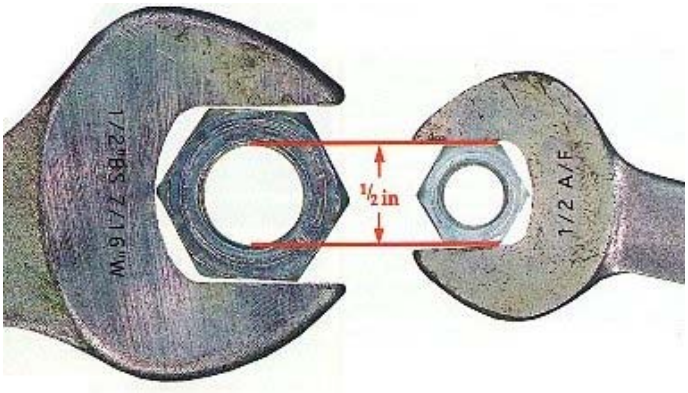
Nuts Screws Washers and Bolts

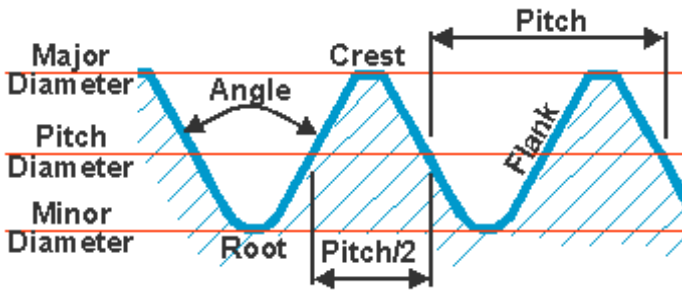
First of all, a note on the headline. I have always wanted to use this title since I heard it in a high-school joke about a deranged man who assaulted some people in a Laundromat and then absconded rapidly; so please excuse my self indulgence.

I was actually prompted to put this together using data from various sources — with special acknowledgement going to an article by Neil Cairns in Enjoying MG, April 1998 — after completing some extensive work on my MGB. It entailed working on the chassis, power-train, hydraulics and electrical system and I was constantly having to be careful that I used the right nut, bolt, washer and wrench as I came across various standards. — Rick Astley.



Unlike Herbert Austin, who manufactured his components in his own company, William Morris purchased from other smaller companies, which he often subsequently acquired. The engine branch of Morris Motors, Morris Engines, was no different. Morris Motors even used a unique French metric thread in certain components following the purchase of the Hotchkiss company. Hotchkiss had been making French designed weapons in Britain during WWI when the original manufacturer could no longer operate due to the occupation. When they began engine manufacture, it was logical for Hotchkiss to continue using the equipment they already had in-house.

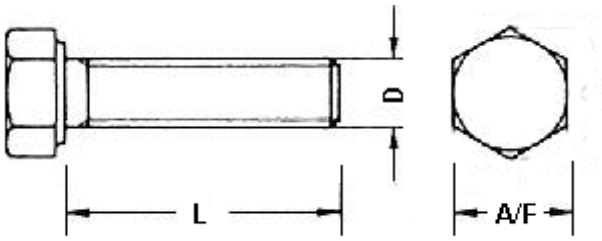
In the 19th century each industrialized company adopted its own thread standards. In 1841, Sir Joseph Whitworth standardized the system by measuring every thread he could get his hands on, and coming up with something that represented an average. As an indication of his abilities, it is interesting to note that as early as 1856 he exhibited a measuring instrument, controlled by a screw, which detected differences in length as small as one millionth of an inch! Whitworth's thread had a 55° internal angle and a depth and pitch of thread that varied with the diameter - i.e., the bigger the bolt, the coarser the thread. Note that the thread angle refers to the ramp angle of the triangular thread its self, not the pitch angle; that is measured in turns per inch or centimeter. Whitworth's form was so succesful that vestiges of it still appear in many current types. To augment Whitworth's BSW thread a fine thread version called BSF was introduced in 1908. British Association (BA) threads were standardized in the early 1920's for sizes smaller than 1/4".



In 1948 the US, Britain and Canada established the Unified series now generally known as UNC (coarse pitch) and UNF (fine pitch) both with a 60° internal angle. Unified threads are commonly used in the automotive, chemical and agricultural industries. European threads are based upon the German DIN standards and are Metric coarse pitch and Metric fine pitch. Metric fasteners have slightly shorter pitch — distance between threads — than the imperial equivalent but also have a 60° thread angle. Note that the French metric thread adopted by Morris is not the same as the metric type we know today. Plumbers also have their own thread size, British Standard Pipe Thread (BSP), sometimes found on sump and gearbox plugs, which has a tapered form so as to 'seal' the hole when tight. They are basically Whitworth 55 degree form but are nominated by the bore of the pipe. i.e. 1/4" BSP is about 0.528" O/D and 20 TPI. This is why 3/16 Whit wrenches often fit brake pipe unions. BSP threads are were adopted by the ISO-metric system so will be found even on BMWs,

To confuse the issue, in the 1940s and '50s, Morris and its offspring MG used the Whitworth bolt head size on their metric threaded bolts, so we that the exisitng assembly line tools that worked with both Whitworth and BSF fasteners could still be used. When BMC arrived in 1952/53 with their Austin ideas, the use of the BSF nuts and bolts was changed mid-model — on the on the body/ chassis of the MG ZB Magnette for example — to UNF. Whereas Whitworth wrenches are labled with the bolt size (D), Unified wrenches are marked with the head size, that is Across-the-Flat or A/

Size (D)	A/F for UNC/ UNF	A/F BSW	Nearest Wrench for BSW
1/4"	7/16"	0·525	12 mm
5/16"	1/2"	0·600	14 mm
3/8"	9/16"	0·710	5/8"
7/16"	5/8" b 11/16" n	0·820	18 mm
1/2"	3/4"	0·920	22 mm
9/16"	13/16" b 7/8" n	1·010	15/16"
5/8"	15/16"	1.100	26 mm
3/4"	1-1/8"	1.300	1-1/4"
A/F data for BSF is the same as that for BSW 1/16" smaller. Example: for the A/F of 1/2" BSF read data for 7/16" BSW.			
b=bolt n=nut Nearest Wrench is the next largest sized standard wrench that may be used on BSF or BSW nuts & bolts			



F. For instance, as shown in the first table below, a 5/16” UNF threaded bolt has a 1/2” A/F head.

Size	A/F
M5	8
M6	10
M8	13
M10	17
M12	19

Size	A/F
M16	24
M20	30
M22	32
M24	36
M30	46

Similarly for metric fasteners:

So as far as the engine is concerned, pre-BMC Morris and MG old metric bolts have heads that are BSW/BSF sizes and post-war post-BMC are UNF bolts with A/F bolt heads. Although Britain adopted metric bolts in 1965, the cost of an immediate tooling changeover was so prohibitive that the Unified sizes were used up to the Metro of the mid-1980’s after which, modern Metric threads arrived as used in the Montego and Maestro. Even then, if only to really confuse us, engines such as the 'A’ series used in the Mini, carried on with the UNF threads, but just gained metric heads.

To summarize by vehicle, the Morris 10HP Series 'M' 1140cc MPJM and MG1250 XPAG engine has the early pre-war French metric threads, with BSF/Whit bolt heads. This engine is in the Midget TB, TC, YA, YB and the 1466cc XPEG version in the TF. The 'A’ series BMC engine fitted to the Sprite/Midget, 1100 and 1300 FWD MG saloon, as well as the 'B' series fitted to the MGA, MGB, ZA, ZB, Varitone, Mk3 and Mk4 Magnettes, six cylinder 'C' series in the MGC, and the Rover V8 in the MGB GT V8, all use UNF and UNC threads with A/F bolt heads. The 'O' and 'E' series used modern metric threads with metric bolt heads, with the MG Metro having UNF threads on its engine, with some metric bolt heads on the engines of later cars.

Coarser threads are more suitable for use in softer materials such as iron and aluminum castings so that studs usually have a coarse thread on one end that goes into the engine block or transmission casing, and a fine thread on the end that accepts the nut. Coarse threads are more resistant to "cross threading" and stripping out because the coarse thread is deeper than the fine thread. However, fine-pitch threads can withstand greater loads than an equally-sized coarse-thread fastener, but are more prone to failure due to stripping threads.

Torque loading threads is very important. The 'load' applied with a special 'torque-wrench' actually stretches the bolt to the correct length to pre-load it so as to both 'lock' the thread in place and clamp the parts being secured together. The thread is simply a tapered coil and if set at the correct 'torque' the bolt will not undo with vibration. Things like cylinder heads, connecting rod bearings and flywheel bolts all have correct torque settings for the appropriate load, all listed in the workshop manual. Although this torque loading sytem is the best we have it is, unfortunately, not very accurate because as much as 85% of the applied torque is used to overcome friction. This friction is a function of lubricant, surface finish, plating type and a host of other variables, and is not consistent. Some of the applications in which certain bolts are used — such as on the connecting rods — means that they should only tightened or torqued-up once as the stress they operate under would mean possible breakage if they are re-used, so always buy new ones.

Those strange looking nuts with nylon inserts (Nyloc) or those with a locking split at one end, (Cleveloc or Aerotight) should not be re-used if you can run them down the bolt by hand.

Washers serve to distribute the clamping load over a greater area than the bolt alone, and may function as a bridge over any gap between the head of the fastener and the mating parts. They also protect the mating parts from damage, and can provide a spring-like tension on the head of the fastener to reduce the tendency to loosen when subjected to vibration. The spring washer, like that shown here, has raised and shaped ends that provide little resistance to clockwise rotation but that cut into whatever is clamping the washer when turned counter-clockwise. Washers come in many sizes and thicknesses and may sometimes have tabs that are bent over against the bolt or nut flat in order to further prevent rotation. Copper sealing and crush washers are commonly used on hydraulic and coolant systems to aid sealing.

Other anti-rotation techniques, found on MG suspensions systems for example, are so called castle nuts that lock against a cotter pin that passes between the castellations and through a hole in the bolt.

A word on cold welding, which happens when 2 identical metals are forced together. Only a thin coat of a different material — either a coating, gas or an oxide — aids threads being torqued. Uncoated materials will weld quickly. This happens often on stainless bolts as they have only a very thin oxide coat. To prevent this, use a thin coat of copper grease on all bolts.

The word ‘bolt’ has been liberally used throughout this article without differentiating it from a ‘screw’. In researching I found 2 definitions:

(1) A bolt is a threaded fastener that when installed goes completely through the mating parts and is secured with a nut. Screws are threaded fasteners that are installed into blind threaded holes.

(2) A screw has a thread that runs right to the head whereas a bolt has an unthreaded section called a shank.

Definition (1) means that the same component could have different name depending on what it threads into and if we follow (2) do we now refer to wood bolts rather than screws? I believe most of us regard a screw as something that is installed with a screwdriver, or perhaps an Allen key, while a bolt on the other requires a wrench.

Speaking of screws, MGs built from the ‘60s will use a cross head screw that, while it looks like a Philips head, is in fact a Pozidrive. These look like Phillips screws but their slot geometry is different and, whereas a Phillips screwdriver often seems to work well on Pozidrive screws, they can tear up a stubborn head or at least cosmetically spoil it. Pozidrivers are sized similarly to Phillips, so try to obtain sizes PZ#1 and PZ#2. Pozidrive screws can be distinguished from Phillips by an additional X lightly