Can screws be reused?

By Martin Rüedy, fastener expert team, Bossard Group

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Ref: FFT160810

Originally published in Fastener + Fixing Magazine Issue 100, July 2016.

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'State of the art' and requirements for product safety

In connection technology normative references relate exclusively to screw elements in mint condition. Adherence to a standard requirement is, in general, not mandatory. Standards are non-binding recommendations but can become binding for particular applications when referenced in specifications. Adherence to basic safety requirements can then be substantiated via technical standards when the order is made. Here the 'state of the art' comes into play at the time of marketing and use for a particular application.

The application of a specified standard supports the presumption of conformity for compliance – such as CE Marking. Where there are no relevant standards or none to draw upon, procedures according to recognised rules of technology must be applied.

When it comes to the reuse of screw elements it is then incumbent upon the user or maintenance personnel to assess the practicality. Replacement is normally prescribed by manufacturers in their instructions. As defined by 'state of technology' the observation and replacement of safety relevant connecting components is also recognised, which represents years of practice and is a prerequisite for a reliable connection.

Furthermore the obligations for putting products on to the market must be observed. In doing so the basic health and safety requirements must be satisfied. In addition to the state of knowledge* and state of the art, the assessment of the pursuance of specific potential hazards of a product or joint(s) must be taken into consideration.

Summary

From the perspective of the requirement for a clear assignment of the related specifications to the identification and compliance with all relevant boundary conditions, the reuse of previously used coupling elements is to be refrained from.

Process capability in assembly

The process capability in assembly can be broken down into five main sections:

1. **Safety in assembly** – friction.
2. **Protection against corrosion** – visual condition.
3. **Surface treatment** – disassembly capability.
4. **Durability** – surface damage.
5. **Cost-effective production** – assembly cost.

Safety in assembly – friction

The controlling factor in the safety of the connection is the assembly pre-stressing. Assembly is carried out on the basis of the assembly instructions and the tribological boundary conditions. Pre-stress force in assembly is considerably influenced during the assembly process by the thread coupling and bearing surfaces (part of the connecting component). Assembly efficiency amounts to only 10% – 20%.

This makes it clear that the tension to be reached according to the design calculation can only be reached with specified friction coefficients. In addition, process safe assembly should also keep the spread of friction effect to a minimum. Practice requires a defined lubrication for safe connections. So-called 'anti-friction' coating solutions allow a verifiable lubrication condition and optimise the tribological boundary conditions.

Summary

The advantages of a tribological coating directly on the connecting components promote the required safety in assembly with a defined assembly window for the pre-stressing force to be achieved. So that there is still safety of assembly even during reassembly with replacement components, brand new coated screw elements should be provided.

Solution – Bossard ecosyn®-lubric

Tribological dry coating is a system solution for mechanically stressed fasteners (screws, nuts and bolts). The coating is a non-electrolytical applied, thin covering film with integrated lubricating properties and additional corrosion protection. The coating consists of a composition of fluoropolymers and organic solid lubricant particles, which are dispersed in carefully selected synthetic resin and solvents. What is known as the AF coating (anti-friction coating) creates a smooth film, which compensates for any unevenness in the surface, thus optimising friction even under extreme loads and working conditions. In turn, the synthetic resin guarantees improved corrosion protection.

Advantages of tribological dry coating

+ Excellent friction coefficients with lower dispersion as a basis for any screw connection.
+ Clean and environmentally friendly coating with simple handling.
+ High installation safety in manufacture and maintenance
+ Cost-effective assembly, disassembly with a reduction in process costs in the case of a comprehensive cost analysis.

**consolidated knowledge being implemented or shortly to be implemented, and available at the time that the product (screw assembly) is placed on the market.*

Protection against corrosion – visual condition

Surface coatings on connecting components have both a protective and a specific tribological surface property. Generally the sliding properties are improved by additional topcoats made of a fluoropolymer composition (e.g PFTE) and enable an increase in assembly pre-stressing for initial window.

In their new condition, connecting components with selected surface coatings can allow a reproducible tension and protection. Practice suggests a sufficiently accurate repeatability for a maximum of five assemblies. The particular acceptance for a permissible spread (discrepancy in assembly pre-stressing) depends on the design of the screw and the intended use of the connection.

Now when screw connections are already in use and operating conditions are affecting the surfaces, the tribological conditions are altered. Increasing re-assemblies and mounting service time can be counted upon to reduce protection against corrosion and at the same time also alter the friction values. We speak in practice also of a reduction in function over time, which can be attributed to our environment in the industrial sector. So the surface coating can be attacked prematurely by aggressive media and/or degraded by chemical processes. These signs can be visually detected (ferric oxide) and lead to specific interpretations according to individual judgment. Even during the warranty period the aspects of a design or appearance can lead to complaints if the level of protection is lost quicker than expected.

Summary

Since surface coatings in operational use are subject to degradation, colouring, appearance and, depending on the screw material used, the residual risk of failure – which are all reasons for replacement – scheduled monitoring and periodic checks (assessments) are to be recommended for safe screw connections.

Surface treatment – disassembly capability

The surface coating provided and/or extra coating (topcoats) generally optimise a specific function. Besides the protective properties, friction behaviour and design requirements, disassembly can also be a focal point when it comes to maintenance.

In particular for supply and transport systems (energy generation, means of transport), supply security or the availability of machines and systems is at the forefront. Simple disassembly for efficient maintenance work is important here, similarly to assembly with assured pre-stressing forces. If for example screw connections of stainless steel can no longer be undone, we talk about the connection being ‘seized up’ – also known as a cold shut.

What causes ‘seizing up’? It is when common contact surfaces of a connection (the thread flanks) reach the limit of adhesive friction. Mechanical resistance (excessive friction) occurs, which prevents movement of the superimposed parts.

Factors that affect ‘seizing up’

+ Excessive stress: Over tension or excessive torque lead to plastic deformation in the thread.
+ High assembly speeds: Assembly using pneumatic impact screwdrivers.
+ High surface roughness: Improperly cut threads/grooves.
+ Impurities: For example chips, particles of dirt or sand in the thread.
+ Flaws: This includes lead misalignment or tolerance deviances in the thread.
+ Assembly process under additional pressure or tensile load: Contraction of non-sealing flanges with soft sealing material.
+ Mounting nuts with locking system: Lock nuts or nuts with a polyamide insert generally produce a coaxial displacement with consequent partial pressure in the thread flank.

Summary

From this it can be concluded that the designer has established the connection design among the aspects of the relevant operational phases. Proof of the necessary safety of the products with maintenance of the functions and consideration of possible maintenance work is at the same time an integral part of the instructions. Spare and replacement parts (including screw elements) must be specified and their exchange described, together with assembly/disassembly instructions.

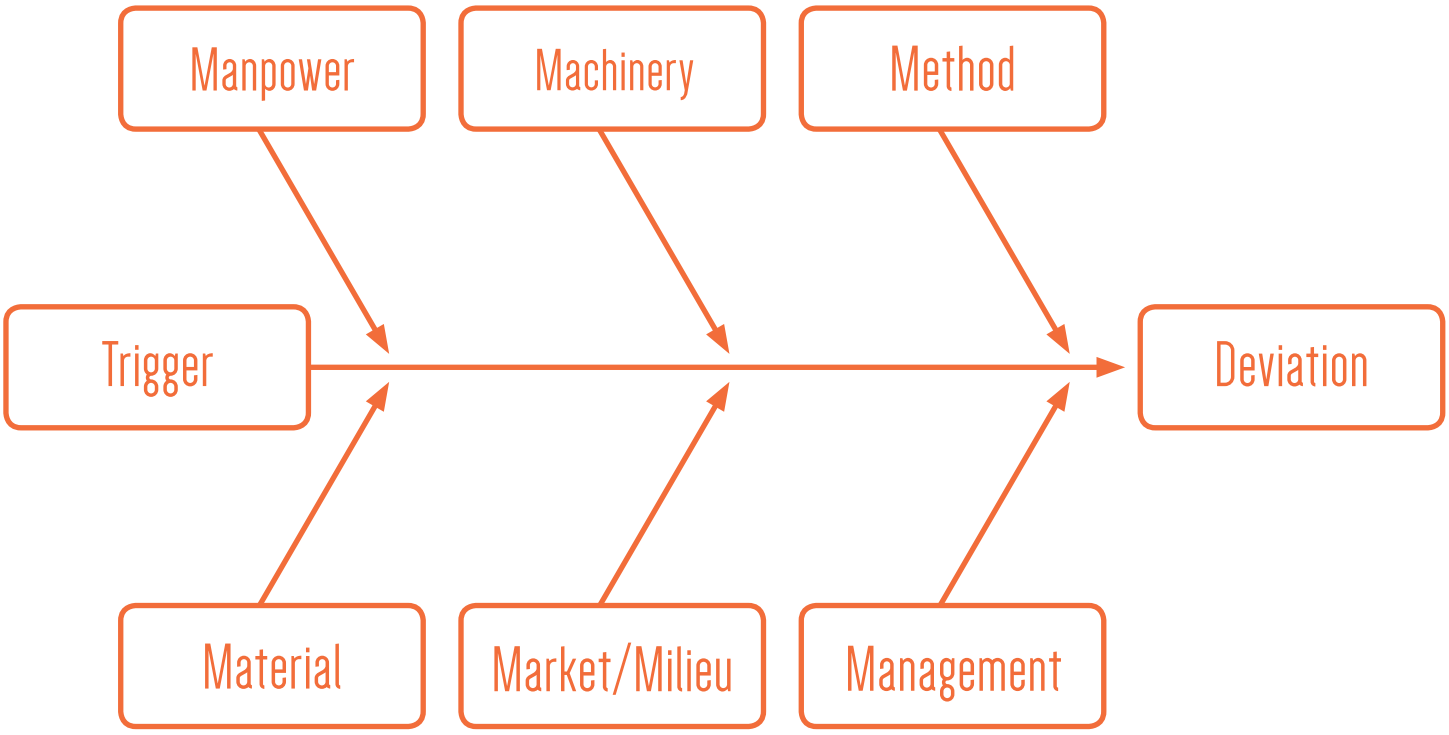
Defining the surface coating and lubrication state is critical in preventing cold shuts and ensuring proper assembly. The replacement of the screw elements with their lubrication is therefore strongly recommended. Professional assembly therefore requires, in practice, brand new connecting components with defined assembly specifications.

Durability – surface damage

Highly stressed connections require a corresponding pre-stressing in the screw system during operation. Both possible subsidence and dynamic stress conditions can affect durability. The state of the surface of the dynamically loaded screw elements is also a critical factor. So surface damage during manufacture or from other operational influences must be avoided.

Industrial manufacturing and assembly is mostly based on quality management in accordance with the international ISO 9001 standard. For the safety of connection technology a corresponding test plan must be provided for manufacture and assembly as well as for operational use. Although every connecting component should meet all requirements of the appropriate production standard or specifications, in mass production this is not always possible. That is why for the purposes of ISO 3269 it should be noted that such a quality check, if carried out, cannot prove with certainty that there will be no defective parts in the production batch.

The reasons for defects in manufacture, operation, maintenance or repair are usually a combination of contributory factors. Here experience shows mainly a relationship between the specified screw elements, matching of components and the assembly methods used. Knowledge of the various screw parameters and expertise in design and assembly are a prerequisite for the safety of the connection.



Summary

Whether the screw elements fulfil their functional requirements takes precedence over the 'beauty' of the connecting components. Surface defects as defined by ISO 6157-1 and ISO 6157-2 are to be assessed in each case. The use of the connecting components is to be approved in accordance with set conditions. Reuse of use screw elements must therefore be reassessed and accounted for each reassembly in a manner similar to that for newly manufactured ones. The liability of approval thus rests with the distributor or in a similar manner with the maintenance operation responsible for the implementation of replacement work.

From the above conditions it can be seen that the use of brand new connecting components is to be recommended for the purposes of the original specification.

Cost-effective production – assembly cost

Demands for cost-effective production continue to grow. Under unfavorable market conditions and decreasing development times it is essential to remain competitive. Additional ecological considerations are also shaping the future assembly of connection solutions. With a modest use of resources and therefore lower production costs, it is imperative to maximise customer value. Customer satisfaction can be further stimulated if all quality requirements are also really complied with. This may involve the customer also taking on certain obligations.

Despite generally comprehensive documentation and certification, customer complaints can arise. Dissatisfaction may now relate to the distribution service, logistics service, cooperation/communication or to product quality.

Practice shows that usually a combination of reasons lead to an unacceptable discrepancy. Thus component design, assembly procedure and screw design with conditions of use are important prerequisites for intended application.

Assembly process capability is therefore an important prerequisite for keeping assembly lead time down. In practice, quality discrepancies or even missing parts cause unplanned downtime. It is essential to prevent this by using the right screw elements and the appropriate assembly instructions. A high process capability therefore means being able to correctly implement decisions according to expectations.

Summary

Cost-effective assembly is based on simple assembly processes with the right assembly equipment. In this the screw elements with their tribological properties set important parameters to achieving the required assembly pre-stressing. As defined by the LEAN principles, the value adding steps must be improved and non value adding activities such as 'wet' lubrication via tribological dry coatings be replaced.

The starting position for the assembler is therefore a brand new screw with the specified treatment and if necessary a topcoat for the appropriate lubrication condition. A used screw with operational environmental effects is no longer in its original condition that it had for the first assembly and must therefore be replaced.

Safe connections should therefore always be provided with brand new screw elements and if necessary documented using your label assignment (production batch).