TEE-ONE TOPICS

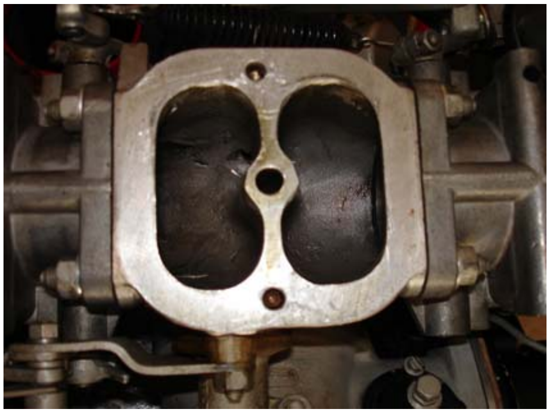
Number 58 November, 2006

MECHANICAL SERENITY

There it sits a 1970 vintage engine which had the strange habit of spitting petrol on the ground from time to time. The concept of environmental concerns was not quite born when this was made so if things went wrong in the float chamber the fuel welled up to the top ran out into the overflow pipe and dropped on the ground behind the engine. The usual reason for this incontinence seemed to be sticking or non-sealing needle valves.

The intake manifold was removed to facilitate dowel removal and refitting. It was also a good opportunity to recover a spanner an assortment of bolts, a few dead flies and a lot of gunk! The loose pipe meandering across the centre cover is actually another drain that lets out any accumulation of fuel in the bottom of the manifold itself. The pipe exits next to the carburettor overflow pipe but has a non-return valve at the bottom to prevent air being sucked back into the engine!

This was a problem that occurred with Silver Clouds judging by the various references in the Service Bulletins. As you know the mechanism to lift and lower the 'needle' in these carburettors is pretty crude. The lever on which the needle sat was very loosely pivoted and had to slide across the top of the brass float as the level rose. Apparently when this 'sliding' didn't occur the lever stuck to the float and held it down, the fuel kept pouring and you not only had a very flooded engine but one streaming fuel out of the overflow pipe not far from a very hot exhaust pipe!



Various needles were tried and even different float chamber tops and usually through some compromise the problem on the odd car was overcome. But here was a car over thirty years old with a very quiet life but with a fairly incontinent overflow pipe.

This is a view of the plenum chamber from underneath. The central hole accommodates the bolts that holds the whole structure on the engine and the other two holes usually have a couple of dowels inserted to ensure that the thing went on the right way and didn't swivel around.

What really brought it to notice was a complaint of petrol fumes. Seems these occurred only when the engine was very hot with the car idling or immediately after being switched off when very hot.

One of my mentors pointed out that the vee eight engines up to the Shadow II did not have any insulation to speak of between the induction tee piece which carries the carburettors and the intake manifold.

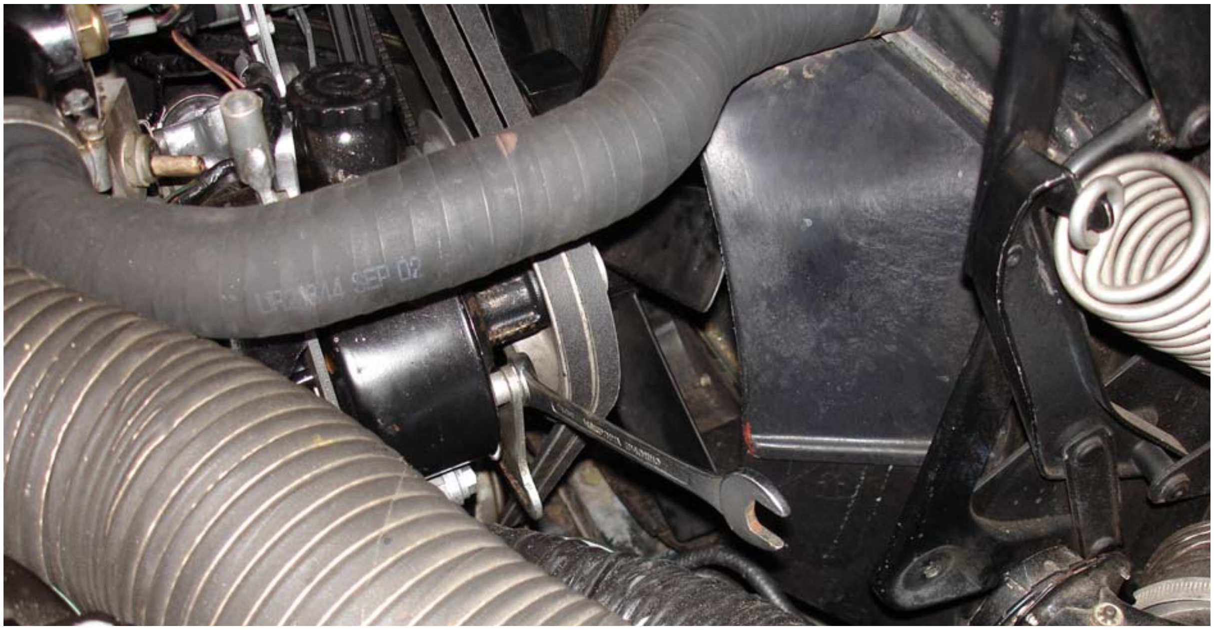
The underside of the induction Tee Piece. Showing the locating dowels in place!

The latter is bolted firmly to the cylinder heads which get extremely hot and the general heat brewed by the engine wafts up around the same induction system.

Here is the insulator beside the original thin brown paper gasket fitted! Note that the dowel holes are symmetrically located so a little modification is to be done.
Longer dowels were made up to allow for the thick insulating block.

the carburettors became inappropriately hot. Petrol boils fairly easily, so you draw your own conclusions. The cure was to insert an insulation block between the tee piece and the intake manifold exactly as the later Shadow II's were assembled. Longer locating dowels had to be made up and a longer centre bolt installed otherwise the modification was fairly straight forward.

There are no more complaints of petrol smells.



STEERING PUMP MOUNTINGS

Phil Sproston is finding mounting bolts for the power steering pump loose. Why, is anybody's guess, other than the reason we often seem to remind ourselves these days – **use by date passed check everything.** It is well to note that in the last 30 years, Shadows for example, even the most perfect cars, have had many hands fiddle with them.

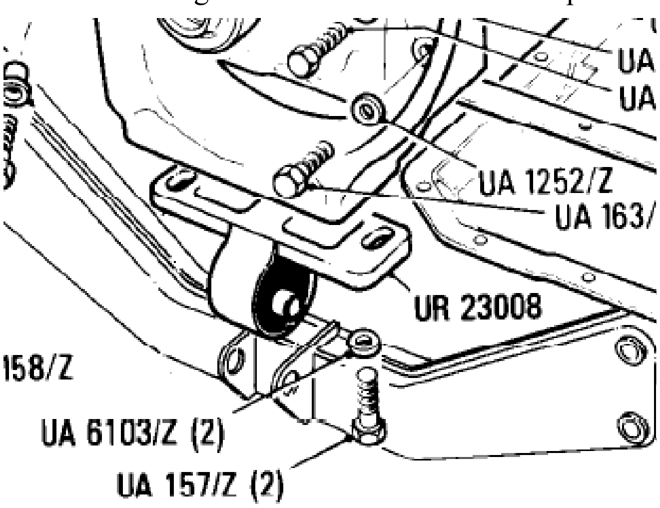
A reminder about tensioning these compressor belts. They have as you know a long run from pulley to pulley so need to be pretty tight. Squealing when you turn the wheels while stationary is a pretty good indication of loose belts. In tightening them do NOT lever on the body lest you dent it!

HOW GREEN ARE MY CALLIPERS?

This little quirk brings out my boils, the old war wound and a small fit of teeth grinding. I found these recently on an immaculate (in the housekeeping sense) Silver Spirit. Apparently callipers were originally painted green since they were destined to run on mineral oil presumably to help assemblers, since most owners don't keep a box of assorted instruments in their garage. It seems though the owner of this car at some time has prepared it for concours judging – one of my more unreasonable pet hates. All the effort that went in to this painting, yet the brake hoses were well over their service life, the calliper bleed nipples were almost frozen solid in their casting with rust and none had dust caps on them! But they were a nice shade of green. Message over eh??

HAVE YOU GOT ONE OF THESE?

You are lying under my car gazing in awe at the Rolls-Royce branded compressor belt. Below it is the front engine mount used on the Spirits Spurs etc for about 10,000 cars. The engines involved enjoyed a slightly different cross member that the engine sat on and the above unusual mounting with a ‘voided’ rubber mounting inserted and held in place by a large block. The one big advantage of this arrangement was keeping the engine more or less where it should be regardless of what the owner was doing. The more conventional setups with a slab mount and a rebound buffer plate works well unless the mount gets rotten with oil from timing case leaks.

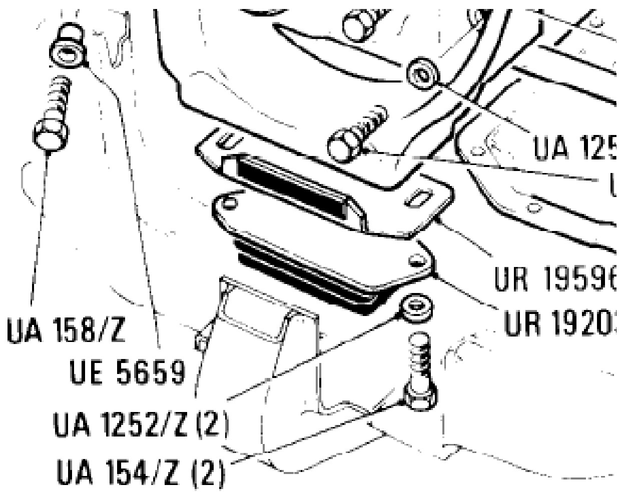


This is a better view of the round front engine mount. The insert is replaceable fortunately

One fine day something runs across the road, you slam on the brakes, the engine through inertia stays where it is and the front of the cars takes a massive dive. The fan particularly on the early Shadows being metal proceeded to eat the header tank above it – quite an expensive exercise.

At left the mount removed and in bits. The insert was replaced about 15,000K ago but for some reason the outer metal ‘container seems to be rotating noting how well polished it is. Note that the voiding (ie the hole) goes to the bottom leaving very little rubber between you and metal to metal contact!

The circular mount clearly prevents this. It is however very expensive to replace and in my experience not nearly as effective in absorbing engine vibrations as the conventional mount. In short the whole setup doesn’t appear to be very satisfactory, reinforced by the fact that the Factory reverted to the conventional mount after a couple of years. Which is what I am doing having raided a wreckers and got me another cross mount.



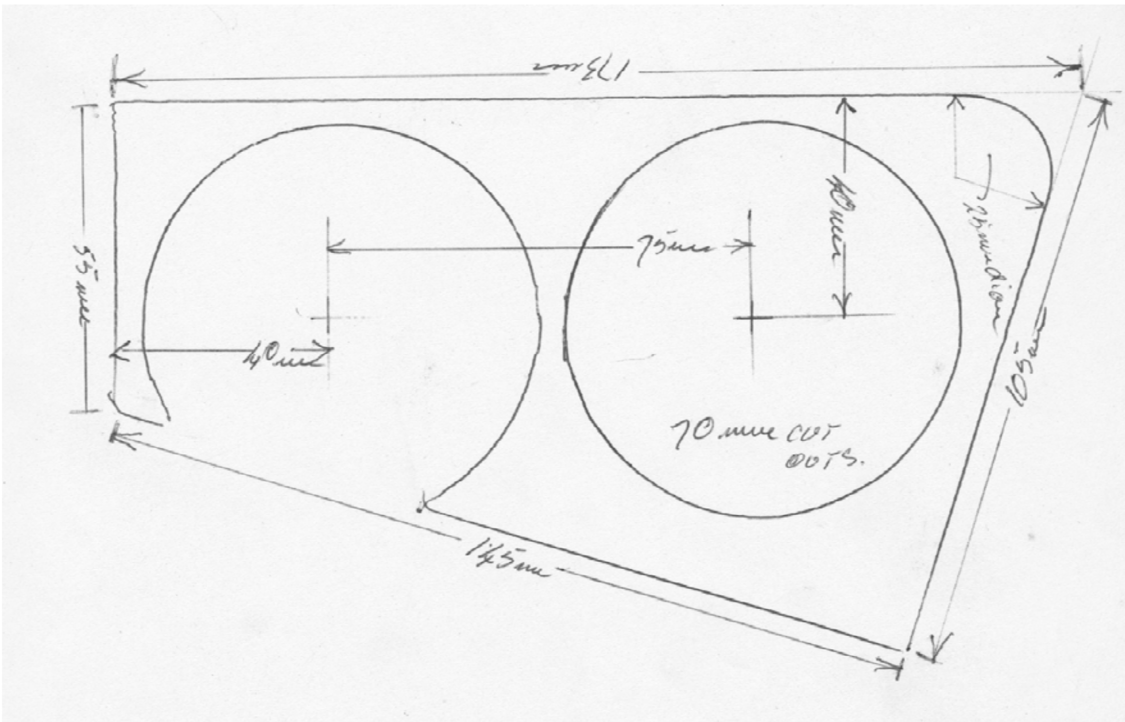
At the left is the original setup. So very simple and effective!

Keep an eye on the engine mounts for SY cars in particular. Again look for rotten mounts thanks to hot oil and believe it or not severed mounts particularly at the rear which simply split at the laminations. The only thing that stopped the engine of my car falling over was the crankcase jamming against a bolt head!!

At left can also be seen the stop plate which is essential with this set up since the ‘sandwich’ mount has little lateral strength!

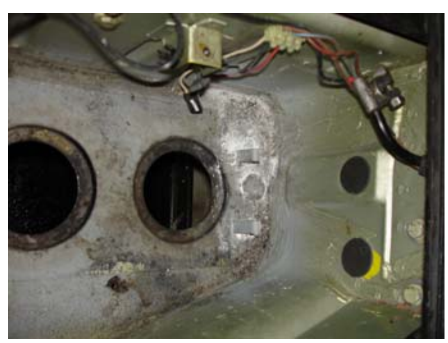
DO YOU HAVE FLOPPY BOTTLES?

Back in 1980 the novelty of mineral oil in our cars’ hydraulics wore off rather quickly when it was realised that the gas station at the back of Bourke did not actually carry the stuff on their shelves. In fact nowadays I am amazed that service stations have anything to do with cars on their shelves, the places having deteriorated into convenience stores for groceries and newspapers. More alarming, the owner of a newish Spirit out the back of Bourke thinking he needed hydraulic fluid occasionally was helped by the local mechanic’s offsider and the system was topped up with brake fluid!! This equates roughly to filling the fuel tank with a dilute solution of honey!!! A very expensive mistake as we all, I hope, know and agree. The latter problem was at least highlighted by the Factory by lead sealing the reservoir covers and adding stern advice that if topping up was required then an ‘Authorised Dealer’ should be approached for the service. So our man at Bourke drives 800 miles to get a litre of LHM inserted and his reservoirs re-sealed! Eventually somebody in the Factory appreciated this absurdity and much play was made of a magnanimous issue of two half litres of LHM stowed in the battery tray. The picture shows the setup. Eventually somebody got sick of the sight of bottles of oil lolling around the battery and made up a little bracket to keep them neat tidy and upright! This little bracket, easily made and installed is not listed as a spare as far as I am aware so I measured the one up in my car and the drawing that follows should enable you to do likewise.. A piece of thick 3 ply is all that is needed and some self tapping screws.



While you are at it, give the battery well a good cleanout, de-rust and descale and paint it.

Modern batteries are very clean things and seldom need maintenance but the odd case of corrosion does occur particularly with English delivered cars. Here the salt on the roads soaks into the soft rubber rings under the battery case and then have a leisurely feed on the metal base on which they stand.



FAN CLUB MATTERS

Richard Treacy wondered about his hearing recently and decided it wasn't a variation of Tinnitus but a dry bearing in the fan hub of his '89 Turbo. For those that have not had their fan off there is a picture at the left. The central hum which is bolted to the plastic fan has no solid connection to the water pump shaft on which it mounts. Instead it uses the equivalent of a transmission torus flywheel comprising an inner and outer member filled with oil. The amount of drive transmitted between the two is controlled by a rotary valve operated by a bi-metal coil seen in the centre of the coupling at left. When cold there is very little drive and the fan idles thereby saving lots of Oxford Scholars in fuel since most fans need several horsepower to drive them. As the radiator heats up the air coming through it heats the bi-metal coil on the unit, the valve opens up and more drive is transmitted.. The fan does have a limit to its speed since at 150 mph there is not much fan cooling required you will appreciate.

The units are non-serviceable, cost an arm and a leg yet seldom fail. When they do they give an excellent rendition of a failed water pump bearing or a concrete mixer warming up! If you are at Bandywallop South the best solution is to get someone to take the whole assembly off and rely on the electric fans out front. This will work well until you hit a traffic jam which is best overcome by switching the engine off before it starts to heat up and restarting when it is time to move on. The other clue to a failed unit is that the fan can be wobbled on its shaft!

The unit minus fan is at upper left. This one as on the later Spirits, screws onto the water pump shaft with a left hand thread. Earlier cars mounted the whole assembly with a flange on the shaft.

Richard's problem was not a failure but a dry bearing which he got at by drilling a small hole inserting some grease and resealing the hole with a little epoxy. Resourceful lad!!

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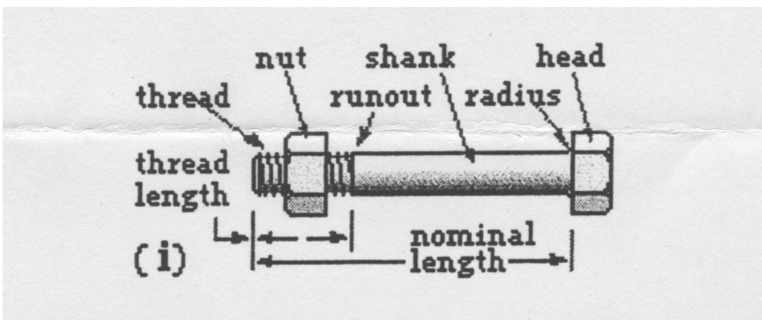
Threaded Fasteners

I appreciate that this is a fairly esoteric subject but you will appreciate that it deals with a very important part of our cars. I have to thank Nick Lang for extracting the detail from the excellent Honda magazine 'Hi Revs' and it seems the Editor of that publication was indebted to one Malcolm Thomas who in turn was indebted to the University of Western Australia. So we thank them all as it is handy reference.

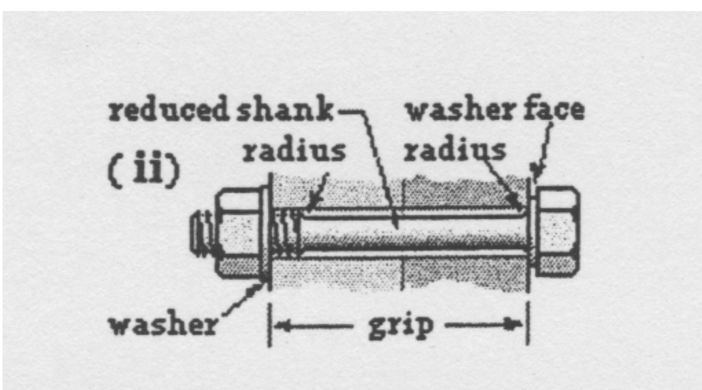
The fundamental operation in the manufacture of threaded fasteners is the creation of shape - this includes assembly, where a number of components are fastened or joined together either permanently by welding for example or detachably by screws, nut and bolts and so on. Since there is such a variety of shapes in engineering to be assembled, it is hardly surprising that there is more variety in demountable fasteners than in any other machine element. Fasteners based upon screw threads are the most common, so it is important that their performance is understood, and the limitations of the fastened assemblies appreciated.

There are two distinct uses for screw threads and they usually demand different behavior from the threads

- ***a power screw*** such as a lathe lead screw or the screw in a car lifting jack which transforms rotary motion into substantial linear motion (or vice versa in certain applications), and
- ***a threaded fastener*** similar to a nut and bolt which joins a number of components together again by transforming rotary motion into linear motion, though in this case the translation is small.

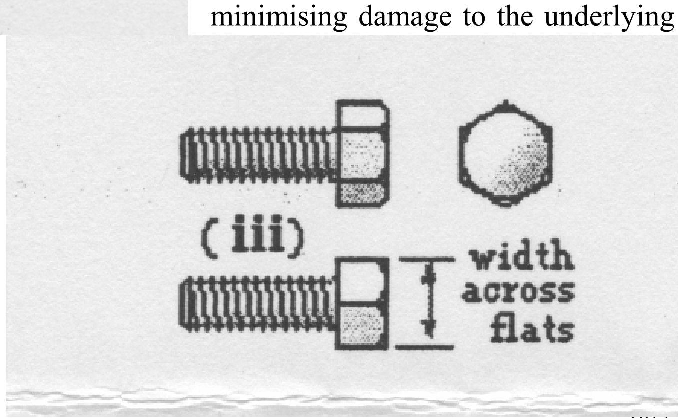


A typical hexagon headed bolt and nut are shown at (i at left). The diameter of the bolt shank is usually the same as the outside diameter - the ***major diameter*** or briefly ***size*** - of the thread. The radiused fillet at the junction of shank and head reduces stress concentration.

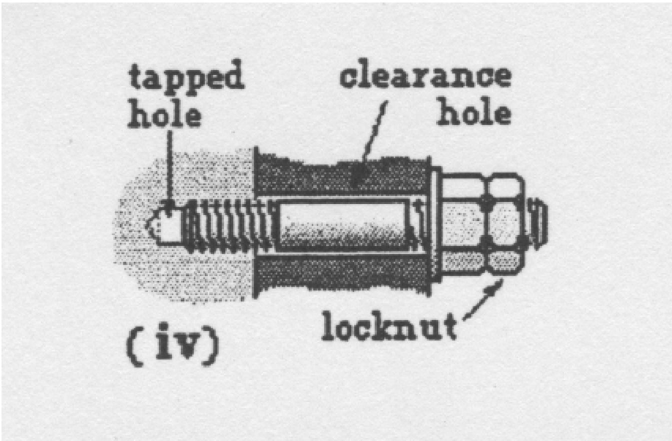


The shank diameter of a 'waisted' bolt (ii at left) is less than the thread diameter thus allowing a radiused thread run out which reduces stress concentration - beneficial in fatigue applications.

The assembly illustrated incorporates a washer under the nut which promotes uniformity of contact - minimising damage to the underlying parts and again lessening stress concentration. The bolt head may be equipped with an optional washer face. A bolt's 'grip' is the combined thickness of the fastened parts.

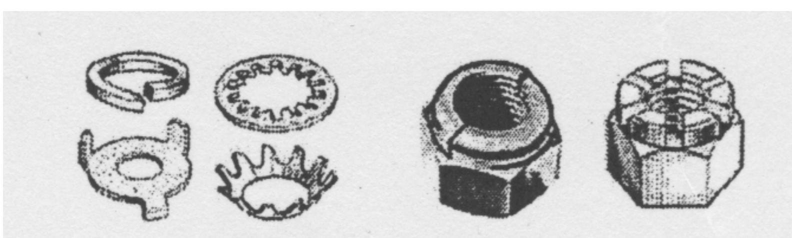


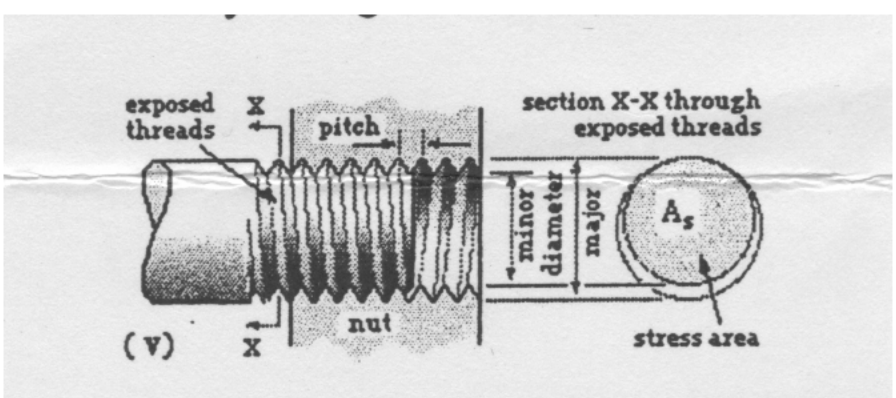
A screw (iii at right) is similar to a bolt - the names are often loosely interchanged - though strictly a bolt is equipped with a nut which is rotated to tighten the assembly, whereas a screw is itself rotated and engages with a threaded (or 'tapped') hole in a stationary component such as an engine block casting. The screw illustrated has no shank, being threaded right up to the head. There is a great variety of **screw head forms** available.



A stud (iv at left) has no head and is threaded at both ends. The ends are not necessarily the same. One end is screwed into one of the components usually before the second component is assembled. The sketch illustrates:

- a ***clearance hole*** through a component, typically 15-20% larger than the bolt/stud size to facilitate assembly and to clear any shank/ head fillet;
- ***a tapped hole*** which is drilled smaller than the root or ***minor diameter*** of the thread - see the enlargement (v) below;
- the illustrated tapped hole is blind, extends deeper than the stud and ends in a conical point of 120° approximately;
- a stud's depth of engagement is typically 1¼ to 1½ times its size;
- a threaded length sufficient for the nut to be tightened whilst leaving a couple of threads 'exposed' (i.e. not engaged) to cater for variations in thickness of the assembled components - though too much exposed thread should be avoided;
- a thin 'locknut' may be jammed against the ordinary nut to assist assembly or to prevent loosening under severe vibration, though resistance to inadvertent loosening is usually effected by a thread locking fluid, a lock washer or a lock nut such as shown here:



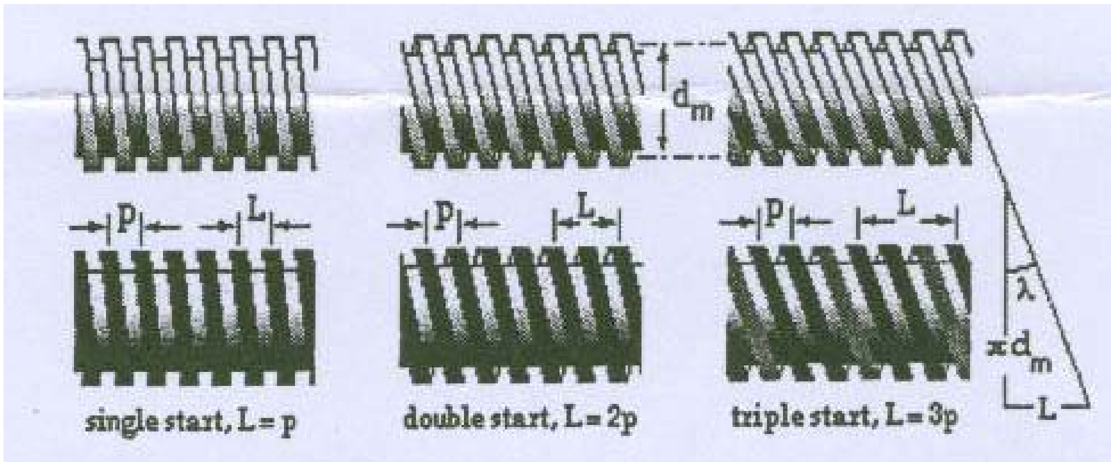


Screws may be supplied complete with captive lock washer to ease assembly - they are then known as 'sems' and they come in **many forms,** including self tapping screws for joining sheet metal.

Salient geometric features of the thread are illustrated in (v). The distance between similar points on adjacent threads is the thread's ***pitch.*** The load on the bolt F_b passes from the nut gradually through the engaged threads into the bolt, however the whole load must pass through transverse cross-sections X-X at the exposed threads outside the nut. Neglecting stress concentration, the tensile stress in way of the exposed threads is therefore :

$\sigma = F_b / A_s$ where A_s is the ***stress area*** - a function of thread size and geometry.

Since the stress area is less than the cross- sectional area of a normal (non-reduced) shank, the exposed threads are usually the most critically loaded part of the assembly - this is why failure of threaded joints occurs most commonly close to the nut face.

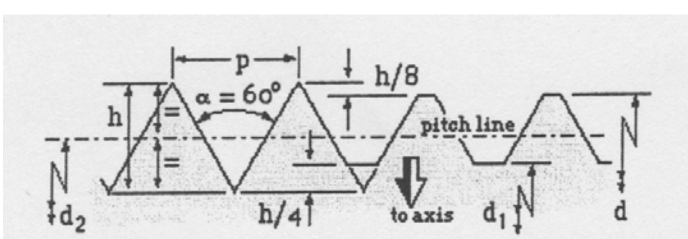


A thread can be likened to a piece of string wound in a tight helix around a cylinder - or around a conical frustum in the case of pipe thread designed to eliminate leakage. When a nut on a screw is rotated by one turn, it travels along the screw a distance known as the ***lead 'L'***. Developing one turn of the thread at the mean diameter d_m (the average of major and minor diameters) gives the ***lead angle*** (or helix angle) λ as $\tan \lambda = L / \pi d_m$.

Power screws may employ multiple threads t starts, so L = p* number of starts as illustrated. Fasteners on the other hand are almost invariably single start (L = p). They are also right handed to avoid confusion in tightening, though LH screws appear in turnbuckles and in certain bicycle parts where the prevailing torque would tend to loosen RH fasteners.

Thread Geometry

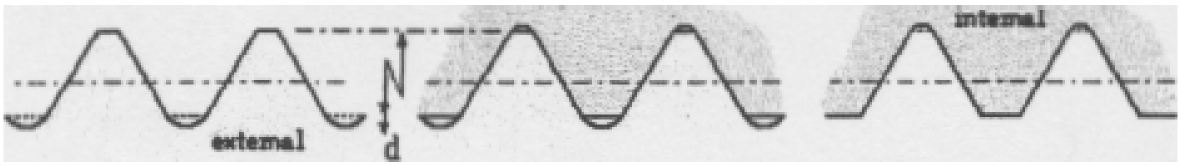
A thread 'system' is a set of basic thread proportions which is scaled to different screw sizes to define the thread geometry. Whitworth, Sellers, and British Standard Pipe (BSP) are just three of the many systems which proliferated before the adoption of the ISO Metric thread system. Since the latter is now universal, it alone is examined here.



The basic profile of ISO Metric threads is built up from contiguous equiangular triangles of height 'h' disposed symmetrically about a pitch line which becomes the pitch cylinder of diameter d_2 when the profile is rotated about the axis to form the thread.

The distance between adjacent triangles - the pitch - is $p = 2h / \sqrt{3}$. The tips of the triangles are truncated by h/8 to form the major diameter (size) d of the thread, and the bases are truncated by h/4 to form the minor diameter d,. It follows that d, = d- 5 h/4 = d - 1.08 p. This leads to the rule of thumb for suitable tapping size drills in normal materials: dtapping = d - p.

The basic profile becomes a maximum material profile for external threads (on screws) and internal threads (in nuts) through the use of suitable radii and tolerances, so that there is adequate clearance when internal and external threads engage. The relatively large radius at the minor diameter of external threads tends to equalise the strengths of external and internal threads. AS1721 sets out comprehensive geometric data including fits and tolerances.



At its most basic, a thread definition comprises a combination of **size** and corresponding **pitch.** Thus **M14x1.25** refers to a Metric thread whose major diameter d is 14 mm and whose pitch p is 1.25 mm.

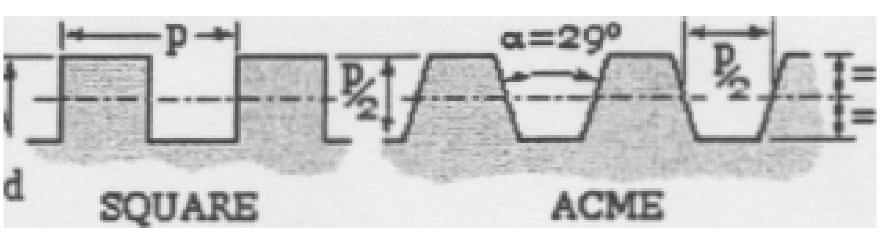
The stress area of an external thread corresponds to a diameter $d_S = d - {}^{13}/_{12}\ h$, that is $A_S = \pi/_4\ (d - 0.9382\ p)^2$. Other salient features follow from the underlying geometry. Most threaded fasteners in general engineering are manufactured to the ISO Metric Coarse Pitch (First Preference) Series outlined in **Table 1.** Fine pitch and constant pitch series are used for special purposes such as IC engine spark plugs and externally threaded thin-walled pipes.

ISO METRIC COARSE PITCH

FIRST PREFERENCE SERIES

Nominal Size	Pitch	Stress -Area	Hexagon a/c flats
D (mm)	P (mm)	As (mm`)	S (mm)
1.6	0.35	1.27	3.2
2	0.4	2.07	4
2.5	0.45	3.39	5
3	0.5	5.03	5.5
4	0.7	8.78	7
5	0.8	14.2	8
6	1	20.1	10
8	1.25	36.6	13
10	1.5	58.0	16
12	1.75	84.3	18
16	2	157	24
20	2.5	245	30
24	3	353	36
30	3.5	561	46
36	4	817	55

TABLE 1



The 60° thread form is not suitable for power screws which transform motion and which therefore must have high efficiency. The 'square' thread offers the best efficiency but is generally impractical. The 'Acme' thread form offers the best compromise between efficiency, ease of manufacture, assembly and wear take-up using split nuts. The stress area of Acme threads is based upon the average of the minor and mean diameters : $d_S = d - {}^3/_4 p$.

A SAD SIGHT

This appeared on eBay some weeks ago. A Shadow II which had been abandoned in the bush in the States somewhere for 20 years. These cars are a little like stray dogs you can't bear to see them lost but what the Hell are you going to do with them. I fantasize that my grandchildren will view these 'finds' and drool much the same as devotees of the 40/50HP do now on hearing that a bit of these old warriors have been found. But for the moment they are abandoned, wreckers don't want them as there is so little demand for the bits and they simply take up space. So far I have placed three of these cars with good homes. The new owners will probably grow to hate me but hopefully they will see the task through to the end.

If you are reading these pages you will be aware of the growing accession list in our technical library. The only glaring omission is the complete manual for the Shadow II but that stalwart ex-patriot Richard Treacy assures me he has the task well in hand. We are getting over 1200 hits a month on the library which is very encouraging and I suspect that commercial repairers are making use of the references themselves. This is excellent and hopefully will avoid cars being damaged with attendant costs through 'voyages of exploration' as my old mate George used to call them .

The rudest thing that has been done to me of recent times is to see an enterprising gentleman in eBay flogging CD's with manuals and spares lists etc which clearly have been downloaded from our site. A couple of the resident scanners rightfully foamed at the mouth but I pointed out that he is still getting the material out which is the object of the exercise and if he is so hard up for a quid we should be charitable.

Finally I apologise for the lateness of this issue but I have not been able to replace the 24 hour clock with one of greater capacity. Fortunately the Canberra population of cars can now be serviced at TK Motors established at Moss Vale near Bowral by the veteran specialist Garrath Will. When he opened, his first customer was Malcolm Yell with his wife's Citröen for a service. Given the hydraulic nexus our cars have with the make, I suppose that was acceptable. But then the word got out and he is now full of cars and working like a dervish. I now, however, do not live in mortal fear that a Spirit with serious engine management problems is going to be dumped on my driveway. I simply say to the tow-man turn round and head for Moss Vale! Which also means that I might actually start doing something to my Bentley which has languished at the back of the garage for the past 8 years!