmission or aftermarket transfer case, will more than likely require the use of a body lift kit (1" or greater). In all instances, possible modification of the stock transfer case shift linkage being required should be expected.



The TH400, 4L60, 4L80E and 6L80 transmissions have all been validated to be installable on the stock 1997-2002 or 2003-2006 Jeep skid plates using nothing more than the parts included with the Novak transfer case adapter for each transmission, and a Hooker Blackheart 71223029HKR or 71223030HKR transmission mount. The stock skid plate will need to have two new mounting slots placed in it to provide a means of attaching the transmission mount to it.

Installation of a TH350 transmission will require the use of a custom made rear mount adapter as its mount position is too far forward to permit it to be landed directly onto the stock skid plate without the shelf parts.

Oil Pans

This system is designed for use with the stock GM truck, Holley 302-2, or Holley 302-3 oil pans in LS applications and the Holley 302-20 oil pan in LT applications.

Intake manifolds

OE LS car and truck intake manifolds can be used in this swap application. The OE LS truck intake manifold cover will not clear the under-side of the hood on vehicles not equipped with a body lift. The front mounting boss for the cover of the LS truck intake manifold will need to be trimmed down, or the front bolt stand-off of the cover itself will need to be modified slightly, for the cover to fit under the hood with a 1" body lift. The EGR valve used on some LS truck intake manifolds may also experience hood interference on vehicles not equipped with a body lift.

OE LT car and truck intake manifolds can be used in this swap application. The OE LT truck intake manifold cover will not clear the under-side of the hood on vehicles not equipped with a 1" body lift. The stock Jeep Wrangler sheet metal electrical harness plug support bracket above the engine must be removed from the firewall to provide clearance for the OE LT truck intake manifold; this can be accomplished by drilling out the rivets attaching it to the firewall with a 1/4" drill bit.

Accessory Drive Systems

Gen 3 and 4 LS/Vortec truck engines

The stock F-body accessory drive system is not recommended for use in this application due to its low-mounted A/C compressor and alternator creating clearance issues with the front suspension upper control arms.

The stock Corvette accessory drive system can provide suitable functionality for some users, provided the A/C compressor is relocated to the top of the right side cylinder head using Holley 20-140 (for R4 compressor), or 20-141 (for Sanden SD7B10 compressor) relocation brackets, or by notching the frame rail to provide clearance for a low-mounted A/C compressor.



The stock Vortec truck accessory drive system is very well suited for use in this application with the exception of the low mounted A/C compressor, which will interfere with the right side frame rail. Solutions to solve this interference include using the same Holley A/C relocation brackets, or frame notching, mentioned above for use with the Corvette accessory drive system.

For users wanting to use a low-mount A/C compressor with either the Corvette or Vortec truck accessory drive systems, The Holley 20-160 low-mount Sanden SD7B10 compressor kit tucks the compressor much closer to the engine than any stock LS/Vortec A/C compressor and requires much less severe notching of the frame in order to install it.

Using any low-mount A/C compressor set-up will require the front suspension to be modified into a 3-link configuration to prevent the right side upper control arm on the front axle from colliding with the A/C compressor.

For users seeking maximum suspension clearance available from an accessory drive system in this application, the Holley 20-180 LS mid-mount accessory drive system will satisfy that requirement. Conversion to a 3-link front suspension is not required to install and use this system.

Gen 5 LT engines

The recommended engine accessory drive systems to use with the Hooker Blackheart Jeep Wrangler LT swap system components are the stock GM truck FEAD system, or one of the Holley mid-mount LT FEAD systems (20-200/20-201).

Fan, Shroud and Radiator

Gen 3 and 4 LS/Vortec truck engines

If desired, a mechanical fan/fan clutch can be used in applications where a stock truck water pump with the threaded pulley snout is being used on the engine. To facilitate this, a fan and fan clutch from a 1999-2004 Chevrolet Silverado 1500 5.3L (LM7) engine can be installed along with a down-flow Radiator and the stock Jeep Wrangler 4.0L fan shroud.

For vehicles not using a body lift, the Jeep Wrangler 4.0L fan shroud must be modified to allow it to be raised approximately 1-1/4" (the absolute amount is determined by the inclination angle at which the engine, transmission and transfer case are installed in the vehicle) from the stock mounting position on the radiator and also be shifted over towards the passenger side of the radiator by 1/2". For vehicles that are using a body lift, the amount the fan has to be raised over its stock mounting height on the radiator will be less (if any, depending on the height of the body lift) than required for vehicles without a body lift. The 1/2" re-position towards the passenger side of the radiator is required regardless of whether a body lift is being used or not.



The modification of the fan shroud should take place after the radiator, engine, transmission and transfer case have all been installed in their absolute final operational positions, as changes to any of them will have an effect on the alignment of the fan shroud with the fan.

An aluminum cross-flow radiator with an electric fan/shroud assembly can also be used to handle cooling duties on vehicles equipped with a suspension lift. A cross-flow radiator would be recommended for use in a no-body-lift swap, or one with a smaller amount of suspension lift, as it will place both the inlet and outlet stubs of the radiator on the passenger side of the vehicle for hose routing convenience and will tuck the lower radiator outlet and hose up higher in the vehicle for greater suspension travel clearance compared to a down-flow radiator. The maximum combined thickness of the radiator, electric fan and shroud intended to be used is limited to 6.5" when an OE truck, or the Holley mid-mount accessory drive system is being used. Shorter length accessory drive systems will provide more radiator/fan/shroud installation space for those seeking it.

Gen 5 LT engines

An aluminum down-flow or cross-flow radiator with an electric fan/shroud assembly can be used to handle cooling duties on vehicles equipped with a suspension lift. A cross-flow radiator would be recommended for use in a no-body-lift swap, or one with a small amount of suspension lift, as it will place both the inlet and outlet stubs of the radiator on the passenger side of the vehicle for hose routing convenience and will tuck the lower radiator outlet and hose up higher in the vehicle for greater suspension travel clearance compared to a down-flow radiator.

The maximum combined thickness of the radiator, electric fan and shroud intended to be used is limited to 6.5" when an OE truck, or the Holley mid-mount accessory drive system is being used. Shorter length accessory drive systems will provide more radiator/fan/shroud installation space for those seeking it.

Air Conditioning

In LS swap applications, the A/C accumulator may be remotely located, or can be mounted near its factory position against the firewall by modifying the bends in the accumulator inlet/outlet tubes and trimming the lower lip of the factory battery mounting tray. The A/C accumulator must be relocated in LT applications due to header interference issues with it being located near the firewall.



Front Suspension

The engine mounting brackets, headers and Y-pipe in this Hooker Blackheart LS/LT swap system were all designed with special consideration given to how their geometry would impact clearances between themselves and various types of suspension system components.

Because of this effort, these components will be compatible with the stock Jeep Wrangler suspension as well as many aftermarket medium/long arm, 3-link, 4-link and radius arm suspension systems, depending on the engine accessory drive system chosen for use.

Electronic Engine/Transmission Control and Wiring

For those pursuing a street-legal engine swap, all the emissions control equipment from the engine donor vehicle, and provisions for operating/monitoring them properly, must be transferred onto the Jeep (i.e. PCM/electrical harness, catalytic converters, O2 sensors, EGR and evaporative emissions).