

How to Extract Stuck Screws.

Here's a guide to un-sticking stuck fasteners.

Imagine this: You're doing the first tune-up on your newly acquired bike. To get the oil filter cover off you need to remove three cross-head screws. You apply your trusty \$1.89 K-Mart screwdriver to the first screw, and turn. The screwdriver slips out, so you try again, pushing harder. It slips out again, rounding the screw head a little. But you've got your trusty Vice-Grips in the tool box, so you clamp them onto the screwdriver's shank and really bear down on the screwdriver... this time stripping the head completely. Arrrgh!

If you've worked on bikes at all you're probably nodding your head right about now, saying "yeah, I did something like that." Bikes today have higher-quality fasteners than they did 10 or 20 years ago, but still the various forces of entropy conspire to stick fasteners together a little stronger than they're designed for. Here's a guide to un-sticking stuck fasteners.

Impact Driver

The best remedy for a stuck screw, or one whose head has been stripped, is the impact screwdriver. An impact screwdriver is essentially two weights held apart by a spring. The bottom one holds screwdriver bits. You smack the top one with a hammer. In between them is a spring and a circular ramp. The ramp makes the bottom weight with the bit in it turn. So when you hit the top weight, giving it momentum, it compresses the spring and hits the ramp which turns the screwdriver-bit-holding bottom weight. The beauty of the design is that the force you impart to the impact wrench by hitting it with the hammer is forced into the screw, helping the screwdriver bit bite into the screw head (or what's left of it). Most impact drivers will let you set them for left and right turning, to loosen or tighten screws.

The high-quality, hardened screwdriver bits that come with impact drivers usually fit the screw heads much better than even the best screwdrivers, which helps all by itself. So at the first sign of a recalcitrant Phillips head screw, reach for the impact driver! Impact drivers are commonly available and cost about 15 (American) dollars - check your local auto supply store.

Some cheap impact drivers have (relatively) stiff springs which require a heavy hammer to compress and get the ramps to turn the bit. Be warned that the force needed may be damaging to the assembly in which the screw is stuck, or may be difficult to counteract on an awkward piece. These impact drivers can benefit from being disassembled and having the springs shortened slightly (no more than 25 percent) to reduce the spring preload. After this modification the driver will not require as much force but may not work quite as well on *really* badly bugged screws.

Screw Extractor

When an impact driver can't remove a screw, or there's not enough of the screw protruding to grip, the next step is to drill off the screw's head and then use a screw extractor.

A screw extractor is a very hard reverse-thread bit. You drill a hole into the screw, then carefully tap the proper extractor (which has a smaller initial diameter than the hole, and quickly flares out) into the hole, and use it to twist out what is left of the screw. The reverse flutes on the extractor cause it to bite harder into the metal of the screw as you put more force on it. Screw extractor bits are made of very hard metal, so they are very brittle. It is very easy to break one off inside the screw. When that happens you are screwed (sorry for the pun)- the extractor metal is harder than any drill bit, so you can't drill it out. The only recourse will be EDM (see below). To turn the extractor you should use a tap handle commonly used to turn threading taps. The screw extractor has a square end to fit into the tap handle. Using a regular wrench to turn the extractor is almost guaranteed to break it.

You should be very careful when drilling the hole in the screw. Obviously you don't want to drill into the material surrounding the screw, so be careful to line up the drill in the center of the screw. Use a drill press if you have one and the part is small enough that you can set it up solidly in the press. Drill slowly and stop often to check your progress. Drill a small pilot-hole first, using a punch to mark the spot before you start drilling.

Drilling out screws

If that doesn't work, the next option, depending on the design of the cover that the screw holds down, is to drill out the screw head completely. Often times, removing the head of the screw releases the pressure of holding two parts together, and again will come out easily, unless of course it is rusted or frozen. In this case, if there is enough of the screw-shank sticking out after the cover's removed to let you file flats on it, use locking pliers to turn it.

Use a drill bit that is just large enough to take out the screw's head; it should be slightly larger than the shank of the screw so that when you drill through the head and get to the shank the head will come completely off. Obviously you need to have the hole exactly centered to do this without touching the surrounding material. If the bugged screw head is irregular this is difficult to do with a hand-held drill, as the drill will catch on the protruding bits and go off-center. You may be able to even out the screw head with a small file or a pointed grinding-stone in a dremel-tool (small high-speed hand-held grinder) then center-punch and drill.

Other Methods

Sometimes you can grasp the head of a screw with a pair of locking pliers and use their better grip to get enough torque on it to get it started. Or you can carefully file flats in what's left of the head, or on the threaded portion itself if it protrudes. This obviously will require that the screw be replaced after it's removed, but it can help you to get it out so it can be replaced.

A couple of tricks for short screws: you can heat the screw with a torch. Often heating and cooling threads loosens them. If the screw is held in with a locking agent (e.g. "LockTite") heat will destroy the bond and make it easier to remove. You need to be able to heat the threaded part of the screw; long screws with their threads deep inside the engine cases will not be affected by heating the screw head. Don't use anything stronger than a propane torch; an oxy-acetylene torch can burn through a set of aluminum cases in short order. Even with a propane torch, don't hold the torch on one section

of the cases for more than a second, play it around a small area near the screw. Don't heat the cases too hot; hot enough to sizzle when a drop of water is put on them is hot enough.

A second trick is to use a dremel-tool to grind a flat on the periphery of the screw head, and then use a hammer and punch on the flat to turn the screw. This works on the tiny short screws sometimes used to hold gear box bearings into crank cases.

Stuck Nuts and Bolts

If you do round off a bolt head the methods to remove it are similar to the ones used to remove screws.

However the usual problem is that you just can't turn the bolt. The first thing to try is more leverage. If you're using a sturdy breaker-bar for sockets you can slip a length of water pipe over it to use as a cheater bar. A regular ratchet handle isn't up to the stress that you can generate this way. For nuts and bolts over 13mm you should use a 1/2" drive bar.

With a long cheater bar the limit to how much force you can apply is determined by what it takes to move the entire assembly. For instance to remove the rotor nut from an RZ350 crankshaft, a four foot cheater bar is required. If the engine is out of the bike you will need to strap it to your workbench and get a friend to help hold it and the workbench in place.

Impact Wrench

One caution, an impact wrench shouldn't be used to tighten nuts or bolts on motorcycles. It's easy to over-tighten a nut or bolt with an impact wrench. An alternative to cheater bars is an impact wrench. These are available in both air-driven and electric models. The air-driven type is what the local car tire shop uses to remove car wheels. Impact wrenches work by using air or an electric motor to turn a rotating weight which slams repeatedly into a lever connected to the socket drive. Since they hammer the socket drive around a small step at a time, there is very little torque reaction, so it doesn't take much effort to prevent the shaft that the nut or bolt is attached to from turning. Most 1/2 inch drive impact wrenches can deliver 75 ft-lbs of torque or more. Air impact wrenches cost from 35 dollars up and require an air compressor. Electric impact wrenches cost more, they start at 80 dollars, but do not require air. They're useful for racers who compete at tracks with electrical outlets in the pit area.

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Desperate Measures

Another way to remove stuck nuts is to use a nut splitter. It's not as painful as it sounds. A nut splitter is a steel collar which slips around the nut. One side of the collar has a hard steel wedge which is driven into the nut to split it by turning a bolt on the side of the collar. These are only needed to remove really badly rusted nuts, usually on the under carriage of cars. Their use on motorcycles is

rare, but if you have a nut that's hopeless and can't be removed any other way you should be aware that this tool exists.

Another option is a small cutting wheel in a dremel-tool. It will spray hot sparks and bits of grit all over, and will generate a lot of heat, but it can cut through the ugliest frozen nut... if you can get to it. If it's buried deep inside aluminum cases, there's one last possibility: EDM.

EDM

The Option of Last Resort is Electrical-Discharge Machining.

EDM can be used to electrically machine a hopelessly stuck steel bolt or screw out of aluminum cases or heads. The equipment is not generally available in the home workshop; you will need to take the entire assembly to a shop that does EDM. Certain hard-core home shop fanatics have constructed home EDM machines of varying capacities, and plans for them do exist, but given the infrequent usage for motorcycle mechanics it is more economical to farm out the work.

EDM, also called spark erosion, uses an electric spark to remove metal. An electrode is moved close to the work piece and sparks are repeatedly struck between the two. The gap has to be controlled very closely, so EDM machines are electrically controlled. EDM can machine to fine tolerances, but the closer the tolerance, the slower the machining.

EDM is becoming more popular and available. If you've broken off a stud inside your cases, it might cost 50 dollars to get someone to use EDM to remove it. You will probably need to drill out the remains of the stud and use a thread insert ("heli coil") in that hole, but if it saves a 500-dollar set of crank cases you're still way ahead.