GOEBEL

THE BLIND RIVET SPECIALIST

Quality
The First
Time

CUP - SEALED BLIND RIVET

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made of stainless steel A2 – AISI 304 or made of stainless steel A4 – AISI 316 with mandrel made of stainless steel

MAXIMUM CORROSION PROTECTION!

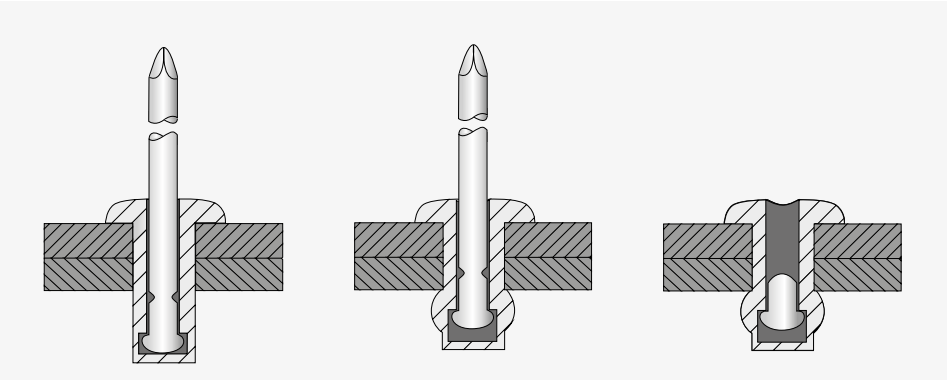
Survey on CUP sealed blind rivet of stainless steel

Increasing demand in more corrosion resisting materials (e.g. in off-shore sector, food sector, oil industry/petrochemical industry, machine construction etc.) raised the question:

„Why do all rivet manufactures sell sealed blind rivets with rivet bodies of stainless steel A2 (AISI 304 / 1.4301 – austenite) and mandrels of stainless steel A4 (AISI 410 / 1.4006 or AISI 420 / 1.4021 – martensite)?“

Sealed blind rivets present following characteristics:

- Sealed against air, dust and water (with appropriate drill hole)
- Captive mandrel
- Well suited for automated processing
- Large contact pressure at join end
- Vibration resistant connection



Therefore sealed blind rivets will be used, if before mentioned properties are demanded.

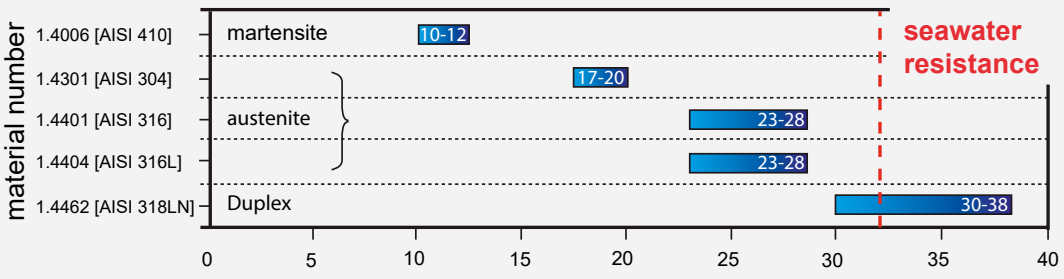
For example in off-shore sector fasteners are daily exposed to aggressive media as saline humid atmosphere or seawater.

Stainless steel A2 (AISI 304 / 1.4301) provides no optimal corrosion protection. Even stainless steel A4 (AISI 316 / 1.4401) is often wrongly praised as corrosion resistant in seawater environments.

Stainless steel A4 (AISI 316 / 1.4401) is more appropriate than stainless steel A2 – 1.4301, because of percentage of chromium (Cr) 16,5 – 18,5 %, higher percentage of nickel (Ni) 10 – 13 % und addition of molybdenum (Mo) 2 – 2,5 %.

The following table shows a summary of corrosion resistance of different kinds of stainless steel.

CORROSION RESISTANCE & PITTING RESISTANCE EQUIVALENT (PRE) VALUE



(PRE) value (%Cr + 3,3%MO + 16%N)

PRE value:

The value is used to estimate corrosion resistance of a nickel containing alloy against pitting and crevice corrosion. This value is also known under PRE (pitting resistance equivalent).

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The ability of stainless steel or nickel based alloy to be protected against these forms of corrosion depends on individual contents of alloying elements. This alloying elements lead to passivation and protection of the metal. If the passivation layer is not sufficiently, the metal will be attacked and corrodes.

To build up a stable passivation layer a chromium content of minimum 12 % is required. Here the chromium content must always be higher than the oxidant content.

After chromium molybdenum is the most important alloying element. Percentage is 1,6 – 2,8 %. Molybdenum increases the resistance to surface corrosion in reducing media and so it is of significant
importance for acid resistance.

Nitrogen is equally important for the material.
The value (WS) is calculated:
WS = % Cr + 3,3 * % Mo + 16 * % N
The higher the value, the more resistant is a material against pitting and crevice corrosion. Alloys with a value beyond 33 are considered to be seawater resistant.

Pitting corrosion describes small appearing corrosion spots or punctual holes in surface of passivated metals, which partly considerably expand trough-shaped into the depth.

Because of low expansion on surface, pitting corrosion often remains undetected for a long time.

Crevice corrosion is a far more important factor. Crevice corrosion appears at places with a gap, which means at a place where a corrosive medium (here seawater and chloride-containing sea air) can stick longer.

For the corrosion test holes were drilled in steel plates and equipped with screws and plastic washers. Under these washers seawater can keep well and due to evaporation of water it comes to enrichment of salt and following on to a significant corrosion at this point.

The measured depth of crevice corrosion was more than 1 mm here.

We used this cognition and developed a new generation of CUP sealed blind rivets.

There were two task definitions:

1.) Equip CUP sealed blind rivets of stainless steel A2 (AISI 304 / 1.4301) with a mandrel, which does not consist of martensitic stainless steel (AISI 410 / 1.4006 or AISI 420 / 1.4021) to increase the corrosion resistance of mandrel remaining in rivet body.

2.) Producing CUP sealed blind rivets of stainless steel A4 (AISI 316 / 1.4401), which were not yet offered on market.

Both points focused on increasing the corrosion resistance – maximum corrosion protection!

Following pictures show CUP sealed blind rivets of stainless steel A2 (AISI 304 / 1.4301) with a martensitic mandrel of stainless steel (AISI 410 / 1.4006 or AISI 420 / 1.4021), which were subjected to a Kesternichtest (DIN 50018 2.0s / DIN EN ISO 6988). Samples of our competitors as well as our own were tested.

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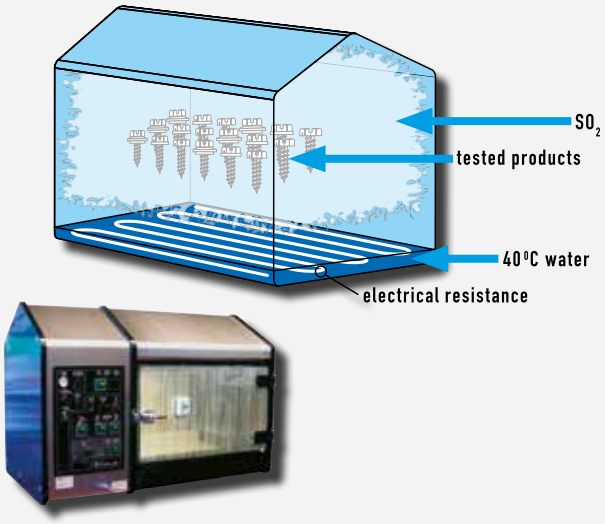
Test Method

Kesternich cycles (to EN ISO 3231):
This method is an accelerated corrosion resistance test in an alternating condensation climate with a sulphur dioxide atmosphere. 1 cycle lasts 24 hours during which the screw is exposed for 8 hours and then undergoes a pause of 16 hours. The Kesternich test investigates how long the screw's corrosion resistance lasts in an acid industrial atmosphere. Results in cycles before red rust is observed.

RESULT after
20 Kesternich cycles = SUCCESSFUL
(no change)



Kesternichtest result shows an eye-catching discoloration of rivet body and mandrel. In the beginning residual oil - due to production process - flows out of rivet body and causes the discoloration. Remaining mandrel in rivet body and spent mandrel corrode during Kesternichtest after some cycles.

Our result of above mention task represents as follows:

1.) A CUP sealed blind rivet of stainless steel A2 (AISI 304 / 1.4301) with mandrel of duplex steel (austenitic/ferritic) has been developed.
2.) A CUP sealed blind rivet of stainless steel A4 (AISI 316 / 1.4401) with mandrel of duplex steel (austenitic/ferritic) has been developed.

MAXIMUM CORROSION PROTECTION!

The difficulty was to find a suitable replacement for hard martensitic stainless steel C1.

High tensile strength to deform rivet body and required contact pressure must continue to be guaranteed.

Duplex steel (austenitic/ferritic) with its excellent corrosion resistant characteristics as well as high tensile strength fulfilled all expectations. Duplex steel also finds application among others in:

Pulp and dyeing industry, petrochemical industry, shafts in acid pumps, seawater stressed machine parts or wherever aggressive media have strong influence on corrosion resistance.

We would be happy, if we had pointed out a new opportunity to optimize corrosion resistance for you.

Please refer to our catalog for available dimensions.