

5. Environmental Testing

The following climatic tests have been carried out to try and replicate the range of temperatures that the High Torque Fastener product might be subjected to in its customer's applications. Trials were conducted to determine the effects of a variety of temperatures on High Torque Fastener Systems screw-helix assembly, and its ability to maintain joint integrity, through expansion or contraction between the different materials.

Component Specification

As shown in figure 1 below, two 40mm square plate with the High Torque helix formed in the centre were clamped together, and assembled to the recommended assembly torque, using a proto-dial torque wrench equipped with slave pointer.

Figure 1
Picture of Environmental test chamber.



Test Procedure

A number of tests were conducted where all samples were assembled using the assembly guidelines noted below, using a torque wrench with a dial and slave pointer or digital screwdriver (which ever is required).

Range of test samples

Sample sizes	Assembly Torque (Nm)	
	Minimum	Maximum
Ø6 x 0.8mm Material	2.0	2.4
Ø6 x 1.0mm Material	2.8	3.5
Ø6 x 1.2mm Material	2.6	3.4
Ø6 x 1.6mm Material	4.0	8.0
Ø8 x 2.0mm Material	16.0	22.0

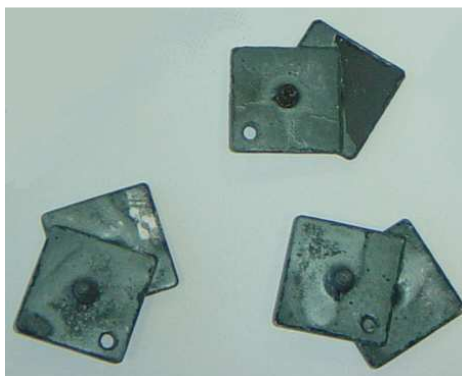
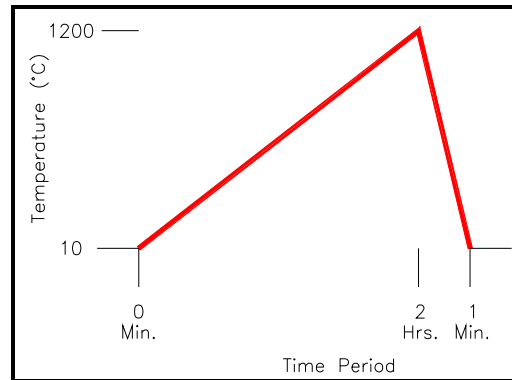


Figure 2
Example of various size plate and screw sizes used during test

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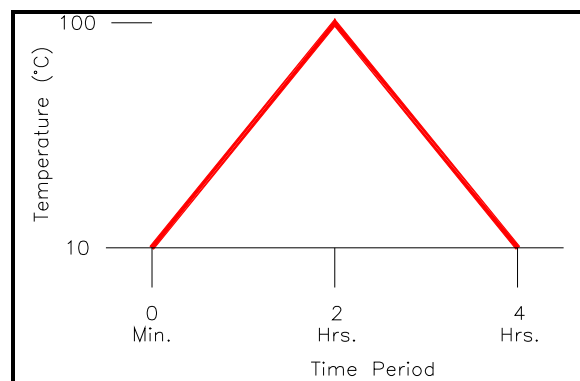
Test 1 (1200°C with shock)

1. Assemble parts and increase ambient temperature to a maximum of 1200 degrees centigrade
2. Allow parts to cool down rapidly by immersing in water (trying to create in shock effect in the joint).



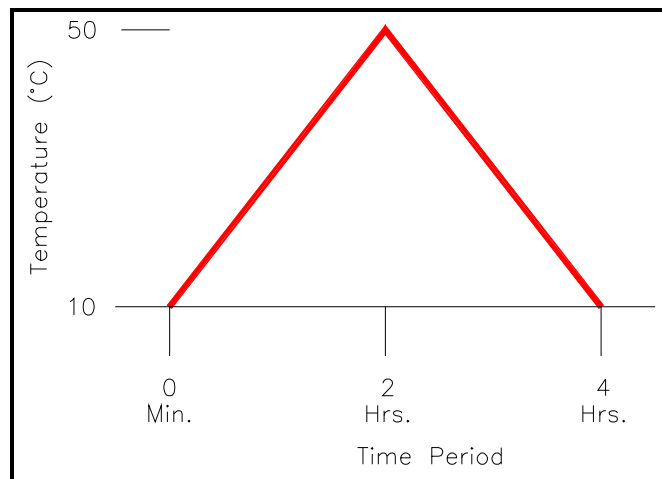
Test 2 (100°C)

3. Assemble parts and increase ambient temperature to 100 degrees centigrade
4. Allow parts to cool down naturally in air.



Test 3 (50°C)

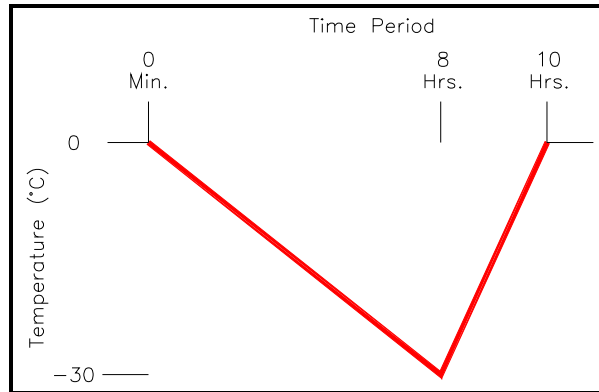
5. Assemble parts and increase ambient temperature to 50 degrees centigrade
6. Allow parts to cool down naturally in air.



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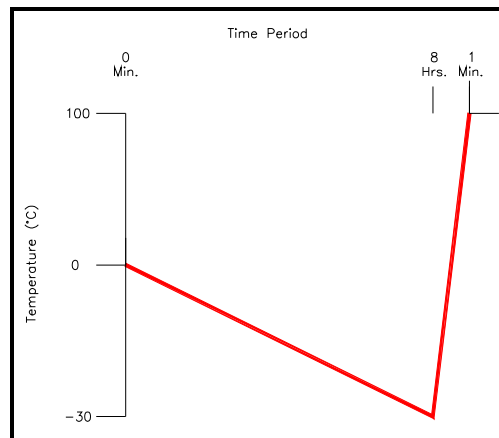
Test 4 (-30°C)

7. Assemble parts and decrease ambient temperature to -30 degrees centigrade
8. Allow parts to acclimatise in air



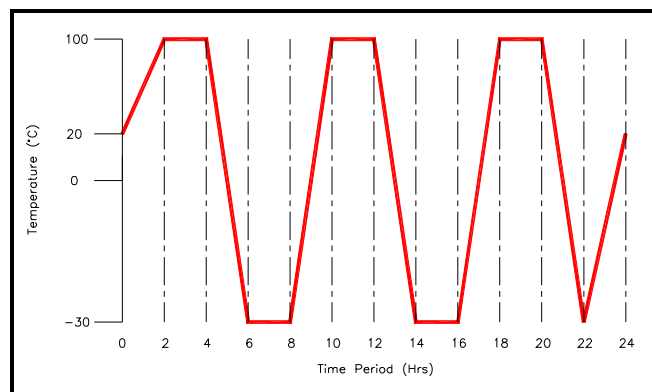
Test 5 (-30°C with shock)

9. Assemble parts and decrease ambient temperature to -30 degrees centigrade
10. Create a shock effect in the joint by quickly increasing temperature to 100 degrees centigrade.



Test 6 – Cyclic Testing (-30°C to 100°C)

11. Subject assemblies to a varying degree of temperatures over a 24hr period.



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Results

After removal from the various test environments, the following results were recorded, for both break loose and assembly torque.

As noted below no difference was evident between original insertion and retightening torque, across all sample plate and screw range.

Thread Diameter (mm)	Material Thickness (mm)	Assembly Torque (Nm)	Retightening Torque (-30°C to 100°C)	Break loose Torque before test (Nm)	Break loose Torque (-30°C to 100°C)	Break loose Torque (1200°C)
6	0.8	1.4	No Change	0.75	No Change	2.0
6	1.0	2.8	No Change	1.5	No Change	6.0
6	1.2	3.4	No Change	1.8	No Change	13.5+
6	1.6	8.0	No Change	2.0	No Change	13.5+
8	2.0	16.0	No Change	5.0	No Change	13.5+

Observations

The results were documented after each of the above trials and the following noted: -

- Inspection of both plates and screws before and after hot and cold trials (noting condition etc.)
- Note any disengagement due to expansion or contraction.
- Appearances of increased adhesion within the joint (noting reasons)
- Comparison in break loose torque before and after trials.

Conclusion

It is the opinion of the writer that when the High Torque Fastener System assembly is subjected to the various climatic environments as indicated in these trials, there are little or no discernable differences in its attributes.

1. In trials (-30°C to 100°C) there were no discernable differences in the assembled joints tightening torque figures after the tests.
2. In trials (1200°C) a significant increase in adhesion between the screw and sheet material was observed. This is caused by surface carburisation on both the screws and sheet material. (see photo below)
3. None of the test pieces disengaged during the temperature trials.

The only observation noted during the trials, is that when the High Torque Fastener system is utilised in a very high temperature environment, the joint integrity is increased between the fastener and the formed sheet material as shown below.

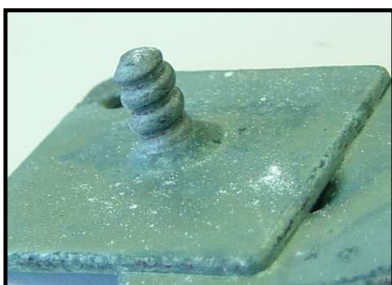


Figure 3

High carburisation between fastener and sheet material after high temperature trial (1200°C)