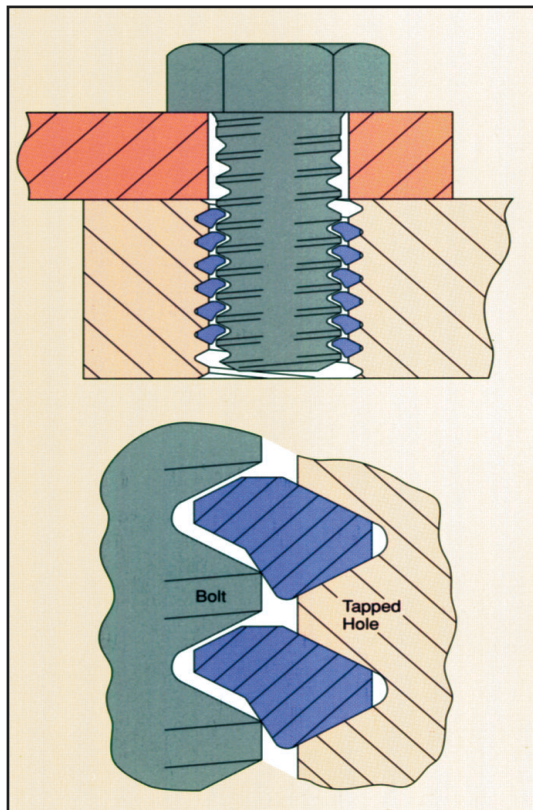


Reliable bolt locking

IT'S FUNNY HOW OFTEN THE MOST SIGNIFICANT DISCOVERIES ARE MADE QUITE ACCIDENTALLY. MARK SIMMS FINDS ANOTHER EXAMPLE, IN A NEW PROFILE LOCKING INSERT THAT MAINTAINS BOLT TENSION EVEN UNDER SEVERE VIBRATION

When Bath-based Cross Manufacturing first developed its Spiralock wire thread insert, it knew it had a good product, with some major advantages over conventional inserts, even if the cost was a little higher. But when a leading helicopter manufacturer began testing the product on the most demanding application imaginable, Cross Manufacturing began to suspect it had something really quite special. In short, not only do these inserts give you the best locking performance you can find, but they throw several other quite unexpected benefits into the bargain.



Spiralock itself is an American company, which developed a revolutionary thread form in 1979 that was exceptionally resistant to transverse vibration – the primary cause of thread loosening. Proven in thousands of applications, Spiralock threaded holes and nuts accept standard male fasteners, eliminate the need for other locking devices, and substantially reduce the potential for fatigue failure when compared to standard threads.

Of course, not every material lends itself to having a threaded hole tapped into it, and so the role of inserts has come to the fore. In the early 90s, Cross Manufacturing applied its wire forming expertise to the Spiralock concept, and began making Spiralock wire thread inserts. These brought the Spiralock benefits to a whole new range of applications, and a measure of the success of the product is that Spiralock itself is now one of Cross Manufacturing's biggest customers.

The system is more than a simple insert – it is a fully independent anti-vibration locking system, so it probably shouldn't even be directly compared with conventional inserts. The Cross Spiralock wire thread system is easy and rapid to fit and take apart, and it has no prevailing torque so bolts can be applied until fingertight, enabling assembly and maintenance to be simple and quick. By contrast, other systems are less easy to install and cause damage to the tapped hole on removal.

This is not to say that high volumes of sales followed straight away, as Cross Manufacturing managing director Rodney Cross explains: "The aerospace industry liked it a lot, but does tend to want to test any new product for a decade or so before committing to an order. The train manufacturers also used it, but again not in huge volumes. Our insert offered some benefits over conventional inserts, but the cost differential was against us."

But then a leading helicopter manufacturer which was struggling to find a reliable locking system for bolting the main rotor head began looking at the Spiralock insert. "There is no application that demands a higher locking integrity – the levels of vibration cause major problems for conventional inserts," says Cross. "We were a little surprised to find that the locking effect was significantly better than



we had dared hope. Indeed, we realised that the locking effect was really quite exceptional." Realising that it needed to do some more in depth testing of its product, Cross Manufacturing acquired a Junkers test rig to simulate demanding conditions by applying varying degrees of transverse vibration to the fastener. In a two year study, various transverse vibration amplitudes and times of application were examined, in a host of different materials, with a range of different bolt and insert finishes. Different lubricants were examined, and a range of vapour deposition finishes were applied to the insert. At the same time, comparative tests were carried out on other anti-vibration locking devices, including helicoil self locking inserts, various washers, Spiralock's own standard threads, and a number of other standard threads.

"We acquired the Junkers test rig considered to be the most searching device for testing thread locking," says Cross. "We wanted to test the full range of sizes, coatings, lubricants and torque, and we also wanted to compare all sorts of other thread locking systems. The results of our tests have confirmed that the Cross Spiralock thread inserts outperform all the thread systems we tested. Even when some of the bolt locking washers offered comparable performance for locking, they still threw up some fatigue problems that weren't an issue with our insert."

But that was far from the end of the matter. Perhaps the reusability of the insert was the most surprising discovery. A single insert fitted in aluminium was tested by tightening, vibrating and loosening over 200 times, and the bolt still locked. "If you could do that just five times with a helical insert, you'd be doing well," Cross comments. "In addition, having tested the insert in the likes of steel, titanium, magnesium and aluminium, it is beginning to look as though the locking effect is independent of the metal alloy in which the insert is fitted. It also appears to be independent of the insert length."

Those characteristics could have major implications for industries plagued by vibration, or in applications looking to reduce weight by using alternative materials. "It clearly has potential for the aerospace industry, which would like to use smaller bolts or fewer bolts in order to help reduce weight," says Cross. "We're already making these products to aerospace tolerances, but we recognise that there will be much more testing to be done before that sector is a big customer. But the rail industry has similar problems with vibration – in locomotive gearboxes, for example – and is also looking to reduce weight. Similarly the automotive industry is making increasing use of lower weight materials such as aluminium, so our insert could be of great benefit there. Then we look at the likes of satellites and other areas of space design where weight is an issue, or for boring machines or any other highly dynamic system where vibration is a problem, and we see huge potential for the insert."

Meeting the needs of helicopter and other aerospace applications, the rail industry and other demanding sectors, Spiralock wire thread inserts are designed to maintain bolt tension under extreme vibration conditions. The Spiralock locking insert uses a thread form that radially centres the male member to the female member and compressively loads each engaged thread on the wedge ramp, resulting in more even distribution of the bearing loads on the entire wedge spiral. Fatigue failures due to high stress concentration on the first engaged thread experienced in standard forms are virtually eliminated. Made from aerospace quality 18/8 stainless steel to DTD734, in the hard drawn condition Spiralock wire thread inserts provide a hard, accurate and lasting thread in light alloys and plastics that are easy and free running to fit, require no pre-winding and have a high number of reuses. The inserts are available in metric and unified sizes. When assembled into the same tapped holes as used for standard wire thread inserts, they provide internal threads to suit standard bolts.