STEELMASTERS AUCKLAND LTD
79-81 O'RORKE RD, PENROSE, AUCKLAND
Phone 579 8196 **Facsimile 579 1392**

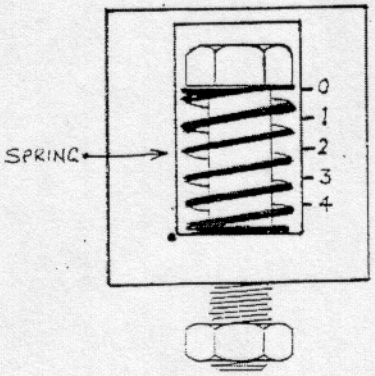
STEELMASTERS SM
Fastener Manufacturers and Distributors

The Nuts and Bolts of It - February'04

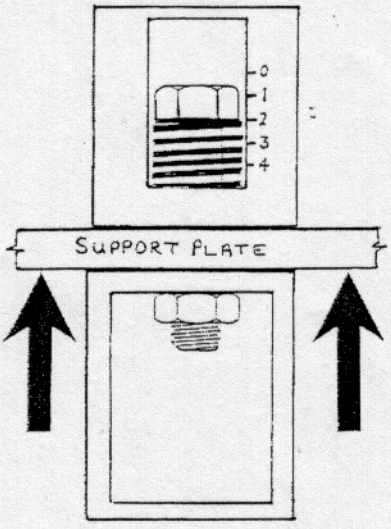
The writer hopes all (or is it both?) readers have had a good break and have returned to the fray fit and refreshed.

Difficulty in trying to explain to a customer that when the clamping force or preload in a bolt exceeded the external force, the bolt didn't "feel" the external force, provided the subject for this Newsletter. At the time my explanation was not all that convincing, but with the benefit of hindsight I'll try again using a model.

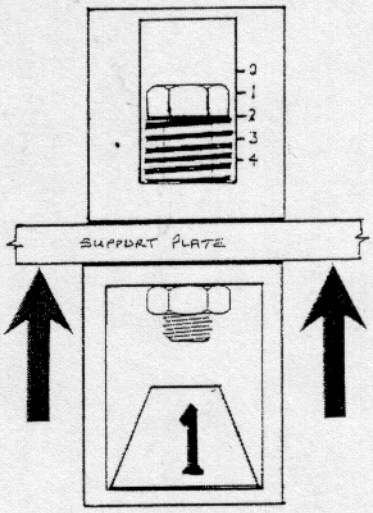
In the first sketch a Bolt is shown in a casing with a Spring included, so that if the Bolt were to be pulled down the Spring would compress. The scale on the side of the casing indicates the force present in the Spring and of course that will also be the force (preload) in the Bolt.



The second sketch shows the Bolt inserted through a Support Plate and a Bracket attached with a Nut. The Nut is then tightened until 2 "units of force" are indicated on the Casing. We now have 2 "units of force" compressing the Spring, and therefore 2 "units of force" Tension in the Bolt. The model now represents a tightened Bolt without any "external working load".



Next we add an "external working load" equivalent to 1 "unit of force" to the bracket, as shown below.



The common reaction is to think that the load in the Bolt must increase, otherwise what happens to the additional force? You will note this sketch shows the Spring is still compressed to 2 Units.

The Bolt does not "feel' any of the additional force!

To visualize why this is so – imagine what would happen if the load in the Bolt did increase. To do this the Spring would have to compress and a gap would form between the Bracket and the Support Plate. If such a gap did form it would mean there were 2 "units of force" acting upwards (due to the Spring), and 1 "unit of force" acting downward from the applied weight. Clearly this force imbalance cannot occur.

What in fact happens is that the applied load reduces the clamping force that exists between the plate and the Bracket. With no "external working load" applied (second sketch) the clamp force is 2, with the "external working load" applied the clamp force decreases to 1 "unit of force".

The Bolt would not "feel" any of the applied force until it exceeded the Bolts clamp force.

Only read on if you want to be picky.

Like most models, this is an oversimplification, in that it ignores factors such as the elongation of the Bolt and compression of the clamped components, which occur upon tightening. This elongation and compression actually results in the Bolt sustaining a small proportion of the applied load, as the applied force reduces the clamp force within the joint. The amount of additional force the Bolt sustains is miniscule compared to the applied force and depends on the ratio of Bolt stiffness to Joint stiffness.