TARMAC

AUCKLAND REGIONAL MICROLIGHT AIRCRAFT CLUB

www.armac.info

JULY 2006

CLUB NIGHT: **1930 hours Wednesday 12th July 2006**
Preceded by Committee meeting 1830 hours
Visitors are most welcome - refreshments available

VENUE: Newmarket Club, 13 Teed Street

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PREZ SEZ:

There is not a lot to sez about just now. Winter has come along with the cold making flights a little more adventurous than one would hope for.

I'll be away (school holidays) for the next two weekends and Chris has made himself unavailable for a couple of weekends as well. I'm not sure this is going to cause too much of a problem as the weather gods will probably have the final say.

I will not be at the next meeting but Chris has an excellent video on DVD to show, all that is required is a DVD player and a telly which takes video in not just RF. If any one can help with this on the night please give Chris a ring.

That's all for now.

Anton Lawrence

REGULAR EVENTS

1st Sunday of the month – Thames – morning tea / lunch
2nd Saturday of the month – Dargarville – lunch
3rd Sunday of the month – Raglan – lunch
Last Sunday of the month – Kerikeri – lunch

BOLTS

by Anton

Over the last couple of months I have been doing a lot of research into bolts and their properties. One of the reasons was to try and find the metric equivalent of a standard aircraft bolt. The other was to try and understand why a bolt breaks and how to tension them properly. All of this will form part of a resource being developed for RAANZ IA's and pilots alike. The topic has turned out to be quite large and I have no intention of writing it all up now but some points of interest are listed below.

There is a lot of confusion amongst bolt suppliers and those using them as to what the different grades mean. In actual fact grades are used to define imperial bolts and metric bolts come in classes. The confusion is not helped by the NZ steel code getting it wrong as well. The table below compares four commonly available bolt types in NZ.

Metric	***Imperial***	***Proof load PSI***	***Proof load MPa***
Class 4.6	*Grade 2*	*32600*	*225*
Class 8.8	*Grade 5*	*87000*	*600*
Class 10.9	*Grade 8*	*120400*	*830*
Class 12.9	*High Strength*	*140700*	*970*

The proof load is the maximum working load of the bolt which is at an acceptable level below the yield point, for 12.9 it normally 90% of yield and for 10.9 and under a figure of 60% yield is normally used.

The class numbers tell you the strength of the bolt in question. A 12.9 has a ultimate tensile strength of 1200MPa and a yield strength 90% of ultimate.

It's easy to see where the confusion comes from, as the numbers don't match between metric and imperial. An aircraft bolt is equivalent to a Class 10.9 or Grade 8. Grade 8 is not to be confused with class 8.8, this bolt is clearly not as strong. Aircraft bolts are made to a very high standard and must be able to bend 180 deg around a radius equal to their diameter.

Metric bolts are supposed to be made to a high standard but it is much harder to track their pedigree as they are mostly made in China. I have been told that if you ask for a bolt to be made and marked 8.8 that is what you will get, ie. a bolt "marked" 8.8, but the material may not be 8.8 so it may be necessary to test a bolt before use. Of course if you asked for a bolt to be made to 8.8 standard you should get just that.

The next problem with bolts is how to torque them to the correct tension. A bolt used in any situation where the bolt is under tension to hold two components together must be tensioned correctly. (eg cylinder head) The bolt in this situation must have preload applied or else it will come loose and if it is hold a shear load will break under cyclic stress. The preload is attained by the bolt stretching to a point below it's yield point, once the bolt yields it's length will be permanently changed. There are many ways to check the preload of a bolt including using a micrometer to measure the elongation of the bolt. The two most common are with a torque wrench or the part turn method. The table below shows the accuracy of the various methods.

Operator Judgment	*± 35%*
Torque Wrench	*± 25%*
Turn of Nut	*± 15%*
Bolt elongation	*± 5%*
Strain Gauge	*± 1%*

So it seems that our trusty torque wrench is not that flash and the greater the accuracy required the greater the cost in time or machinery. The reason the torque wrench is so inaccurate is due to friction in the threads and under the bolt or nut head, these can vary depending on the amount of lubrication on the bolt and the plating material. The table below gives correction factors for using a torque wrench, which should help to improve its accuracy. If a bolt is installed heavily greased then it may be possible to take it beyond yield and still not achieve the desired torque, conversely if a bolt is degreased then it is unlikely to achieve the required preload.

Galvanised Degreased	*x 2.1*
Galvanised Lightly Oiled	*x 1.1*
Zinc Plated As Supplied	*x 1.0*
Zinc Plated Lightly Oiled	*x 0.9*
Heavily Greased	*x 0.7*

The coefficient of friction for a zinc plated bolt or nut is 0.17 and for a cadmium plated bolt (aircraft) 0.12.
The milspec MIL-HDBK-60 has a detailed formula for calculating torque based on various friction coefficients.
This report has been based on the Milspecs MIL-HDBK-60 “Threaded Fasteners - Tightening to proper Tension”, MIL-HDBK-5J “Metallic Materials and Elements for Aerospace Vehicle Structures” and Steelmasters newsletters.

Thought for the day:

Speed is life, altitude is life insurance. No one has ever collided with the sky.

Does the statement, "We've always done it like that" ring any bells? Then read this article to the end; this is a new one for me…

The US standard railroad gauge (distance between the rails) is 4 feet, 8.5 inches.
That's an exceedingly odd number. Why was that gauge used?

Because that's the way they built them in England, and English expatriates built the US Railroads.

Why did the English build them like that?

Because the first rail lines were built by the same people who built the pre-railroad tramways, and that's the gauge they used.

Why did "they" use that gauge then?

Because the people who built the tramways used the same jigs and tools that they used for building wagons, which used that wheel spacing.

Okay! Why did the wagons have that particular odd wheel spacing?

Well, if they tried to use any other spacing, the wagon wheels would break on some of the old, long distance roads in England, because that's the spacing of the wheel ruts.

So who built those old rutted roads?

Imperial Rome built the first long distance roads in Europe (and England) for their legions. The roads have been used ever since.

And the ruts in the roads?

Roman war chariots formed the initial ruts, which everyone else had to match for fear of destroying their wagon wheels. Since the chariots were made for Imperial Rome, they were all alike in the matter of wheel spacing.

The United States standard railroad gauge of 4 feet, 8.5 inches is derived from the original specifications for an Imperial Roman war chariot. And bureaucracies live forever.

So the next time you are handed a specification and wonder what horse's arse came up with it, you may be exactly right, because the Imperial Roman army chariots were made just wide enough to accommodate the back ends of two war horses!

Now, the twist to the story:

When you see a Space Shuttle sitting on its launch pad, there are two big booster rockets attached to the sides of the main fuel tank. These are solid rocket boosters, or SRBs.
The SRBs are made by Thiokol at their factory at Utah.
The engineers who designed the SRBs would have preferred to make them a bit fatter, but the SRBs had to be shipped by train from the factory to the launch site.

The railroad line from the factory happens to run through a tunnel in the mountains.

The SRBs had to fit through that tunnel.

The tunnel is slightly wider than the railroad track, and the railroad track, as you now know, is about as wide as two horses' behinds.

So, a major Space Shuttle design feature of what is arguably the world's most advanced transportation system was determined over two thousand years ago by the width of a horse's ass.

- *And - you thought being a HORSE'S ARSE wasn't important!*