ALL ABOUT...

Nuts

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It's very easy to take your nuts for granted, until one drops off or rusts up solid. But there's more to the little fellas than meets the eye

EVERYONE likes a good bargain bucket, and there's none better than one full of nuts. You know, every size and type you'll ever need in one handy container and all you have to do is choose between metric and imperial. Only it always seems to contain every nut you'll ever need except for the one that'll finish the job off when you're working late and the shops have shut.

But I'm not blaming the suppliers for this. After all, there's a mind-boggling range of different threads for both metric and imperial, (we counted 46 standard metric threads between 1mm and 10mm alone), so you can hardly cover all eventualities in one plastic tub. But even that's simple compared with the poor engineer 160 years ago – all his threads were made individually so each nut would only mate with a single screw.

This bespoke type thread cutting ended in 1841 when Whitworth's standardized thread (BSW) system was accepted by the Woolwich Arsenal for manufacture. At the same time nuts were changed from the original square shape (still with us on coach bolts) to the now familiar hexagonal shape, which was spanner-friendly and easy to produce.

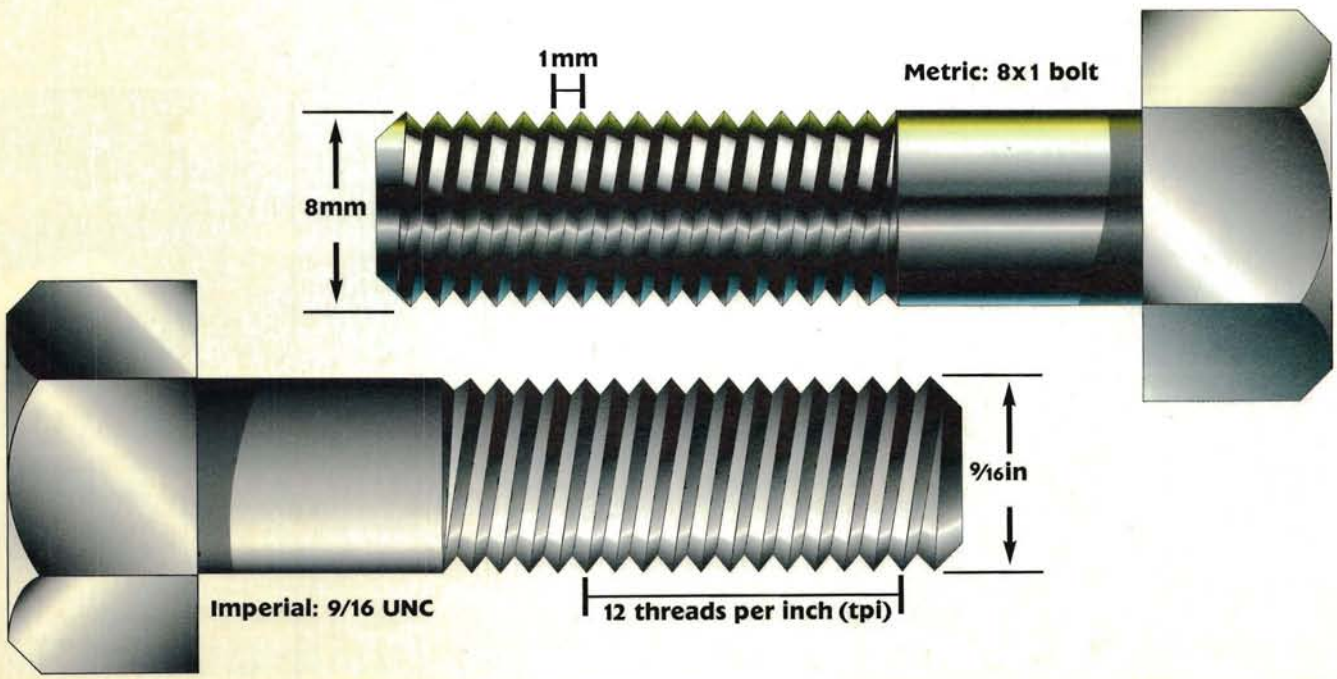
Following quickly on the heels of BSW was British Standard Fine (BSF). This had more threads per inch and was brought out primarily for brass and soft metals, and to ensure vibration-proof adhesion on harder metals. The thinking was that the finer the thread, the firmer the hold.

Things went much the same way for most of the nineteenth century until, with the inception of bicycles, we got the Cycle Engineers Institute, usually referred to as CEI. This is a fine thread, with the most common having 26 threads per inch. As well as cycles (and motorbikes until the demise of the British industry), this thread also found its way onto early cars. Also on 26 threads per inch is British Standard Brass, which is therefore much the same as CEI except that the angle of the thread is different.

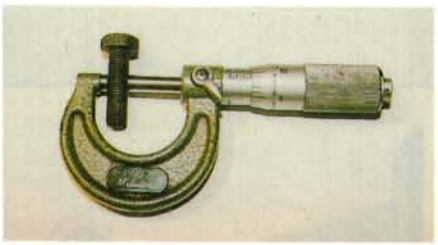
That had the man-sized nuts pretty well covered, but for those fiddly little components that are always getting lost, BA threads were developed to fill the need for fine and small diameter fixings. 'BA' is short for British Association, sometimes referred to as Bloody Awful, and is in fact a metric thread. The range goes from OBA with a diameter of 6mm and a pitch of 1mm, to 23 BA with a diameter of 0.33mm and a pitch of 0.09mm. Model engineers and modellers of all disciplines favour the BA system of threads, but you'll also find them inside voltage regulators and other electrical components on pre-1960 cars.

Metric threads have always been with us, but only really penetrated the British market when Continental cars took over in the UK. The pitch in the metric system is expressed in mm, so a 6x1 bolt is 6mm wide with 1mm pitch (between the thread tops). But even metric threads can get complicated, with a huge range of so-called standard threads and plenty of specials, which firms introduce to stop you fiddling with their products. And if you're working on anything from the former Soviet Union, you'll find unusual combinations of thread and head sizes you can't get from Western suppliers.

And then there's the American influence, with cars from the Ford and General Motors stables introducing the unified thread system, UNC being coarse and UNF being the fine. The strange thing about UNC is that, apart from thread angle which is 5° different, it matches perfectly with Whitworth. Although the book says not to, that 5° difference is small enough to mean you can use UNC and Whitworth together, but not the ½in version where there is one thread per inch difference.



Use a thread pitch gauge to accurately measure how many teeth there are per inch.



Micrometer shows the width across the thread tops. Vermier calipers do same job.

And the indispensable Zeus will translate your measurements into type and size.

One of the mysteries which regularly rears its head is the name for the spanners for UNC and UNF. These are Imperial AF and I have heard them referred to as American Fit and American Fast. The 'AF' refers to an across-flats measurement of the nuts.

Water and steam joints have always been in a world of their own, but now they are grouped together as British Standard Pipe (BSP). In this, the dimension refers to the hole in the pipe rather than the external diameter of the thread, so a ¼in BSP plug is much wider than a ¼in BSW or BSF bolt. It also comes in two categories – BSP and BSP (T), with the 'T' indicating a taper thread both in tap and die. Don't expect to find these in your fuel lines because they're restricted to water joints, but you could find them in your water pump.

And if you have an LPG conversion, that will have its own system of thread. These are coarse and are divided: those handling explosive mixes are lefthand and those handling inert gases are righthand threads.

Some cars have a wonderful mixture of thread systems in their construction, the Morris Minor for instance has BSW, BSF, BSP, UNC and UNF, and therefore can be a minefield of errors. Incidentally the countersunk brass screws which hold down the gearbox cover plate are 1x26 tpi BSF, not 1/4 UNF as is often forced in. Still reckon one tub of nuts can cover all eventualities?

This diversity of thread disciplines also illustrates the limited use of tap and die sets. Mostly they include an imperial thread gauge and a set of UNF and ISO metric taps and dies, and you can imagine the one you want is never included. (ISO metric threads are the standard coarse ones, and it's surprising how many components have either fine or unusual threads.) Perhaps the better course is to buy various taps and dies as and when you need them. But how do you find out what exactly you are dealing with? Well, you need a thread pitch gauge, a micrometer, and a trusty little book called Zeus. Your local motor factor should stock all of these except for Zeus, but you can get it from specialists such as Toolbank (call 01322 321400 for your nearest branch). It'll cost around a fiver and save you hours of head scratching.

Once you've stocked up on the necessary gear, put the thread pitch gauge against the thread until you get a perfect match, then measure the bolt's diameter. Once you've got these two measurements you should be able to figure out from Zeus what thread it is. So, for example, ⅜in diameter and 24TPI is 5/16 UNF. A quick and easy guide as to whether you are into imperial or metric is that most cars made from the Eighties onwards are metric, (Ford GB went metric in 1977).

The bolt's natural partner is the nut. And just to make it really confusing, there are several different sorts of nuts to go on your several different sorts of bolts. On pre-Eighties cars, most of the track rod ends had castellated nuts, with a hole in the stud for a split pin to go through. Forget to put the split pin in its hole and you fail the MoT, after which you never forget to complete the job again.

There is also such things as half nuts, basically ones that are just half the height of ordinary nuts. Wound together they make a very effective lock on the thread, which is why they were initially called 'jamming nuts'.

And then we have our old friend the 'Nyloc' nut, used extensively on more modern track rod ends and suspension components. This has a nylon insert above the threaded portion, which is why the top bit of this type of nut is rounded instead of hexagonal. The nylon grips the thread and stops the nut working loose – you won't be able to wind a Nyloc nut down a thread with your fingertips even if the threads are brand new. Unfortunately the nylon gets cut to shape when it is first used and the official advice is never to use them more than once, so before you take one off make sure you have a new one to replace it.

Washers come in many shapes and sizes, and are designed to counteract what engineers call fret. This is the loosening of a fixing by vibration. Spring and flat washers are aimed solely at eliminating fret.

On pre-war cars they loved locking wire, usually on fittings like big end journals. Never dispense with locking wire or throw away locking tabs, they are there for a purpose – to eliminate fret. One of the modern aids which almost completely defeats fret is thread-locking compound. However, this will only grip if you take the time to get both surfaces almost clinically clean.

Castellated nuts never work loose, until the day you forget the split pin or R-clip.

Two half nuts or 'jamming nuts' wound tightly together can act as effective lock.

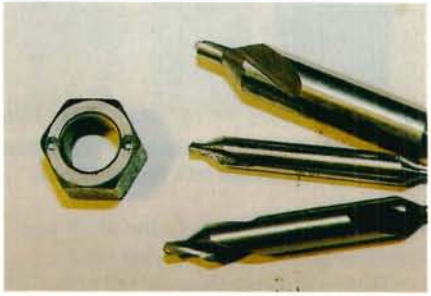
Nyloc nut has rounded top to contain a nylon insert. They can only be used once.

Copper washers are for sealing fluid joints. Collapsible ones are for single-use only.

Doughty washer is flat metal with a rubber seal in the centre. It also holds fluid in.

Shake-proof, spring and tab washers are all used with flat washers to eliminate fret.

Seized and rusty nuts



Slocum drills have narrow points to make accurate pilot holes to guide regular drill bit.

Sharp, cold chisel completes the job on the weakened nut without damaging stud.

Nut splitter is effective and inexpensive, but requires plenty of room for access.

SO MUCH for the raw material. But what happens after a few decades on the roads? How do you persuade rusty nuts and bolts to release their hold on mechanical vitals?

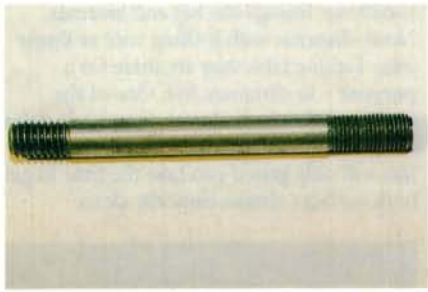
One of the best methods of unseizing a nut is a cup of tea. It won't budge? Soak it in penetrating oil, give the assembly a few light taps with a hammer to get the oil moving into the thread and go have a cup of tea. By the time you've finished, the offending article will have let go of the thread.

Judicial heat is a very good aid in shifting the unshiftable. You need surprisingly little heat to shift a seized nut, and a propane torch (or even the butane type) will often do the trick. Heat the nut and the bolt, not to the extent where they are both red hot, as this tends to damage surrounding bits such as bodywork and electrical equipment, but to a dull black heat that permeates slowly. After the nut has been warmed up, leave it for about 30 seconds for the heat to do its work and then, holding the nut under tension with the correct size spanner, give the back end of the spanner a sharp tap with a hammer. Nine times out of 10 this will get it undone without damaging anything.

Still stuck? In this case heat the nut again, just a little more, to dull red perhaps. Let it cool, then wrap a rag around the nut and the bolt. Soak the rag with release agent, cover the whole thing in a polythene bag and leave it overnight. The next morning the nut will usually have given up its grip.

If it's still stuck and access is good enough, put two dots on the nut either side of the centre with a centre punch and drill on those two dots initially with a centre or Slocum drill. This is a drill on which the diameter of the cutting end is reduced from the shank in the drill, and therefore it doesn't wobble when cutting. Once you've got two starter holes either side of the nut, continue these with a jobber drill of a suitable size down to the base of the nut. (A handy depth gauge to stop you drilling into the metal underneath the nut is a piece of masking tape wrapped around the drill bit at

Taps, dies and thread repairs



Come classic BMC studs have UNF thread on one end and UNC on the other.

Home-made tap can be very effective at cleaning minor damage to female thread.

Uni-thread kit is cheap at around £25 when you see what comes in the set.

IF YOU end up destroying a stud, you'll need to get a new one. If these are readily available locally, fine. However, often what you need is out of stock and on back order. So, you can either go to your local machine shop and part with a wad of cash, or make the stud yourself. If you decide to make your own it may take a couple of attempts to get it right, but persevere as all toolcraft takes practice. Firstly you need a quantity of the right metal, not a bit of mild steel out of the scrap box. Go to your local engineer supplies shop, or use mail order with Tracy Tools, and get a length of silver steel. This is high-carbon steel, which comes in 13in lengths (13in so you get a full 12in of usable metal.) The diameter of this is ground to the exact stated diameter.

Once you've got the material, check the measurements of the required stud and cut the silver steel to 1/16in over-length, thus giving you enough to fettle (clean up). Then check the threads on each end of the stud and their length. (On some old BMC studs you have UNF one end and UNC the other.) Having checked this, assemble the necessary dies and die holders, together with a nut of the correct size for each end. With a file, cut a slight taper on the end of the new stud as this will assist the die to cut more readily. Then set the die on its largest diameter, place the stud in the vice and push the die against the stud, turning it clockwise at the same time. (It will take some practice to get the die to cut accurately first time.) Eventually you'll end up with a stud with the required thread both ends. Then try the nuts on the stud. If they are a tight fit, firstly you can fit the nut, oil the stud and work it up and down until you get a good fit. If it's just too tight you can adjust the die to cut smaller. But be careful – too much and it'll never fit.

When it comes to buying taps and dies, if you've got an occasional need or want to clean threads, then carbon steel items are fine. But if you use the taps and dies regularly, especially on harder steels or cast iron, you almost certainly need the more expensive high speed steel (HSS). At least buying individual taps and dies as and when you need a particular size, rather than buying a whole set, means that you are more likely to splash out the extra 200% for an HSS item. Basically if it doesn't say HSS on a tool, then it's carbon steel and brand names such as Presto or Osbourne are usually an indication of quality.

There are some solid dies on the market, but these can't be adjusted for thread fit.

Sometimes it's the female thread holding the stud or bolt that gets damaged. When

Commercial stud removal tools are also effective, but they can damage threads.

Home-made tool gets stud out undamaged, but you'll need a centre lathe to make it.

Sacrifice a nut, and you can hold studs or bolts in a vice without fear of damage.

the required height.) With a sharp, cold chisel cut into the weakened nut at either side near the drilled holes and it should fall into two halves and release. You can buy a nut splitter for around £7 to do all of this for you, but it does need a lot of access room. It fits over the offending nut and has a hardened blade inside which you wind into the nut with a spanner until the nut is cut in two.

If all these options fail, reach for your angle grinder and grind off one side of the nut down almost to the thread. You can tell when you are getting near, as the thin metal close to the thread will blue quickly. If accessible, grind the other side too and break the nut off as described above. The action of the angle grinder will heat up the nut and the stud, and they may well part company from this alone.

Sometimes a stud won't budge. You can get very effective stud-extracting sets for less than £20. My own version of the stud extractor requires a centre lathe, or a friend who will let you use his. Get a piece of hexagonal steel, it doesn't matter what size as long as it is substantially over the stud size. Drill and tap the hexagonal throughout its length to the stud size. Wind the tapped hexagonal onto the stud, for about half its length. Place a bolt of the stud size into the other end of the tapped hexagonal and wind the two together so that the bolt is forced onto the end of the stud. Then hold the hexagonal and the bolt together and tighten the stud up a quarter of a turn. This breaks the rust seal and then, by rocking the stud back and forth, you should be able to wind the stud out. The advantage this little gizmo has over the standard stud extractor is that it does not damage the threads. Drilling out broken head studs is usually the province of the machine shop.

And another stud tip: ever wanted to hold a stud or bolt in the vice, but are concerned about damage from the vice jaws? Take a nut the same size as the bolt and cut along its length with a hacksaw. Place the split nut on the thread and roll it along, then place the nut in the vice and pinch it up. The stud or bolt will be held very firmly without damage.

Good things come in threes – especially taps. They must be used in specific order.

Solid die (left) can't be adjusted for fine changes, unlike the split one (right).

cutting a thread with a tap, always stick to the recommended tapping drill. 'Guestimating' the size of a tapping drill is bound to result in the tap getting broken off in the hole. Tapping and clearance drill sizes and a mass of other useful information is contained in the 'Zeus' book.

Hand taps usually come in sets of three: first or taper, second, and finally plug or bottoming tap. They must be used in strict order – a taper tap is useless for cutting a final thread as the thread form is only present at the back end of the tap. A good universal is the second tap, as it does have a slight taper on it. For thread cleaning always use a plug or bottom tap. And always keep taps and dies wrapped in rag as their edges go dull really quickly when rattled about in a toolbox.

As a first step, try the correct size tap down the hole as this may rectify the fault. If you haven't got the right size tap, cut a slot down the side of a correct size bolt and insert it like a tap. It has a similar action to a tap and works 50% of the time.

If this doesn't work or if the damage is too severe, you'll have to go for a thread repair. I find the stepped stud particularly successful. It has the original thread at the outer end, but a larger thread at the bottom where the damage is present. You just have to drill out the original threaded hole and cut a new, wider thread in the newly-exposed metal. Remember to position the stud before the unit is assembled, or the wider stud won't fit through the hole.

There are also several commercial systems on offer which will get you out of this problem. If the damage to the thread is not extensive – if the thread has disappeared and the hole is not oval – you can use a wire thread insert. These look like compact springs, but in effect they replace the damaged thread and by use of a four-step system take the thread back to original. The cost of a Uni-thread kit to do a 7/16in UNF is £25.25, but it includes 10 inserts, a tapping drill and an insertion tool.

Where the thread damage has caused the hole itself to wear oval, a thread repair system won't do. You need something like the Time-Sert from Wurth which is a solid insert instead of a wire, threaded both inside and out. It has the same internal thread as your original fixing, but the outer thread is non-standard and peculiar to Time-Sert. The kit contains all you need to cut this new thread into the workpiece and the insert collar is then simply screwed into place.

Finally, with both taps and dies don't just wind the tool into the metal as this will almost certainly get it jammed. The rule is two strokes forwards and one back to break the swarf ridge, and be sure to use tapping fluid or tallow.

Useful numbers

Draper Tools (02380 266355) suppliers of engineering and other tools. **Namrick Ltd** (01273 779864) for nuts, bolts and washers. **Tracy Tools** (01803 833134), suppliers of single taps and dies, jobber and centre drills. **Uni Thread** (01803 559595) suppliers of thread repair systems. **Wurth UK** (0870 5987841) suppliers of the Wurth system of thread repair.