The Cross Spiralock
Thread Insert

A Wire Thread Insert with extraordinary properties.
Piston rings made from coil
Ralph Flower
The Spiralock thread

Bolt

Tapped hole
Cross Spiralock Insert wire section

Bolt

Tapped Hole
Cross Spiralock Insert assembly
London Underground Central Line gearboxes
Blade attachment to main rotor head mast
The Junkers Vibration Rig
The vibration test

- **Peak preload**
- **Vibration start**
- **Vibration end and removal of bolt tension**

- **No loss of bolt tension**
- **Holding force**
- **Locking force**

**Number of vibrations**

**Bolt tension**
Test other available Thread Locking Systems:

- Spiralock taps
- Prevailing torque inserts
- Thin wall inserts
- Spring washers
- Schnorr safety washers
- Nord-Lock
- Loctite
Spiralock Standard Thread (steel)

No loss of bolt tension

Bolt tension

Number of vibrations

No loss of bolt tension
Spiralock standard thread (light alloy)

No loss of bolt tension only at lower amplitudes
Standard insert (non-locking)
Prevailing torque insert

Prevailing torque coil
Immediate loss of bolt tension at the critical amplitude.
Cross spring washer (BS 2 SP.47)

Bolt tension is maintained only under less severe amplitude.
Bolt tension is maintained only under less severe amplitude.
Commercial spring washer

Bolt tension is maintained only under very low amplitude.
Loctite 270 (studlock)

The *studlock* version of this *threadlocker* produces a ‘permanent’ bond between fastener and nut.

At high amplitudes and high bolt tensions, the onset of fatigue is rapid - *the fastener does not loosen*.

Due to the fatigue problem, bolt tension is only maintained at lower amplitudes.
Loctite 268 (threadlock)

The ‘268’ version of this threadlocker is in the form of a ‘Pritt Stick’ – a self-feeding stick applicator.

At high amplitudes and high bolt tensions, the onset of fatigue is rapid - the fastener does not loosen.

Due to the fatigue problem, bolt tension is only maintained at lower amplitudes.
No loss of bolt tension but bolt fatigue problems increase.
Nord-Lock

No loss of bolt tension but bolt fatigue problems increase

Bolt tension

Number of vibrations
No loss of bolt tension but bolt fatigue problems increase.
Cross Spiralock Wire Thread insert

No loss of bolt tension *plus* improved bolt fatigue life
What we needed to find out:

- What's the ideal bolt tension?
- What happens if the tension is reduced?
- Is the length of the thread insert significant to its locking effect?
- Do “base” materials alter the locking effect?
- How many times can you “do and undo bolts” and still get the locking effect?
- How long do bolts stay locked?
Insert re-use assessment

Multiple repeating of vibration test cycles
Cross Spiralock Wire Thread insert

Repeat vibration tests – 75% $R_{p0.2}$

Bolt tension

Number of vibrations...increasing number of cycles
Cross Spiralock Wire Thread insert

Repeat vibration tests – 62.4% $R_{p0.2}$

Bolt tension

Vibration test 98

Vibration test 99

Vibration test 100

Vibration test 101

Vibration test 102

...more vibrations...more cycles...
Cross Spiralock Wire Thread insert

Repeat vibration tests – 62.4% $R_{p0.2}$

...after 200 complete vibration tests
Extended vibration testing

Continuous testing of a Cross Spiralock Wire Thread insert
Cross Spiralock Wire Thread insert

24 hour vibration test

No loss of bolt tension and no indication of fatigue problems
Cross Spiralock Wire Thread insert

24 hour vibration test

Bolt tension

No loss of bolt tension and no indication of fatigue problems

...further vibrations...
Cross Spiralock Wire Thread insert

24 hour vibration test

End of test

No loss of bolt tension and no indication of fatigue problems

1 million cycles

Number of vibrations

Bolt tension
What have we found out about the locking effect of the Cross Spiralock Thread Insert?

- Base materials
- Length of insert
- Finish of bolt
- Lubricant
- Long term
- Undoing & doing up
- Straight line relationships
- Bolt tension reduction
The vibration test – reduced bolt tension

Bolt tension

Peak preload

Vibration start

No loss of locking effect

Vibration end and removal of bolt tension

Holding force

Locking force

Number of vibrations
…better than we thought it would be…
Cross Manufacturing Co (1938) Ltd
Midford Road
Combe Down
Bath
BA2 5RR
01225 837000
www.crossmanufacturing.com/spiralock

............better than we thought it would be............
Torque / preload relationships
Torque resistance ($T_r$)

- Frictional effects – underhead, thread, etc.
- Torsional effects – eg the release of stored energy when vibration starts
- Embedding – interactions between fastener, insert, parent material, head and clamping material and washer, etc.
The vibration test

Peak preload

Vibration start

Vibration end and removal of bolt tension

75% $R_{p0.2}$

Bolt tension

No loss of bolt tension

Holding force

Locking force

Number of vibrations

CROSS
Torque resistance ($T_r$)

Application of a Universal Equation

$$T = PD T_r$$

where

$T$ = torque
$P$ = preload (bolt tension)
$D$ = fastener nominal diameter
$T_r$ = torque resistance
CMC research has proved that this relationship is correct for...

All fastener types, finishes, lubricant types
CMC research has proved that this relationship is correct for all fastener types, finishes, lubricant types.
The vibration test – reduced bolt tension

- Peak preload
- Vibration start
- Vibration end and removal of bolt tension
- No loss of bolt tension
- 75% $R_{p0.2}$
- Bolt tension
- Holding force
- Locking force
- Number of vibrations

CROSS
The vibration test – minimum locking force

Minimum locking forces as low as 25% $R_{p0.2}$

- 75% $R_{p0.2}$
- 50% $R_{p0.2}$
- 25% $R_{p0.2}$

Bolt tension

Vibration start

Peak preload

No loss of bolt tension

Holding force

Minimum locking force

Number of vibrations
The Blanchard Effect

• The *minimum locking force* is inversely proportional to the *torque resistance*

• Fasteners having *high values of torque resistance* lock at *lower bolt tensions* than fasteners having *a low torque resistance*
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