**How-To**

**Chain Drive** Replacement, Modification & Maintenance  
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**Tools Of The Trade**

Before launching into a full-scale final drive replacement, you’ll need to collect a few things. Obviously the new chain and sprockets must be chosen, but you’ll also need a multi-purpose chain tool. These are used to a) “break” endless chain (an OEM or replacement chain that lacks a clip-type master link), b) remove links from a new chain that’s longer than necessary, and c) install a rivet-type master link (the most common type on street bikes). These tools are available in different sizes and configurations and across a wide range of prices.

**Break It Down**

Strip off everything in your way, like the chain guard, countershaft sprocket cover, and—if your bike is so designed—clutch actuation hardware. Read the related sections of your shop manual before taking things apart for any special procedures.

A worn-out endless chain will come off whole if you remove the swingarm, but it’s much easier just to break the chain. This can be done with a hand grinder and a small punch, using the former to grind off the staked end of a chain pin and the latter to force that pin out of its bushing. But it’s much easier to use a chain tool, which clamps onto a link and forces its pin out using a powerful screw mechanism. But as the chain pin is made of hardened steel, it’s still not a bad idea to grind off the head of the rivet first, to eliminate the possibility of breaking the tool’s pushing bit.

If the old chain has a clip-type master link, the job may be as simple as slipping off the master link’s clip, removing the

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sideplate, and sliding it out the other side. But some of these clipped links are so tightly pressed into place that they require the same treatment as an endless chain. With a pin or master link gone, the chain can be pulled off the bike easily. However, it may be able to serve a final purpose before being removed and discarded.

**Turn, Turn, Turn**

Countershaft sprocket retaining nut removal requires that the countershaft be held still. Putting the transmission into a high gear may work, but the high torque necessary to break it loose may also put a strain on your gearbox. Leaving the old chain in place makes possible an alternative. You can apply the rear brake, so that with the chain in place, this immobilizes the countershaft.

Many countershaft sprockets use a special locking washer to prevent loosening of the retaining nut. These are wide, splined rings made of metal soft enough to allow a section to be bent against a flat on the retaining nut. These must naturally be re-flattened before removing the nut. This can be accomplished with a hammer and a chisel or thin flat-blade screwdriver (their tips may chip in the process, so wear eye protection). A 1/2"-drive air impact wrench or similarly powerful electric impact tool can then quickly spin off the retaining nut. Without one, a large breaker bar will be needed, as these nuts are very tight. See your shop manual for the correct procedure if your bike uses a different retention system.

Note that countershaft sprockets aren’t always symmetrical front-to-back, so be sure to have the proper face outward when mounting the replacement. You may have to wait until the new chain is installed when mounting the replacement. You may have to wait until the new chain is installed (to again immobilize the countershaft) before torquing the retaining nut. Afterward, the edge of the lock washer can be lifted and then pressed squarely against a flat on the retaining nut with a large pair of slip-joint pliers.

To change the rear sprocket, remove your rear wheel and lay it sprocket-side up on a wheel stand, wooden blocks, or extra tire. Make sure your brake rotor doesn’t bear any weight as it can easily be bent out of true. Sprocket retaining nuts are usually on very tightly, and it can be difficult to keep the wheel from rotating as you try to undo them. This would be another good occasion for an air impact wrench. Otherwise, pull your breaker bar or long-handled wrench in an arc across the wheel’s center. This will put you in the best position to hold the wheel still while maximizing your leverage on the nuts.

Once freed, the bolts that held the sprocket will probably fall into the wheel hub. Pull the hub out of its rubber dampers and notice their orientation, so you can reposition them correctly during reinstallation. Inspect the sprocket carrier’s wheel bearing, and apply fresh grease if needed.

Reverse the process to install the replacement rear sprocket using proper torque on the nuts, and the rear wheel can now go back on. Set the axle adjusters to their most forward positions without tightening anything to ease the job of getting the new chain over the rear sprocket.

**Together Again**

Thread the chain around the front sprocket and bring its ends together at two o’clock on the rear sprocket; this keeps the end links aligned and lets you insert the master link without having to also support the ends of the chain. The ideal length chain (with proper slack) will situate the rear wheel in the forward third of its adjustment.
range, leaving plenty of room to take up excess slack as it wears.

Always use the same brand, size and type master link as your chain; new chains will have one included. Coat O-rings (if present) liberally with high-pressure grease (also usually included) and slip them on the pins. Cover the pins with grease and fill the holes where those pins will go. Insert the pins into the chain ends from the inboard side, then slip the remaining O-rings, also greased, onto the pin tips.

Depending on the master link’s tolerances, pressing the outboard sideplate onto its pins may require considerable force, and the sideplate must be pressed on evenly. This is best done with a chain tool (reconfigured now to press mode), but slip-joint pliers may also work if their handles afford adequate leverage. The sideplate must go on far enough to allow adequate securing by the clip or pin flares, but not so far that it causes binding with adjacent links. This takes patience. Carefully monitor the master link width while you squeeze, and stop when it’s almost even with its neighbors. You can always apply more pressure if needed, but it’s virtually impossible to reverse the process.

On a clip-type master link, the sideplate is on far enough when the grooves in the pins have been fully exposed to allow the clip to seat properly. Always mount retaining clips with the closed end pointing in the direction of movement (i.e., toward the front of the bike when on the top chain rung). Mounting these clips can be tricky because of their high tension. They tend to either fly off or end up stuck in a not-quite-seated position, quickly losing the ability to return to their original shape. The sideplate must go on far enough to allow adequate securing by the clip or pin flares, but not so far that it causes binding with adjacent links. This takes patience. Carefully monitor the master link width while you squeeze, and stop when it’s almost even with its neighbors. You can always apply more pressure if needed, but it’s virtually impossible to reverse the process.

Check It Out

Excessive chain slack will result in driveline snatch, and can, in extreme cases, allow the chain to jump a tooth or completely fly off a sprocket during operation. Inadequate chain slack can break the output shaft, as well as put additional strain on the chain, possibly resulting in its failure. Either way, the consequences can be catastrophic. Slack adjustment is a simple, albeit tedious, procedure that should be checked regularly.

Chain slack is affected by the drive sprocket’s concentricity and not all drive

The old sprocket (right) is slightly “hooked.” Its replacement is lighter, and lacks the noise-dampers of the stocker.

Cleaning the grungy chain pathway was by far the worst part of the entire job, but once clean, it looked much better.

Wheel Removal—Rear wheel liberation is very simple once the chain is out of the way.
sprockets are perfect. Inconsistent flexibility along a chain’s length can also make significant differences in how much slack shows up, depending on which links are being checked. Turn the rear wheel to find the point of least slack and set the recommended chain slack at this point. Also, be sure to have your bike supported properly for the measurement. If your manual gives you a slack spec for the bike on its side-stand, don’t take the measurement with the bike on its centerstand. If you don’t have a recommended slack figure, remember that when the centers of both sprockets are aligned with the swingarm pivot (which may take some heavy weight on the rear suspension with the wheels on the ground to achieve), the chain will have minimum slack and it should still have some noticeable slack at this point.

To measure slack, locate the middle of the lower run of the chain, and with a ruler stabilized against the swingarm, push down lightly on the chain and read where its upper edge rests against the ruler. Next, push the chain upward with the same pressure and take a second reading at the exact same place on the chain. Subtract the second measurement from the first; this is your slack. It’s best to be toward the looser end of the acceptable range; this may mean more frequent adjustments, but it guards against the possibility of engine and/or chain damage caused by inadequate slack.

**Let’s Get Something Straight**

Those hash marks on your swingarm can help get your adjusters “in the ballpark,” but they’re notoriously imprecise and can’t be relied upon for accurate rear wheel alignment. Proper alignment will ensure: a) the rear wheel is in-line with the front wheel, b) the rear wheel is parallel with the swingarm pivot, and c) the rear sprocket is in-line with the countershaft sprocket. Ideally, these would all be synonymous, but inconsistent manufacturing tolerances, especially in the manufacturing of frames and swingarms, can create misalignments.

Various alignments can be given priority, depending on an owner’s preference. Wheel alignment may be more important to some, as it affects handling, than perfect chain alignment, and there are a variety of tools available to make a variety of measurements. Keeping the swingarm pivot parallel to the rear axle is sensible, and Muzzys Performance Products makes a special tool for this job. It has cones that can be arranged on a graduated bar to ensure the distance from pivot to axle is the same on each side (www.muzzys.com); $149.95.

If sprocket alignment is your priority, you can use Motion Pro’s Sprocket Alignment Tool, which clamps onto the rear sprocket and allows sighting down a pointer that mimics the sprocket’s plane (a straightedge against the rear sprocket might also work, if space allows).

Once you are satisfied, torque all the related fasteners and check slack again, as the tightening process can sometimes cause it to change, either due to accidental adjuster movement or because of design or manufacturing anomalies. Re-adjust until it’s just right.

Nobody wants to repeat tedious work more than necessary. Once the rear is aligned, slack adjustments will be quick if you very carefully turn each adjusting bolt just one flat at a time—moving them both the exact same distance. Check slack again after the first 100 miles as chains typically wear most rapidly when new (assuming they aren’t neglected or abused later), and inspect alignment regularly.
Final Touches

We’re not sure expensive chain lubes do much more than plain old WD-40 or silicone-based lubricants when it comes to O-ring chain maintenance, although they must be applied more often. Use a dedicated chain lube if you’ll be riding through dust or rain. For less extreme conditions, cheaper general-purpose products may serve just fine, and sling less mess onto your rear wheel.

The white grease on your new chain should be wiped off before use; it’ll quickly fling off the chain and what remains will catch and hold debris. Use a chain-specific cleaner or WD-40. Subsequent cleanings may require brushing to remove grunge from the chain’s myriad cracks and crevices, and the aptly named “Grunge Brush” works well (see Innovation of the Month, January 2011). Never use a wire brush on O-ring chains, as it can damage the O-rings.

Lubing a chain is something best done while spinning the rear wheel by hand with the bike on its centerstand or supported by a work stand. Aim the spray can’s straw downward onto the sideplates, both inboard and outboard, on the lower rung. Spin the wheel a few extra revolutions to work in the lube. Ideally, chains should be lubed at operating temperature; at the end of a ride, not the start, and the lube allowed to set-up (giving time for the lube’s thinning solvents to evaporate) before riding again.

Making Gearing Changes

If your bike’s final drive ratio doesn’t suit you, it’s easily changed. If you’re already replacing worn components, there’s little additional cost involved. For easier take-off from a stop and more vigorous acceleration, choose “shorter” gearing—that is, gearing with a higher reduction ratio. For instance, a 15-tooth countershaft sprocket paired with a 45-tooth rear yields a final drive ratio of 3.00:1 (45/15), meaning the front sprocket turns three times for every revolution of the rear. Switching to a larger rear and/or smaller front will give the engine greater leverage—just like shifting to a lower gear.

Pairing a 14-tooth front with that 45-tooth rear will yield a final drive ratio of 3.21:1 (higher ratio = “shorter” gearing). Or, you could go up three (to 48) out back for the same result (48/15 = 3.20). Although front sprockets are typically cheaper than rears and don’t usually require a new, longer chain, there are reasons for going with the bigger rear sprocket: One is pressure on the chain slider (the plastic piece that prevents the chain from touching the top of the swingarm). Smaller countershaft sprockets will also increase the “squat” effect inherent in chain-drive systems during acceleration and cause the slider to wear faster. Smaller drive sprockets also increase friction and accelerate wear as each link in the chain must bend more tightly around the sprocket’s smaller diameter on every revolution.

Rear sprocket size increases may, however, be limited by other factors, such as chain guard height. Before selecting your new sprockets, check such clearances. Shorter gearing delivers harder acceleration in each gear, but each gear will also have a lower top speed. Likewise, at any given road speed in a particular gear, the engine will be spinning faster, and gas mileage will drop accordingly. So, riders seeking a higher top speed, improved mpg, increased range, or simply a more relaxed engine while cruising rpm may want taller gearing—if they can live with...
softer acceleration. It’s always a trade-off! Check www.gearingcommander.com for ratio tables.

If your bike’s speedometer uses a countershaft speed sensor rather than a front wheel speed sensor or worm-drive speedo cable, changing sprocket sizes will distort its readout (and the odometer’s). A recalibration module like the SpeedoHealer (www.healtech-electronics.com) will also be needed or you’ll have to mentally adjust your speedo reading by the percentage of final drive ratio change.

Changing sprocket tooth count may change the required chain length. Add one link for every tooth added to your sprockets. But, whether or not you change your sprockets’ number of teeth, you may want to change their size, along with that of your chain. Why?

**Chain Sizes**

Changes in size differ from changes in length. The most popular is the “520 conversion”—replacing a stock 525 or 530 chain with a smaller, lighter 520 aftermarket chain. Chain numbers specify two dimensions: The first digit indicates a chain’s pitch (the distance between its pin centers) in eighths of an inch. Most motorcycle chains begin with “5,” and thus have a 5/8” pitch; “6” is for 6/8” or 3/4”. The remaining numbers designate the width between the inner sideplates. Chains ending in 20 have 2/8” or 1/4” clearance, those ending in 25 (read 2.5) have 5/16” clearance, and those ending in 30 leave a 3/8” space. Chain and sprockets must be the same size.

Switching to a 520 chain can result in reduced friction and more than a pound of weight savings. But you should check the maximum engine size/horsepower recommended for any chain under consideration. Also, since racers are the most interested in saving weight, and have the greatest need for the widest variety of gearing options, the largest selection of chains and sprockets to choose from are in the 520 size.

**Chain Types & Prices**

O-ring chains have—as you’d guess—tiny O-rings that seal grease in their bushings. X-ring chains simply use seals with an X-shaped cross-section. This shape traps additional lubricant along each seal-sideplate interface, increasing the chain’s flexibility and further decreasing wear.

Variations on this theme are seen in XR- and XW-ring chains. Non-O-ring chains don’t have any seals, therefore wear more quickly and are consequently rare.

Chains vary widely in price; don’t spend more than necessary. High-end chains may provide “advantages” that are meaningless in normal use, such as miniscule additional weight savings, colors or strength that’s just more overkill on non-competition machinery. Buy the least expensive X-ring chain you can find for your engine size/horsepower from a reputable manufacturer (e.g. D.I.D., EK, RK, Regina or Renthal). Don’t cheap out with questionable hardware! Having a chain break could result in not only the loss of forward thrust, but also sudden rear wheel lock-up and/or severe engine damage—not to mention leaving you stranded or possibly with a physical injury.

**Bottom Line**

While this article may inspire you to purchase the special tools you need to break and rivet chains and change sprockets, it should also make you appreciate the skills you’ll have to pay for if you let someone else do the job. Happy wrenching! 😊