Rivets: An Introduction

“You have to sell billions of them to make money…”
“...Don’t waste your time!”

I can still remember my father’s words. However, over the last few weeks I thought it was time for me to learn about rivets. I started by asking people who have been in the industry a long time - they simply rolled their eyes. What I have learnt is, there are rivet guys and non-rivet guys……. and there aren’t many rivet guys around!

This article is not meant to be a detailed technical publication; I have attempted to keep it interesting to a person in the fastener industry who does not know a lot about rivets.

Advantages of Rivets:
• Excellent system to clamp relatively light gauge materials together. There are many applications where the back of the job cannot be accessed such as fastening to tubes or walls. Rivets are perfect for these applications and hence are known as “BLIND” rivets as there is no need to access the rear of the joint.
• Cost effective as they can be installed by non-specialised labour up to 15 rivets per minute.
• Reliable

Blind rivets are a two part fastener consisting of the Shell (Rivet Body) and the Stem (Mandrel). The rivet is “set” by drawing the stem through the shell, which causes the shell to “swell” and clamp the material together. The stems breaks off during this process once the correct clamping force is achieved. The head of the stem remains trapped in the bottom of the shell to ensure the clamping force is retained in the joint. Various tools are used to withdraw the stem ranging from hand operated to pneumatic tools. Blind rivets are designed to clamp together specific thicknesses of material and it is this grip range that forms part of the ordering description for rivets.
How is a Rivet Described?

n. A metal pin for passing through holes in two or more plates or pieces to hold them together.

Head Type:
The most common is the Truss type or often referred to as Dome head, and is known as type 73.

<table>
<thead>
<tr>
<th>Head Type:</th>
<th>Truss Head (Dome Head)</th>
<th>Countersunk Head</th>
<th>Large Flange Truss head (Dome Head)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Head Designation Number:</td>
<td>73</td>
<td>72</td>
<td>72ASL</td>
</tr>
</tbody>
</table>

Material:

<table>
<thead>
<tr>
<th>Shell Material:</th>
<th>Stem (mandrel) Material:</th>
<th>Code:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aluminium</td>
<td>Steel</td>
<td>AS</td>
</tr>
<tr>
<td>Steel</td>
<td>Steel</td>
<td>SS</td>
</tr>
<tr>
<td>Stainless Steel</td>
<td>Steel</td>
<td>LS (STS)</td>
</tr>
<tr>
<td>Stainless Steel</td>
<td>Stainless Steel</td>
<td>LL (STST)</td>
</tr>
<tr>
<td>Nickel Copper</td>
<td>Steel</td>
<td>MS</td>
</tr>
<tr>
<td>Copper</td>
<td>Steel</td>
<td>CS</td>
</tr>
<tr>
<td>Aluminium</td>
<td>Aluminium</td>
<td>AA</td>
</tr>
</tbody>
</table>

Size:

Shell Diameter - The logic used for the sizing is based upon the imperial system. Shell diameters are always specified in 1/32nds of an inch (0.787mm).

<table>
<thead>
<tr>
<th>Shell Code:</th>
<th>Diameter (Inches):</th>
<th>Diameter (mm):</th>
</tr>
</thead>
<tbody>
<tr>
<td>3</td>
<td>3/32”</td>
<td>2.4</td>
</tr>
<tr>
<td>4</td>
<td>4/32” (1/8”)</td>
<td>3.2</td>
</tr>
<tr>
<td>5</td>
<td>5/32”</td>
<td>4.0</td>
</tr>
<tr>
<td>6</td>
<td>6/32” (3/16”)</td>
<td>4.8</td>
</tr>
<tr>
<td>8</td>
<td>8/32” (1/4”)</td>
<td>6.3</td>
</tr>
</tbody>
</table>

Grip Range:

This is where a lot of people get confused; the grip range is NOT the length of the rivet. The grip range is specified in 1/16th of an inch (1.6mm). To select the correct rivet, it is necessary to measure the thickness of the material to be clamped.

To specify a rivet by the accepted code, practice is:

73AS43 → 73 = Truss (Dome) head
          → A = Aluminium Shell
          → S = Steel Stem (Mandrel)
          → 4 = 4/32” shell diameter (3.2mm)
          → 3 = 3/16” Grip range (3.3-4.8mm)

There are many different types of rivets, and the above article is purely an introduction to the most common, basic types.
KNOW YOUR WALL PLUG COLOURS!

Plastic wall plugs are inexpensive expansion plugs for light duty anchoring applications in concrete, stone, solid brick and solid block. They come in an assortment of colours which indicates their size.

<table>
<thead>
<tr>
<th>Plug Number</th>
<th>6</th>
<th>8</th>
<th>10</th>
<th>12</th>
<th>16</th>
<th>20</th>
<th>22</th>
</tr>
</thead>
<tbody>
<tr>
<td>Drill Size</td>
<td>4mm</td>
<td>5mm</td>
<td>6mm</td>
<td>6.5mm</td>
<td>8mm</td>
<td>10mm</td>
<td>12mm</td>
</tr>
<tr>
<td>Screw Gauge</td>
<td>#1,2,3</td>
<td>#4,5,6</td>
<td>#8,9</td>
<td>#10,12</td>
<td>#14,16</td>
<td>#16,18</td>
<td>#20,24</td>
</tr>
<tr>
<td>Colour</td>
<td>YELLOW</td>
<td>WHITE</td>
<td>RED</td>
<td>GREEN</td>
<td>BLUE</td>
<td>ORANGE</td>
<td>GREY</td>
</tr>
</tbody>
</table>

How much load does each nut thread carry?

When a bolted joint is tightened, the nut moves along the bolt thread and is pressed against the surface of the part to be fastened. This force at the bearing surface leads to the bolt being loaded in tension and the nut in compression. The bolt thus stretches axially, causing an increase in pitch of the male thread; and the nut compresses, resulting in a reduction in pitch of the female thread. The consequence of these two actions is that the threads near the loaded nut face are forced into much harder contact than the remainder; resulting in a concentration of load, and therefore stress in the thread in this region - as shown in Figure 1. Typically, the resulting maximum stress is about three times the nominal stress. As an approximation of the first thread carries 33% of the load and the second carries 25% of the load. Studies have suggested that for the same length of thread engagement, the finer the thread pitch the higher the average load on the first thread. This is one of the contributing factors why fine pitch threads have a higher susceptibility to thread stripping failures.

It is good engineering practice to have two full bolt threads protruding past the end of the nut.

Sources
Design Society
Bengt Blendulf Seminar
Introduction and Behaviour of Bolted Joints by John Bickford
What every engineer should know about threaded fasteners: Material and Design by Alexander Blake

Figure 1: Change of pitch in nut and bolt threads, resulting in uneven distribution of stress in the threads close to the loaded face of the nut.
I would choose a square drive screw over a Phillips drive any day, as every time I use a Phillips drive it “cams-out”. To cam-out is a process by which a screwdriver slips out of the head of a screw being driven, once the torque required to turn the screw exceeds a certain amount. What I have never understood is why Phillips drive screws are so popular, so I thought I would find out. What I discovered is as follows...

**Phillips:**
The Phillips screw drive was created by Henry F Phillips and was actually designed to cam-out when the screw stalled. This was to prevent the screw damaging the work, or the screw head, and was required in those early days when torque limiting screwdrivers were not readily available.
The American Screw Company of Rhode Island successfully patented and licenced their manufacturing process. Other manufacturers in the 1930’s preferred the slotted type screw due to its ease of manufacture, never the less, the Phillips drive gained popularity.

**Pozidriv:**
My only real experience with Pozidriv screws is in the New Zealand market, for whatever reasons they are most common there.

The Pozidriv screw drive, which is occasionally purposely misspelled “Pozidrive” to avoid trademark infringement, is an improved version of the Phillips screw drive. It is jointly patented by the Phillips Screw Company and American Screw Company. They can be unscrewed with a regular Phillips screwdriver. The advantage of the Pozidriv over a Phillips drive is its decreased likelihood to cam-out, which allows greater torque to be applied. As mentioned above, Phillips drivers have an intentional angle on the flanks and rounded corners so they will cam-out of the slot before a power tool will twist off the screw head. The Pozidriv screws and drivers have straight sided flanks.

The Pozidriv screwdriver and screws are also visually distinguishable from Phillips by the second set of radial indentations set 45 degrees from the cross recess.

This design is intended to decrease the likelihood that the Pozidriv screwdriver will slip out, provide a greater driving surface and decrease wear. The main disadvantage of Pozidriv screws is that they are visually quite similar to Phillips; thus many people are unaware of the difference between the two, or do not own the correct screwdrivers for them and therefore use an incorrect one. This results in difficulty removing the screw and can cause damage to the recess, rendering any subsequent use of a correct screwdriver difficult. Phillips screwdrivers will fit in and turn Pozidriv screws, but will cam-out if enough torque is applied, potentially damaging the screw head. The drive wings on a Pozidriv screwdriver will not fit a Phillips screw correctly, and are likely to slip or tear out the screw head.

**Robertson Square:**
Both the tool and the square socket have tapers, which makes inserting the tool easier, and also tends to help keep the screw on the tool tip without the user needing to hold it there. Robertson screws are commonplace in many countries such as Canada, and are gaining popularity in Australia. Hobson carry square drive screws in many of our ranges of decking screws. Robertson screwdrivers are easy to use one-handed, because the tapered socket tends to retain the screw even if it is shaken. The square drive screws are self-centering, they reduce cam-out, stop a power tool when set, and can be removed if painted-over or old and rusty. In industry, they speed up production and reduce product damage.
As with other clever drive types conceived and patented in the late nineteen century, it was not manufactured widely (if at all) during its patent lifespan due to the difficulty and expense of doing so at the time. Robertson’s breakthrough in 1908 was to design the socket’s taper and proportions in such a combination that the heads could be easily and successfully cold formed, which is what made such screws cheap to manufacture.

Robertson had licenced the screw design to a make in England but the party that he was dealing with intentionally drove the company into bankruptcy and purchased the rights from the trustee, thus circumventing Robertson. He had spent a small fortune buying back the rights and subsequently he refused to allow anyone to make the screws under licence. When Henry Ford tried out the Robertson screws he found they saved considerable time in Model T production, but when Robertson refused to licence the screws to Ford, he continued with the Phillips head. Robertson’s refusal to licence his screws prevented their widespread adoption in the United States, where the more widely licenced Phillips head had gained acceptance.

If I were to draw a parallel to a topic most have experienced, the Beta video tape was widely recognised as a far better system than the VHS tape system, but as we all know, it died a quick death because it was not adopted by other companies outside of Sony.

**Hobson Newsfeed:**

Our hopeful South Sydney fans ahead of the NRL Preliminary Final!

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Einstein wrote this riddle early during the 19th century. He said that 98% of the world population would not be able to solve it.... Are you in the top 2%?

1. In a street there are 5 houses, painted 5 different colours
2. In each house lives a person of different nationality
3. These 5 homeowners each drink a different kind of beverage, smoke a different brand of cigar, and keep a different pet.

Clues:

1. The Brit lives in a red house
2. The Swede keeps dogs as pets
3. The Dane drinks tea
4. The green house is next to, and on the left of the white house
5. The owner of the green house drinks coffee
6. The person who smokes Pall Mall rears birds
7. The owner of the yellow house smokes Dunhill
8. The man living in the centre house drinks milk
9. The Norwegian lives in the first house
10. The man who smokes Blends lives next to the one who keeps cats
11. The man who keeps horses lives next to the man who smokes Dunhill
12. The man who smokes Blue Master drinks beer
13. The German smokes Prince
14. The Norwegian lives next to the blue house
15. The man who smokes Blends has a neighbour who drinks water

**Qu: WHO OWNS THE FISH??**
First person to solve this wins a $50 gift card!

email your answers:
emma.hobson@hobson.com.au

**Answer from Vol. 25:**

...The mathematician made a small fence around himself and declared himself to be on the outside.
NATA Labs are not all the same.

NATA is the National Association of Testing Authorities Australia. It is the authority responsible for the accreditation of laboratories, inspection bodies, calibration services, producers of certified reference materials and proficiency testing scheme providers throughout Australia.

So, one would think that one NATA lab is the same as the next…. WRONG! NATA accreditation is specific to the type of testing carried out. So if a lab has NATA accreditation to test the hardness of screws to AS3566 it is NOT necessarily accredited to do tensile testing of B7 studbolts to ASTM nor tensile tests on AS1252 structural product.

NATA conducted an assessment of the Hobson Engineering Fastener Testing Facility (HOBLAB) in regards to Mechanical Testing and confirmed that Hobson’s testing facility continued to comply with the requirements for NATA accreditation. The surveillance process completed by NATA included a review of the management system at HOBLAB, and of selected technical matters. The inspection was conducted against ISO/IEC 17025 Standard / Mechanical testing application document (July 2013).

The following is from the NATA website, detailing the accreditation of a number of labs associated with Fastener Importers. It is extremely interesting and confirms: One NATA lab is not the same as the next NATA lab!

Hobson:

NATA determined that our HOBLAB facility complies with the requirements of ISO/IEC 17025:2005

13.01 Metals and metal products
   .11 Tension tests on test pieces
   Tests with strain rate control in the range 10 kN to 1000 kN including proof stress tests to AS 1391, ASTM A370, ASTM E8, ASTM F606 and ISO 6892.
   .21 Brinell hardness tests
   By the methods of AS 1816.1, ISO 6506-1 and ASTM E10
   .22 Rockwell hardness tests
   Tests using B and C scales to AS 1815.1, ASTM E18, ISO 6508.1 and SAE J417
   .23 Vickers hardness tests
   Tests to AS 1817.1, ASTM E384 and ISO 6807.1
   .24 Microhardness tests
   Tests at 3.27 N By the methods of AS 4291.1, ISO898-1 and ASTM F2328.

13.08 Threaded fasteners
   .11 Tension tests
   Breaking load and wedge tensile tests in the range 10 kN to 1000 kN to AS 1252, AS 4291.1, ASTM A370, ASTM F606, ASTM A193, ISO 898.1, ISO 898.2, SAE J429, SAE J1199
   .12 Proof tests
   Proof load tests on nuts, bolts, screws and studs including determination of stress at 0.2% permanent strain and elongation after fracture in the range 5 kN to1000 kN by the methods of AS 1252, AS 4291.1 (ISO 898.1), AS 4291.2 (ISO 898-2), ISO 898-8, DIN 267-4, SAE J429, SAE J995, IFI100/107 and ISO 2320
   .13 Tension-torque tests
   Assembly testing of coated Fasteners To AS 1252 Appendix C
   .21 Drive tests
   Drilling and driving tests for self-driving tests by the methods of AS 3566.1 Appendix C, IFI1113 and ISO 10666

13.90 Microstructural tests on ferrous materials
   .12 Case depth and depth of decarburisation tests to AS 4291.1, ISO898.1, ASTM F2328, ISO 2639 and SAE J423

13.94 Coatings
   .01 Metallic coatings
   Local thickness by microscope to AS 2331.1.

When comparing these specifications with competing testing laboratories within the fastener industry, it is clear that not all NATA labs are the same.
**Bremick:**

This facility complies with the requirements of ISO/IEC 17025:200

13.01 Metals and metal products
   .22 Rockwell hardness tests
Using Scale B and C from 98N to 1471N by the methods of -
ASTM E 18, AS 1815.1

   .58 Bend tests
Ductility by the methods of - AS 3566.1 Appendix A

13.08 Threaded fasteners
   .99 Other tests
AS 3566.1 (Dimensional measurements of self drilling screws
only) AS 3566.2 Appendix C (coating porosity).

**Exafast:**

This facility complies with the requirements of ISO/IEC 17025:2005

13.01 Metals and metal products
   .22 Rockwell hardness tests
Tests using B & C scales to AS 1815.1 ISO 6508

   .23 Vickers hardness tests
Tests in the range 19.6 N to 294 N to AS 1817.1 and in-house
.procedure LAB-014
Low load tests in the range 0.3 kgf to 5 kgf to AS 1817.1 (ISO
6507), in-house procedure LAB-014

13.08 Threaded fasteners
   .11 Tension tests
Breaking load tests (Ultimate Tensile strength) and wedge tensile
test in the range 5 kN to 600 kN by the methods of -
AS 4291.1 (ISO 898-1), AS 1252, SAE J 429 and in-house pro-
duress LAB018 and LAB019

   .12 Proof tests
Proof load tests on nuts, bolts, screws and studs in the range 5
kN to 600 kN by the methods of -
AS 1252, AS 4291.1 (ISO 898.1), AS 4291.2 (ISO 898-2), ISO
898-6, DIN 267-4, SAE J429, SAE J995 and in-house proce-
duress LAB-016, LAB-017

13.90 Microstructural tests on ferrous materials
   .12 Case depth and depth of decarburisation
Tests by hardness method on bolts, screws and studs
by methods of -
AS 1252, AS 4291.1 (ISO 898.1), SAE J121, in-house procedure
LAB-011.

It’s OK.
It’s SOKO™.

Class 12.9 SHCS - Let’s get real about what quality is:
→ Quality is all about batch testing of product.

Is the Company supplying your Class 12.9 product batch testing? Is your supplier offering an independent NATA certificate on-line to prove they are batch testing?

Class 12.9 products are getting used in critical applications; that is why strength Grade 12.9 is specified. Surely everyone wants the reassurance of a quality product. Hobson Engineering has led the industry in batch testing all of its fasteners - strengths Class 8.8 (Grade 5) and higher. We have also led the Industry in having NATA test reports available on line so everyone can see we are doing what we say we are.

All Hobson SOKO™ branded products are batch tested in NATA labs in Australia. The reports are available through our web portal. If your current supplier is not doing this, perhaps you should be asking “Why Not?”

Below you can see some of the testing that our SOKO™ range may endure before we give them the tick of approval, and get a glimpse at HOBLAB - Hobsons own NATA accredited testing facility

1. Stress Under Proof Load:
A Universal Testing Machine (100Tons Criterion 64.106) is used to measure the expression of minimum stress a material must achieve prior to permanent deformation.

Countsunk both ends. Measures Elongation.

2. Strength Under Wedge Bolt:
A Universal Testing Machine (100Tons Criterion 64.106) is used to test the SHCS tensile strength. A tapered plate is placed under the head of a fastener, causing a bending stress.

3. Decarburized Zone:
Evaluation of surface carbon condition using the Hardness method with a Vickers Machine (Tukon - 2500T) - Pitch >1.25mm.

1,2,3 = Measurement Points, 4 = Pitch Line