Fixing Failed Fasteners

by Thomas Doppke

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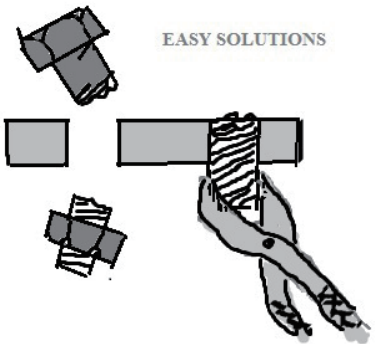
The obvious solution, when faced with a failed fastener, is to replace it with an identical part. However, the joint damage may be such that a one-to-one substitution is not possible. A stripped screw, fastened in place welded fasteners, clinched parts, damage to holes and surrounding material, stripped threads in mating surfaces are just a few of the possible conditions that preclude the use of an identical replacement.

Although there are many solutions to a failed fastener, let's review several situations and see what solutions can be commonly tried. Remember a review of what has happened is important to determine what caused the failure in the first place so that a repeat does not occur. Also an examination of the area to determine the extent of corollary damage will assist in making the right decision.



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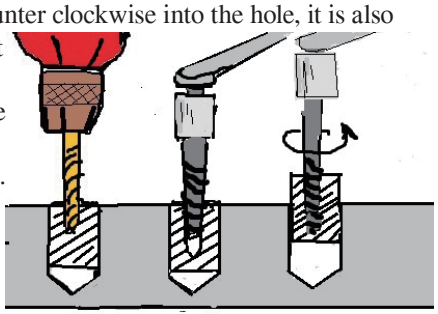
If the bolt breaks off but has part of the shank sticking out above the break or the threaded end sticking out below and is accessible, it may often be removed with a vise grip firmly clamped onto the remainder. If the break is flush, one solution is to drill a pilot hole and use a bolt extractor. This is a device that is inserted into the pilot hole, and as it is turned counter clockwise into the hole, it is also removing the bolt fragment. The device is available from most hardware sources. Replacement with a new, identical part is recommended.



SCREW EXTRACTOR
Drill, Install Counterclockwise,Remove

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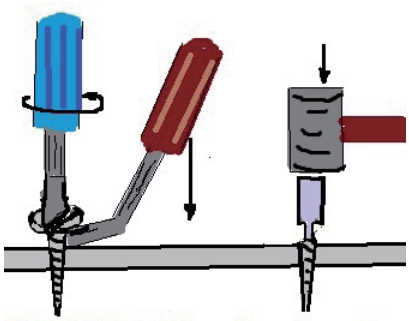
If the failure entails a bolt spinning in the hole (stripped threads) the only viable course of action is to remove the bolt by pulling it out by force, pushing it out from the backside if accessible and practical, or cutting the head off and pushing it out from the front. All these are predicated upon no interference from backside clearance or adjacent components. The hole threads should be examined closely. Hole repair is another problem which we will not go into here, but the use of a threaded insert will usually allow the same size bolt to be used. Worst case again is to drill out to next larger size with matching hardware.

INSERT FOR STRIPPED THREAD REPAIR

In most instances the bolt is usually stronger than the internal threads so a repair to the tapped hole (if present) will be required (usually a re-tap to the next larger size). If the use of a larger size fastener is not possible, as in the case of an expensive component or a limited and costly item, a thread insert has been used successfully.

The hole is drilled out, per instructions from the insert, and a special tap cuts a set of threads. The insert is threaded on both its outer and inner diameters. The inside thread of the insert matches the original thread of the damaged part. The insert is threaded in and a new original size bolt can be threaded into the insert. This is often done in racing car engine where they desire a stronger thread strength than can be obtained from the cast iron engine block material.



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distance of the cross flats of the bolt head. Areas of larger damage requires a consultation with engineering as to loss of joint strength and attachment security.

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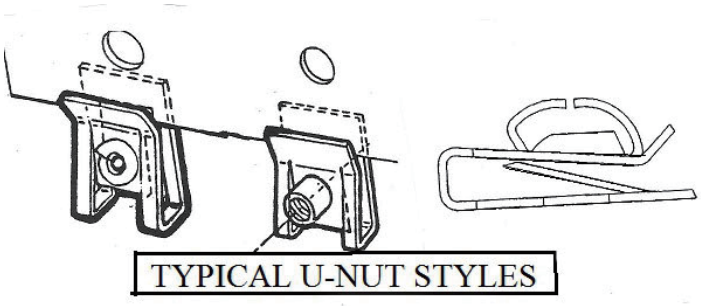
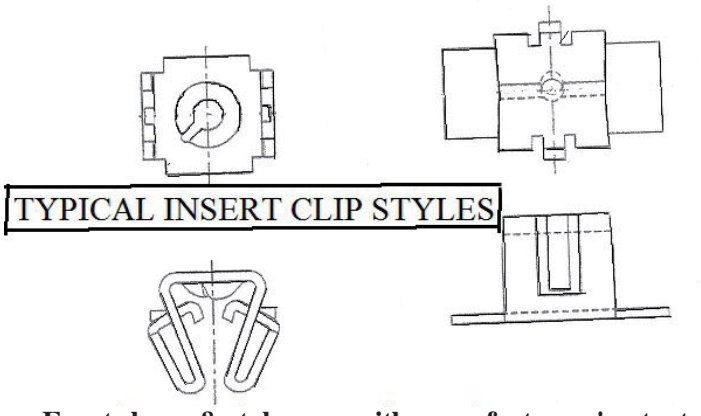
By far the greatest occurrence of fastener failures are those involving screws. Because of the sheer volume of screw attachments and/or the fact that little control is usually given to proper torqueing and assembly practices ("It's only a screw! Just tighten it down!"), screws are constantly being stripped. There are two failure situations that should be determined at the outset: Is the backside accessible or not? If the screw is stripped but turns in the metal, just turning it out from the backside will force the screw to cut new threads as it turns out. The sheet metal is softer than the screw and has probably stripped. If the backside is not reachable, use a vise grip type tool to work the screw out, prying as necessary. Replacement with the next larger size screw is required. The same solutions apply if the screw is jammed and does not turn. This works well if the screw head is large enough to afford a good grip.





Exact shape & style vary with manufacturers' patent

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If size is an issue, screw failures can be repaired by using a metal clip with a formed feature to accept screw threads. Similar in construction to the many U-nuts in use today, these clips can replace screws which fail. For parts near edges the push on U-nut style is readily available. If the screw is located a distance away from an edge or if the hole is not large enough to accommodate U-Nut installation, an insert type snap-in clip design is available but will require lots of labor to install (make square hole, push in clip, install screw, and hope for the best). A solution but not very viable, as the parts have to be ordered, tooling available to cut holes, etc. This makes both for a non-workable solution, or if parts are to be on hand, a failure that must be corrected if that many occurrences happen.

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The worst nightmare in assembly is the failure of a welded part after the whole component has been assembled. There are four general types of failure; stripped threads caused by cross threading or over torqueing; loose parts caused by poor welding practices; missing parts; and wrong size part (which is a rare occurrence). Again, if backside access is available,

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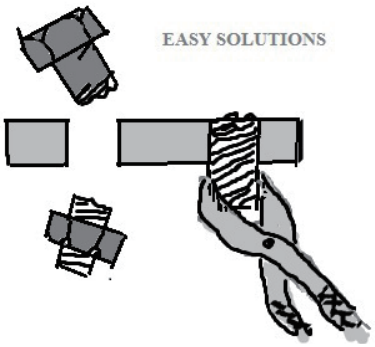

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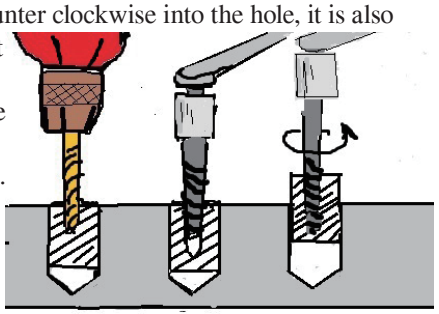

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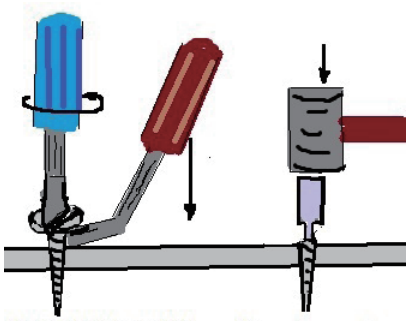

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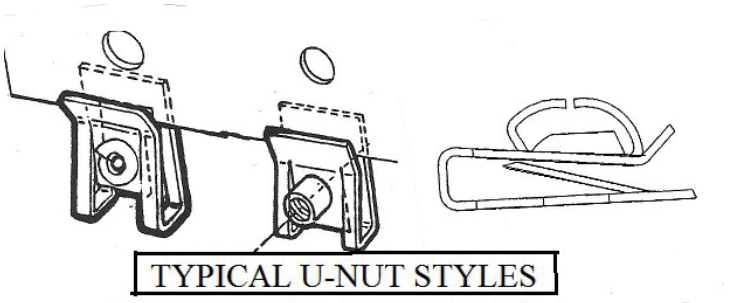

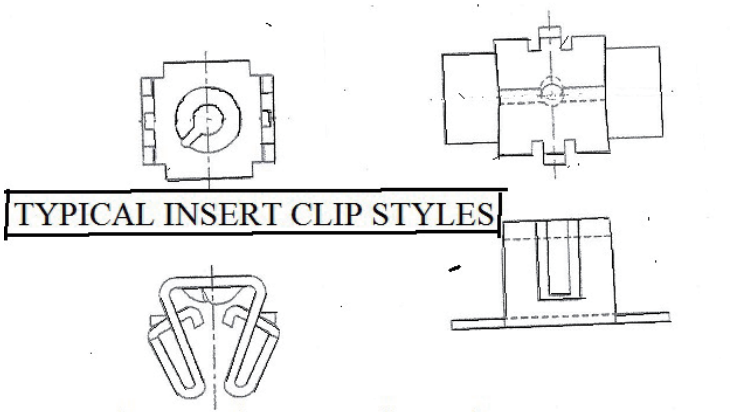

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the repair is fairly simple. The weld nut is knocked off and a loose nut is installed. A stripped part may be re-threaded but there may be a loss of strength. Consult with engineering about this. Often a thread rolling bolt is used in place of a standard bolt. The thread roller bolt (similar to seat belt bolts in automobiles) has a feature, usually a tri-lobular thread form, which 'rolls' a thread in the hole. It has been successful in stripped threads in many cases. Failing that a re-tap to the next larger size is in order. Missing parts and parts that warrant a replacement but are not accessible from the backside readily are handled in a unique way by line repairmen. After removing the failed part, they tack weld a regular nut onto a long rod, fish that rod down whatever channel or opening they can find and run a bolt into it. After the nut/bolt is tightened in place, they break off the rod. The worst case is where the nut cannot be repaired due to size considerations or locational difficulties. The only solution is to scrap the component with the failed weld nut/stud on it.

Rivets, both solid and blind break mandrel types, are repaired by drilling out the rivet to its original hole size and installing another part of the same diameter. Solid rivets and tubular types are set with a backside anvil. Lack of access to the backside may preclude the use of a replacement solid or tubular rivet. The next best solution is to use a break mandrel rivet in those cases if the strength requirement is not great. There are some styles of break mandrel rivets available with higher strength levels than people expect (commonly used on truck bodies) and have been with some success as replacement attachments. Rivets are fasteners which hold against sideway forces and fill the installation holes entirely. Bolts are tensional loaded fasteners fitting within a clearance hole, they may not be as strong as expected and slippage may occur.

Plastic fasteners are the easiest failure types to correct. Usually there is no damage other than to the failed plastic part. Generally, replacement with a new part solves the problem. If damage to adjacent surfaces and components has occurred the cause of failure should be reviewed with all parties. Plastic parts are not high strength attachment parts and things like hole shape and size, grip range, and installation issues (angle, force required, etc.) may lead to a continuing concern.

Many plastic failures are solved with the use of a screw in place of the plastic part. Not a very pretty solution but one that seems to work well as evidenced by the numerous ones found on many vehicles repaired by owners.

While there are other types of fasteners that end up used on the repair stations of assembly lines, their characteristics are somewhat unique and their repairs are also a one-of-a-kind solution. While these solutions have been used and others are possible, it should be noted that most companies have a return policy for broken parts if it is determined that the part broke due to shipping or manufacturing irregularities. Those failures encountered on the assembly line are solved by scrapping the parts. In question is that the time to repair them is excessive and the problem is unique (once or rarely occurring). Routine failures are, of course, a concern for engineering.

Below is a review chart for the solutions that have been discussed above. I am sure that there are other ideas and practices in use for these problems. Add them to the chart and keep it handy when that phone call from the floor comes in.

BOLT FAILURES

Examine hole and area for corollary damage. If present, go to B.

	Failure description	Solution
A	Broken, falls out of joint	Replace with new part
	Broken, above joint interface into tapped hole	Turn out with vise grips
	Broken, at joint interface into tapped hole	Drill out, use E-Z out bolt extractor
	Broken, end sticks out bottom	Turn out with vise grips
	Stripped in hole	Pull out with loading devise or cut off at interface and drill out to next larger size. Use next larger size fastener if possible.
B	Area slightly damaged	Use a washer to span damaged area after leveling.
	Area greatly damaged	If possible, drill out to the next usable size fastener.
	Worst case	Drill another hole in the next usable area and install new fastener.

NUT FAILURES

Stripped, falls off	Replace with new nut. Examine bolt threads for damage.
Stripped, frozen in position	Cut off as close to joint interface as possible without damaging surfaces. Break off nut. Or, use nut splitter.
Stripped, spins in position	Use nut splitter.

SCREW FAILURES

Backside accessible

Recess stripped	Force cross recess bit into recess, hammer in if necessary, turn screw out. Or, cut a slot through screw head, and use slotted driver to remove. Or, if possible, grab head with vise grips and turn out. Or, grab backside with vise grips and turn out.
Stripped in hole, turns	Push from backside while unscrewing. Sheet metal probably has stripped. Screw will cut new threads on way out.
Stripped in hole, jammed	Grip backside with vise grips, turn out. See Worst Case below.
Broken off at joint interface	Twist off with vise grips on backside

Backside not accessible

Recess stripped	See above.
Stripped in hole, turns	See above.
Stripped in hole, jammed	Cut off head flush. Use punch to knock screw from metal. Check for damage. May have to go to next larger size screw.
Broken off flush	Use punch to knock out screw.

Worst Case Fix

The most damaging fix is to punch out the screw as this will probably damage the sheet metal. If at all possible to leave the failed screw in position, and install a new screw adjacent to the old one. If the screw is punched out, the next larger size should be used if at all possible. Worst cases include using a bolt and nut in place of the screw or, if the backside is not accessible, using a break mandrel rivet.

WELDED PART FAILURES

Stripped threads, wrong part	Drill out and re-tap. May degrade the strength of joint. Consult engineering.
Loose welded part	Remove loose part if not already gone. Install a loose nut and tighten.
Missing part	Install a loose nut and tighten.

RIVET FAILURES

Solid and Break Mandrel	Drill out to original installation hole size and insert new, identical part.

While this works well with break mandrel rivets, the lack of access to backside of solid riveted parts may preclude the use of a solid rivet. Break mandrel rivets available with higher strength capacities and may be able to be used.

PLASTIC FASTENER FAILURES

Stripped, broken and missing	Replace with new part if surrounding surfaces are intact. Determine what caused the initial failure.