IHI COLD FORMED ALUMINUM SCREWS – COLD FLOW "SHALLOW FOLDS"

Insights to cold formed aluminum socket set screws and process artifacts.

What are the marks on the top of some screws?

1. Cold formed aluminum screws are upset extruded like an aluminum pop can. The wall of the hex socket is created by material from the center (bottom of hex socket) being extruded up the sides to form the wall of the hex socket.

The flow of material upward forms up the top perimeter of the hex socket. That material does not all arrive at the same time so at some point, material moves laterally to fill the remaining empty space.

This commonly creates a shallow radial fold in the material, usually near (but significantly not at) the location of a hexagon apex point, whichever is the last to "fill" at the tightest spot.

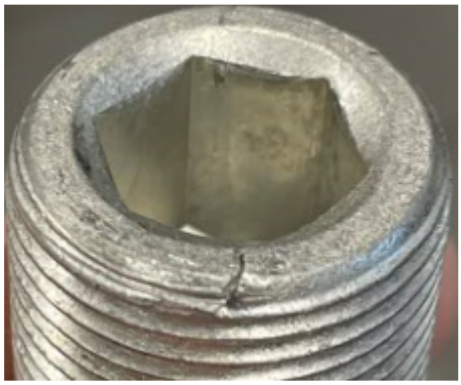


Fig 1

2. Other process related cold radial flow striations are to be seen at the bottom of the hex socket recess, where aluminum was moved outward to the periphery before its journey to the form the wall of the hex socket.

Fig 2

3. When the secondary operation of thread rolling occurs, also a cold forming operation, the hidden fold can open up a little or extend a little, becoming more prominent and sometimes can look more like a stress crack due to the localized temporary strain from thread forming. It is not caused by the hex bit torque and resulting bursting type hoop stress.

Fig 3

4. The shallow folds on the recess top surface are normal and do not in any way detract from the target engineered strength requirements of the hex socket in use.

Since this temporary thread rolling stress is local to the shallow fold and at the same shallow depths there is no subsequent propagation down the wall even under torque numbers way in excess of the user torque.

The depth of the fold is in the non-active portion of the hex socket since the hex socket is heavily countersunk, so the material above it is not in direct contact with the hex key.

There is more than adequate hoop strength in the main body of the hex even if the chamfer portions were machined away.

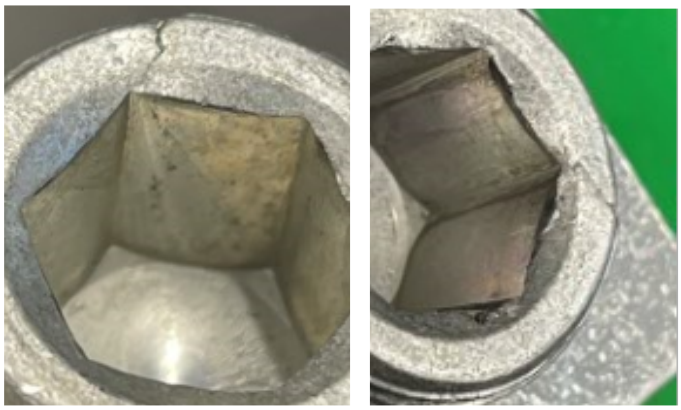
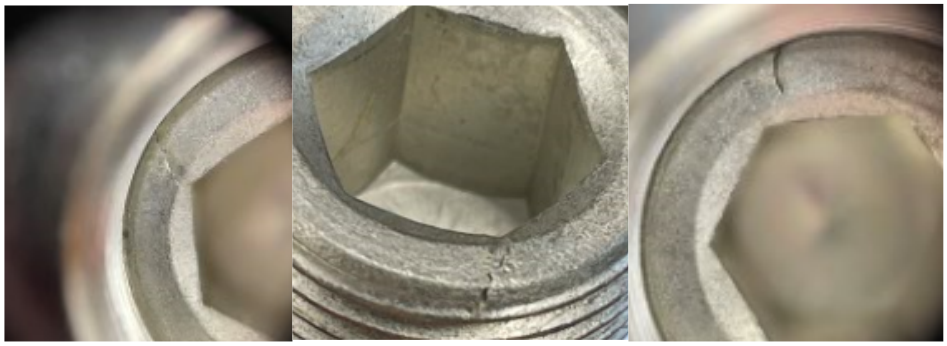


Fig 4

5. High percentages of visible folds are commonly seen and even when not visible (very tight folds) or barely visible, they are still there, on many if not most screws of this type.

Fig 5 

6. Testing on screws (11939 screws in this case) which had prominent shallow folds visible tested in worst case conditions:

100% of the hex socket depth outside the lug body thread, so no support of the recess walls is provided.

Fig 6 

7. Even at an arbitrary +60% over user torque of 375 in-lbs (600 in-lb) no signs of failure or any crack propagation was seen on “worst case” samples pulled from stock.

Fig 7  600 in-lb test user torque is 375 in-lbs 11939 screw 1/2” hex socket

8. All screws lots are “torque torture tested” by IHI before releasing them for assembly.

9. There is no history of wall failure complaints from customers.

10. IHI has no evidence showing that screws with visible shallow folds will not meet the user torque every time. On the contrary.

11. The cold formed aluminum screws have been in the field since 2001. The 11939 since 2011.

12. All IHI cold formed screws are made from 2024 aluminum a “hard alloy” aircraft grade aluminum and are very tough.

IHIConnectors.com

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