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EJOT MAXXtip® – direct fastening in ultra-high strength materials

Direct fastening, where a screw forms its own female thread, is an economical and process-reliable alternative especially for highly stressed joints. The range of applications is limited by the maximum strength of the screw tip, which must not deform plastically during thread forming.

In order to increase the hardness of a self-tapping tip made from low-alloy carbon steels commonly used as screw material, different hardening mechanisms are combined. On the one hand, the maximum hardness is influenced by the carbon content in the material, which should be as high as possible. Such a condition can be set in the thread flanks by so-called carburization, during which the carbon diffuses into the surface while being heat treated. On the other hand, the material in the screw tip can be induction-hardened. If subsequent tempering can be avoided, especially in case of galvanic processes, the tip hardness achieved has a beneficial effect on the fastening process.

However, subsequent tempering can only be omitted if the structure in the head and bearing area of the screw is completely insensitive to hydrogen embrittlement. The screw tip is only stressed for a short time during fastening so that a delayed hydrogen brittle fracture is excluded, provided that the tip is not or only slightly mechanically stressed in further use.

There is actually a high-strength microstructure that is very insensitive to the influence of hydrogen. This so-called austempered structure can be obtained by first exposing the screw to a carbon-enriched atmosphere during heat treatment and then cooling it within a salt bath in such a way that a bainitic microstructure is formed across the cross-section, with the parameters being selected in such a way that the strength of the screw in the head and bearing area is around 1000 MPa.

It could be proven that such a microstructure still shows ductile fracture behaviour after hydrogen-loaded galvanic processes (e.g. zinc coating) under destructive slow mechanical testing, whereas a screw after conventional 10.9 heat treatment shows hydrogen embrittlement under the same conditions. Therefore, a screw that is austempered in the first step and induction-hardened in the second step can fulfil exactly the requirements mentioned in the beginning for a particularly hard self-tapping tip without the risk of hydrogen embrittlement.

Thus, the EJOT thin sheet metal screw SHEETtracs®, produced according to this so-called MAXXtip® material concept, can excellently form its thread in ultra-high strength sheet metals having an ultimate tensile strength of up to 1500 MPa. It is only necessary to ensure that the self-tapping tip always passes through the sheet completely. This opens up a wide range of applications that enable a secure connection for crash-relevant automotive components that can later be sustainably dismantled for recycling. Examples are bumpers, reinforcements on the B-pillar or seat structures to which add-on parts are to be fastened.

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For the fastening of thicker sheet metals or in blind holes, this material concept can also be applied to the so-called Spiralform® screw. This screw requires an installation depth that excludes subsequent heavy stress on the self-tapping tip. This is achieved by calculating the screw length from the sum of the clamping part thicknesses, the length of the induction-hardened area and the length of 1.5 times the screw diameter. This enables a reliable application of the screw concept mentioned.

Additionally, such a screw can be used for thread forming in cast steel materials. In this case, no threads have to be drilled into cast holes for fastening, so that it is possible to screw directly into these holes, provided that the geometry is suitable. This means that both tools and process steps can be saved on a sustainable basis.

This unique combination of different heat treatment processes results in a new type of screw that, in addition to a head and shank area that is completely insensitive to hydrogen embrittlement, has a particularly hard and resistant self-tapping tip that extends the application range of direct fastening to ultra-high strength steels and cast steel materials in a process-reliable manner. With the MAXXtip® material concept, it is thus also possible to coat high-strength screws with a galvanic finish (e.g. Zn or ZnNi) without being exposed to the risk of delayed hydrogen embrittlement in otherwise critical applications.

MAXXtip® at a glance:

- Process-reliable direct fastening in ultra-high strength steels and cast steel
- No risk of hydrogen embrittlement – even with galvanic coatings
- Removable joint – excellent reusability

Caption I:
Potential application areas of the MAXXtip® screws in the automotive sector

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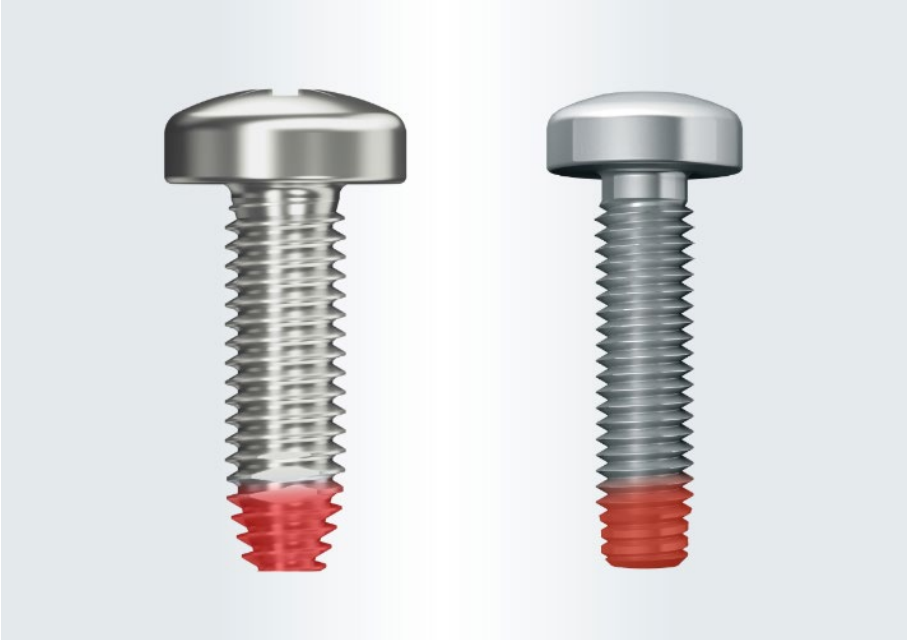

Caption II:
The MAXXtip® material concept is available for the EJOT screws SHEETtracs® and Spiralform®

Caption III:
EJOT. Bringing it together.

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