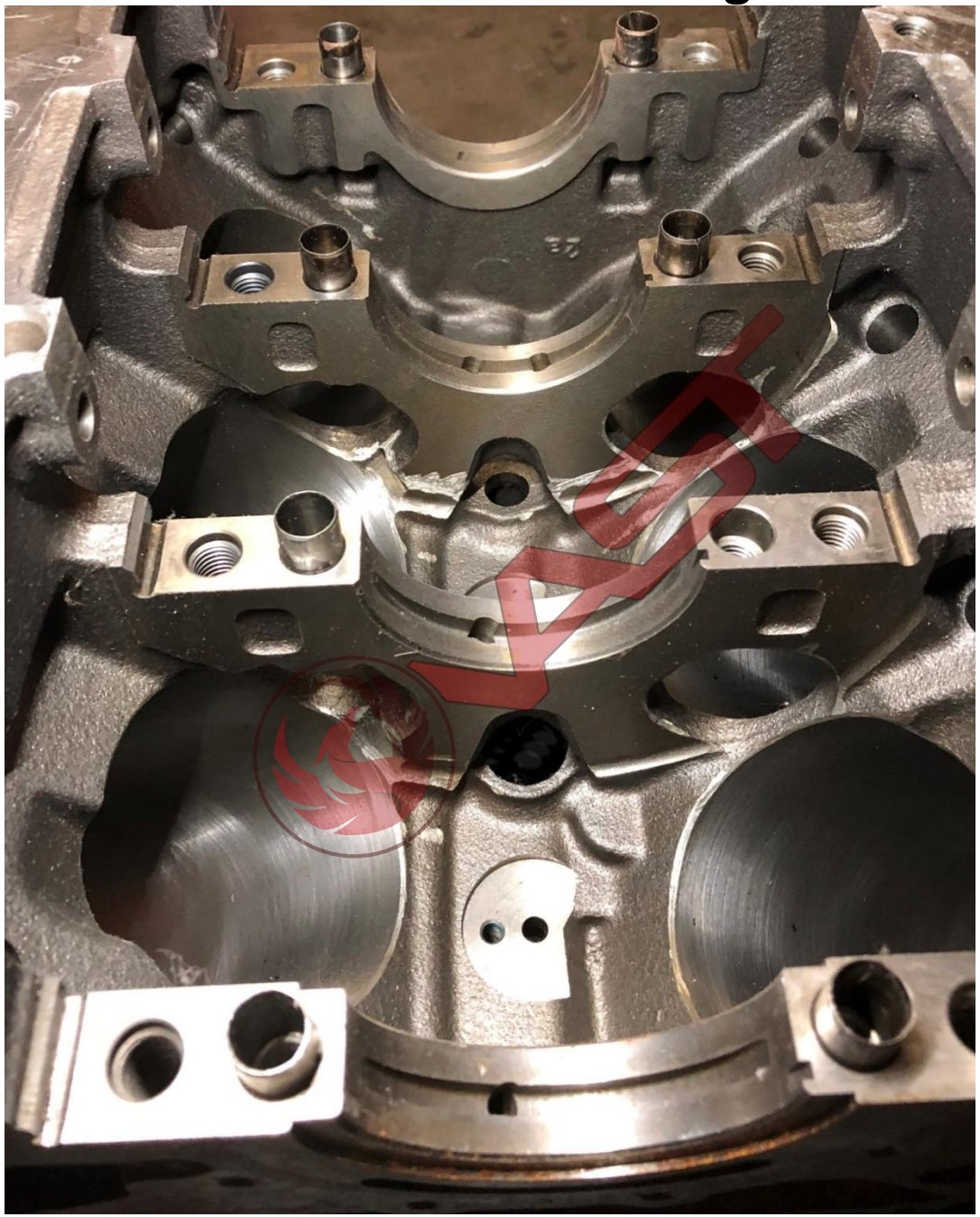
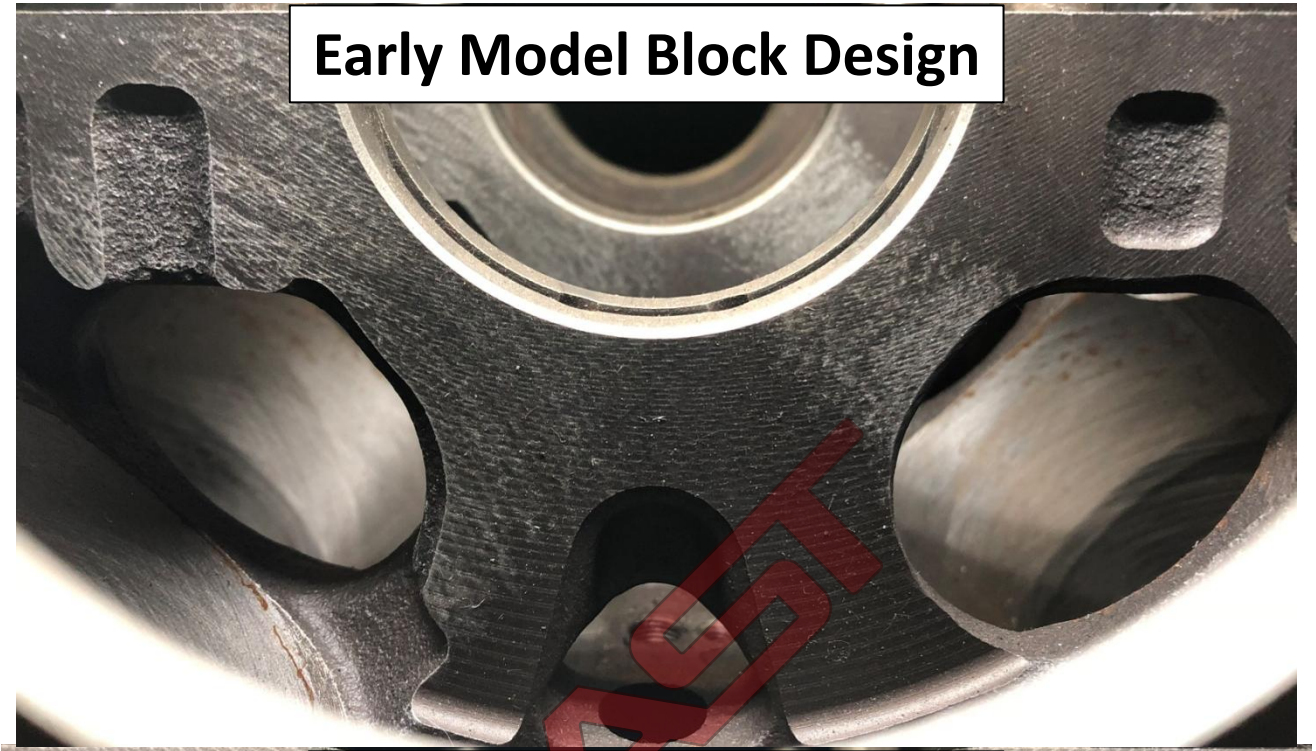
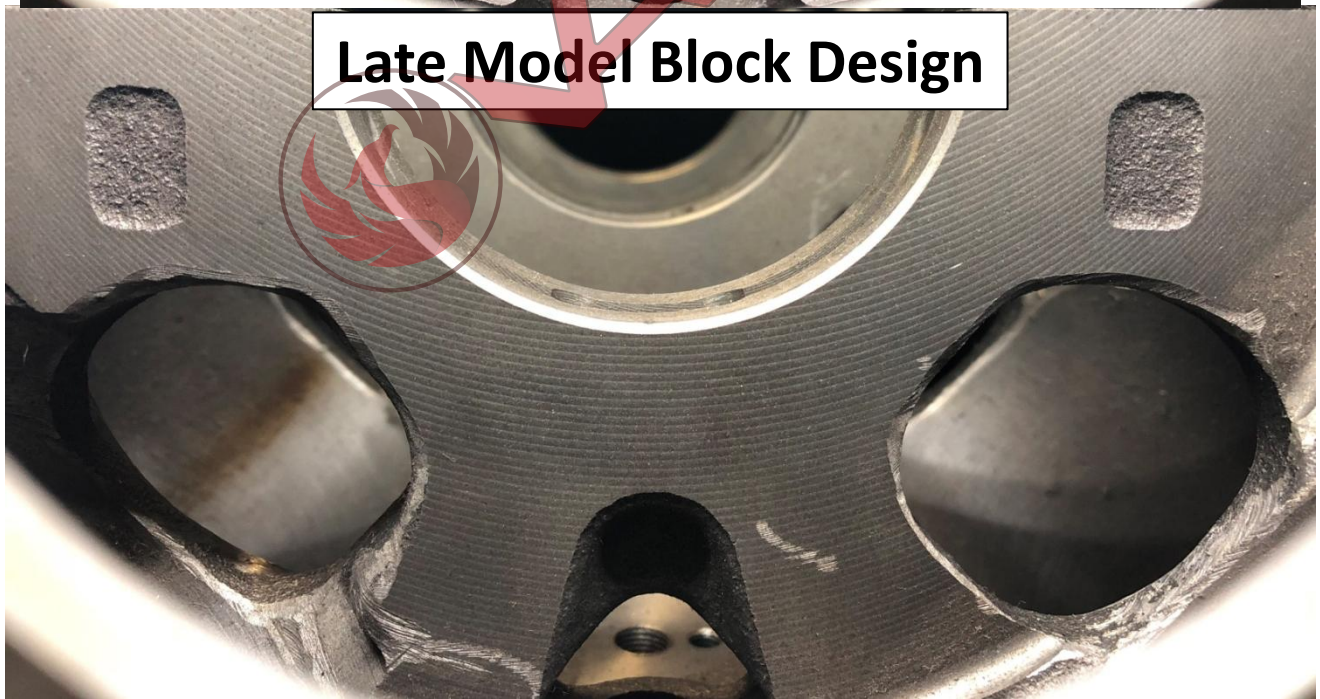
Analysis of Audi 2.7L Block Failures Without the Use of a VAST Girdle

June 2018

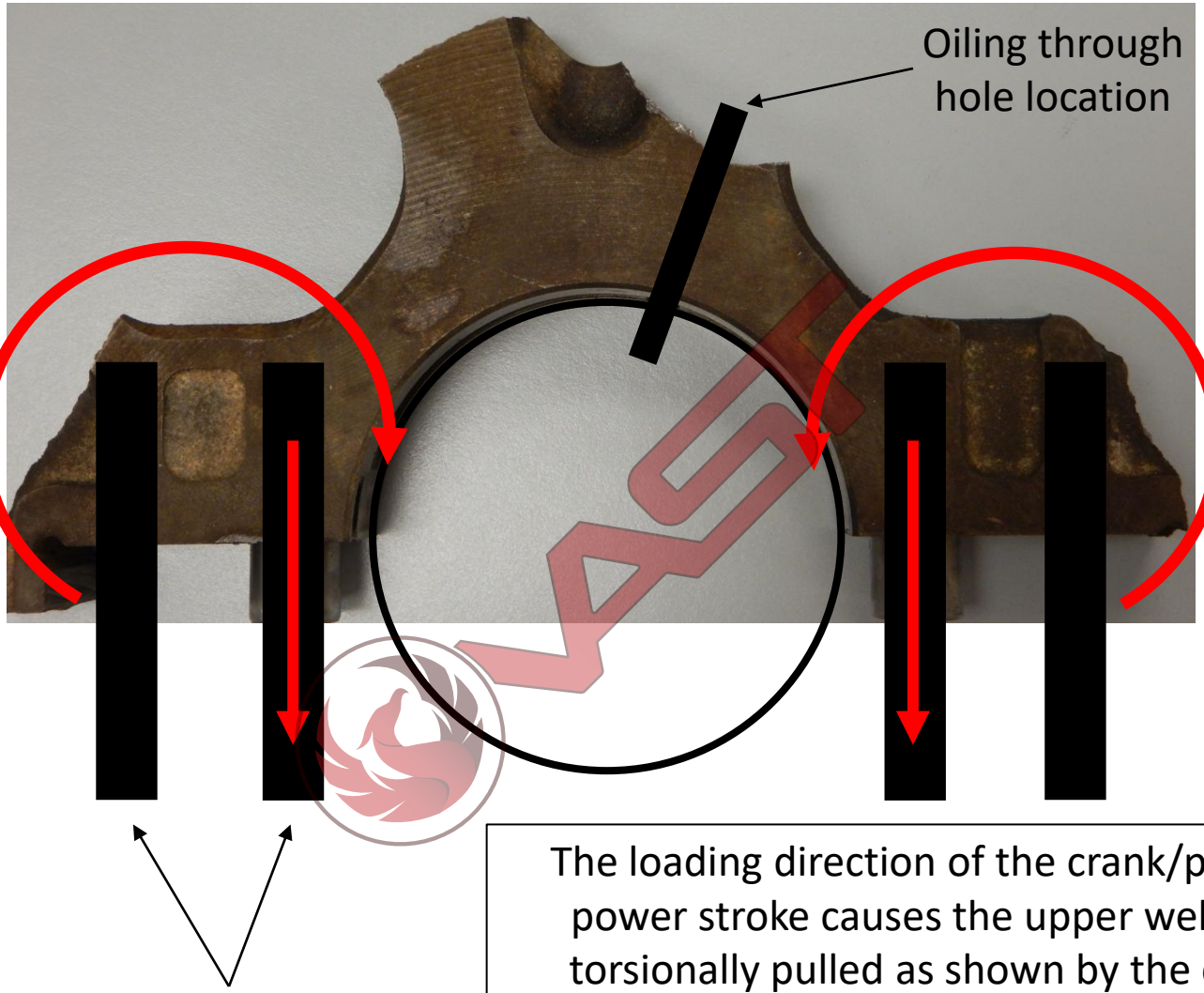
Late Model Block Design




Early Model Block Design

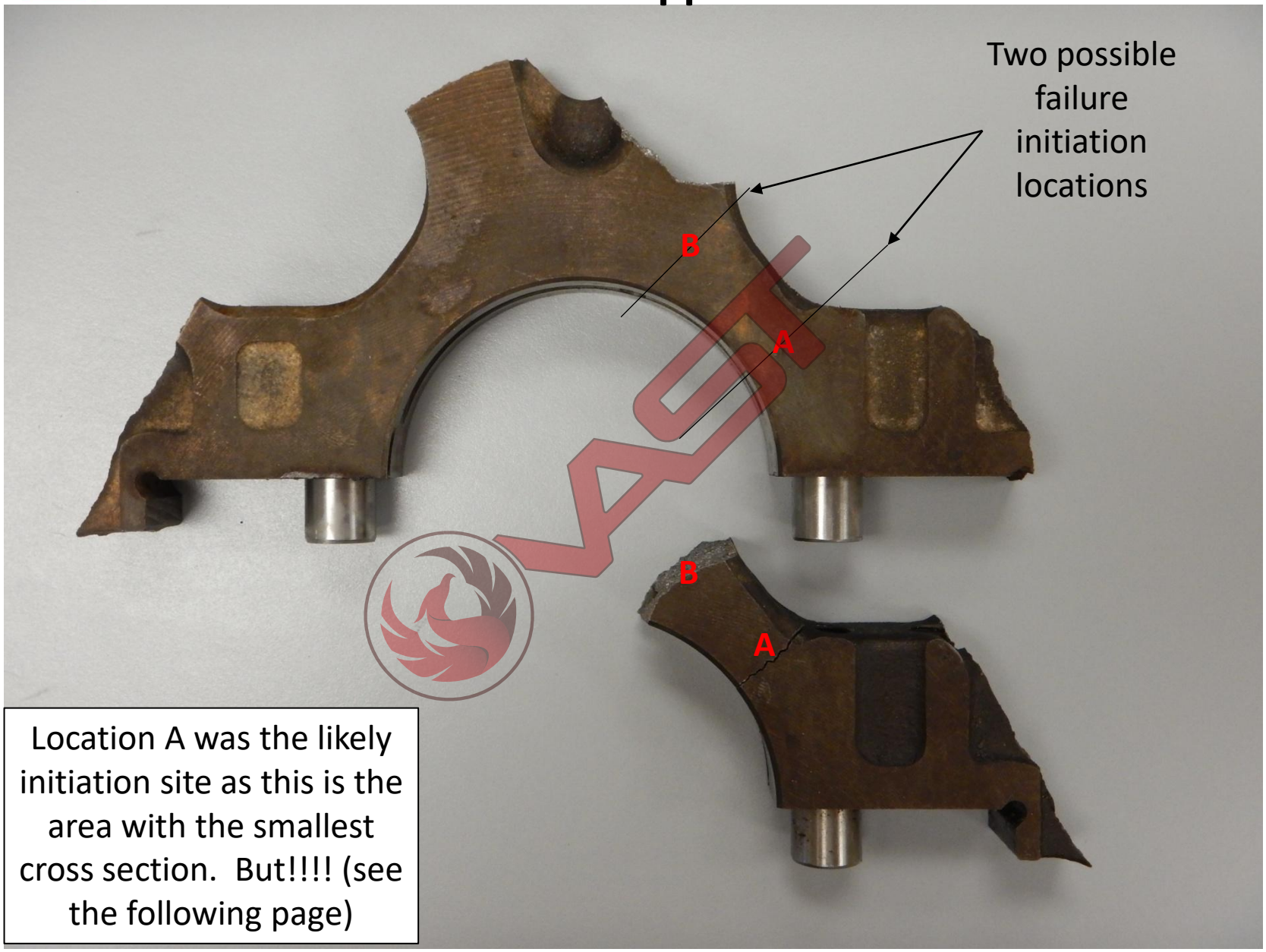

Late Model Block Design

Failed Block Main Support (for example)

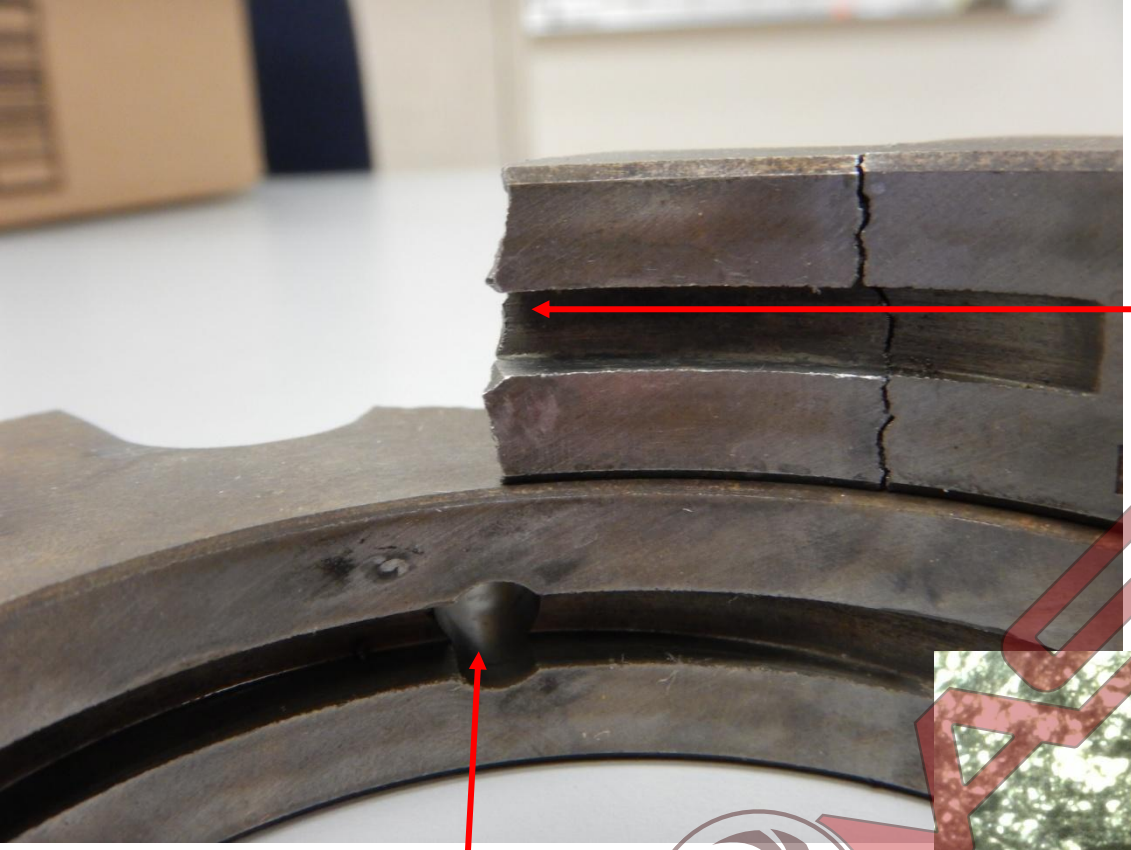


The loading direction of the crank/piston on the power stroke causes the upper webbing to be torsionally pulled as shown by the circular red arrows. The inner main cap bolts pull on the block as shown. This loads and fatigues the smaller cross sectional areas shown in the following pages, eventually to failure.

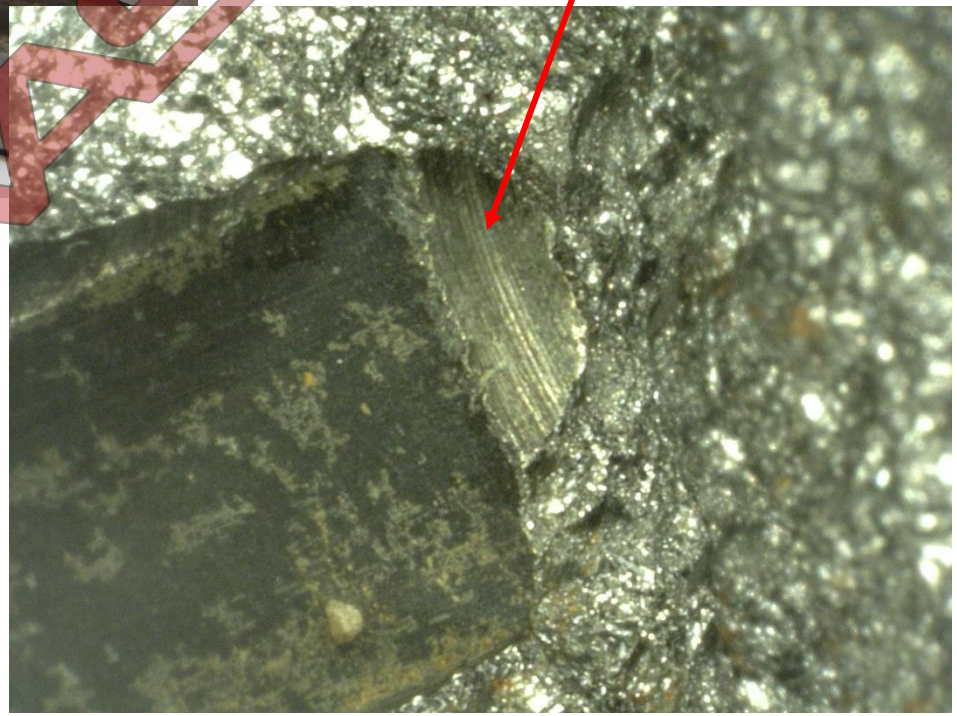
Failed Block Main Support Parts



Location A was the likely initiation site as this is the area with the smallest cross section. But!!!! (see the following page)



This break initiated at the inner diameter, of the groove, coincident with the edge of the oiling hole.



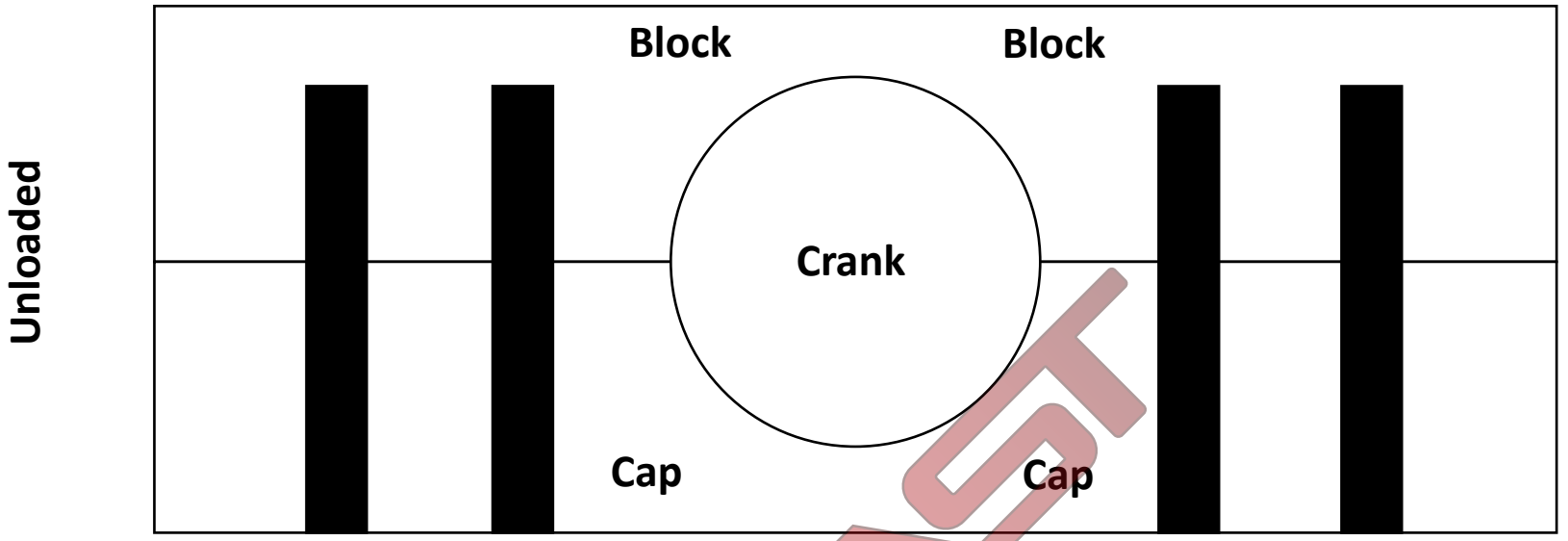
The cross sectional area of the block in the location of the through oiling hole is about the same as the other break location next to the main cap bolt through hole. And the oiling through hole creates a stress concentration area that could quickly initiate fatigue in the material.

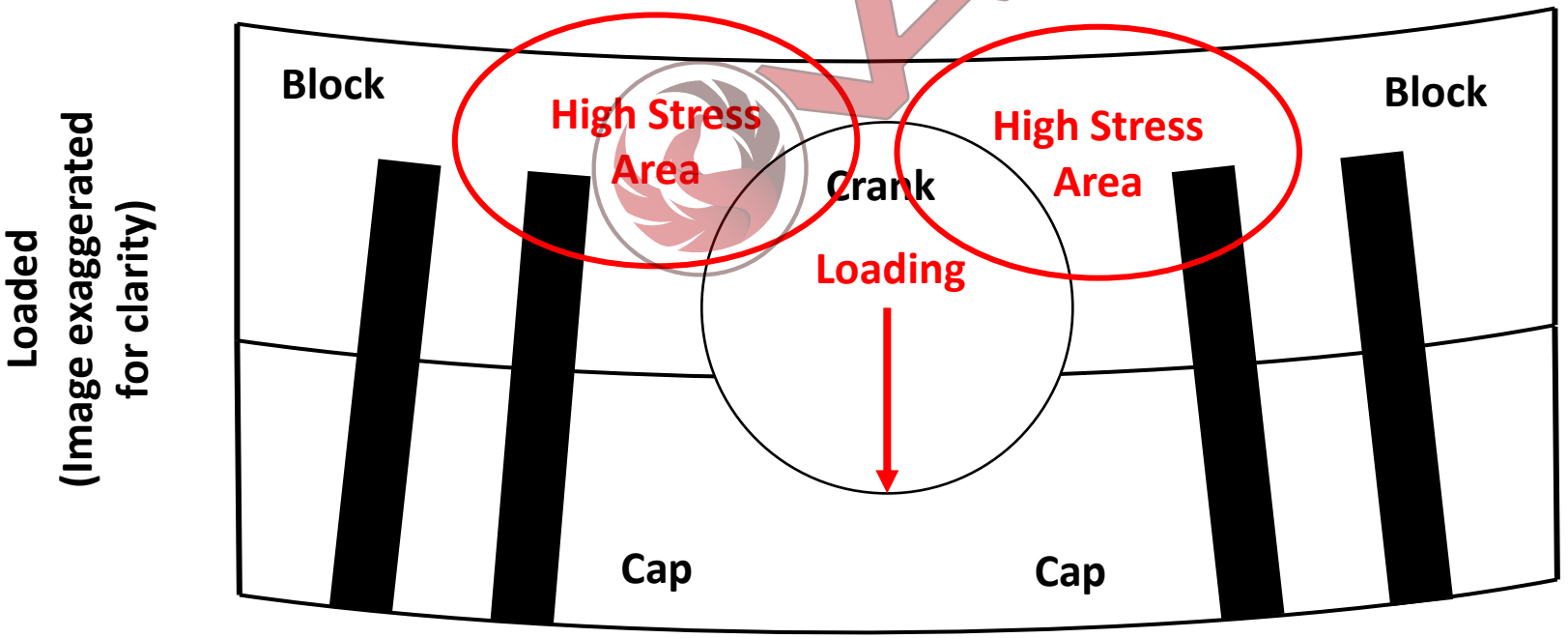
Series of Events Leading to Block Failure

- During the power stroke, main caps and bolts pull on the upper webbing on the block side.
- Micro motions are created by the main cap bolts and create a torsional action on the block webbing.
- The area next to the inner main cap bolt is an area of the smallest cross section and the cap bolt through hole creates a stress concentration area for fatigue initiation.
- The oiling through hole reduces the cross sectional area of the block webbing and creates a stress concentration area for fatigue initiation.
- Repeated loading causes the fatigue to propagate to the point of overload.
- Unknown if the initial failure was in the area of the oiling through hole or next to the inner main cap bolt.

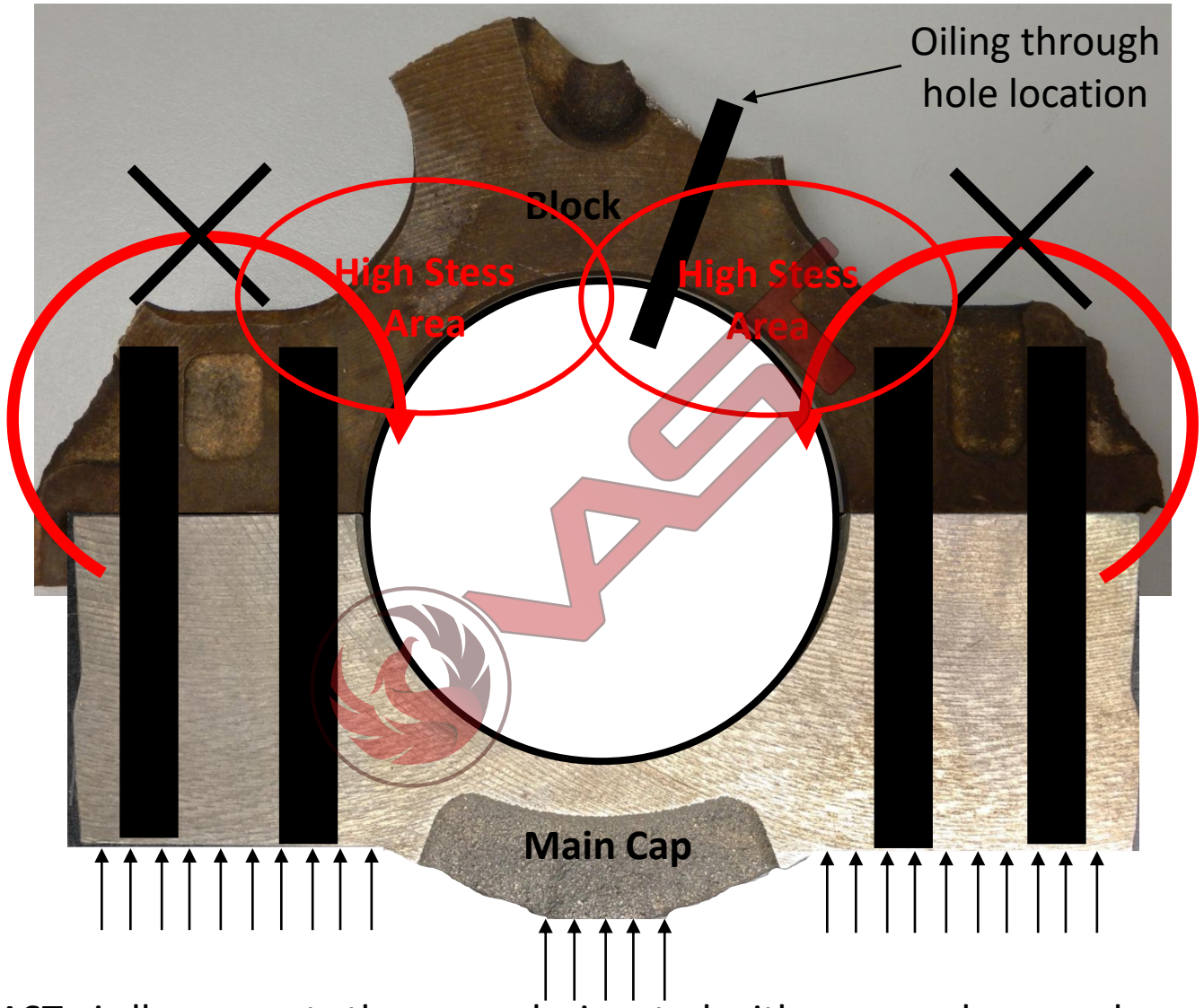
This engine girdle by VAST supports the bottom side of the main caps as well as spreading the load in the locations where the main cap bolts attach. This eliminates the torsional action near the inner main cap bolts and prevents fatigue initiation and propagation in the areas previously identified as failure points (and shown in this writeup).

Visualized Micro-Motion Under Load



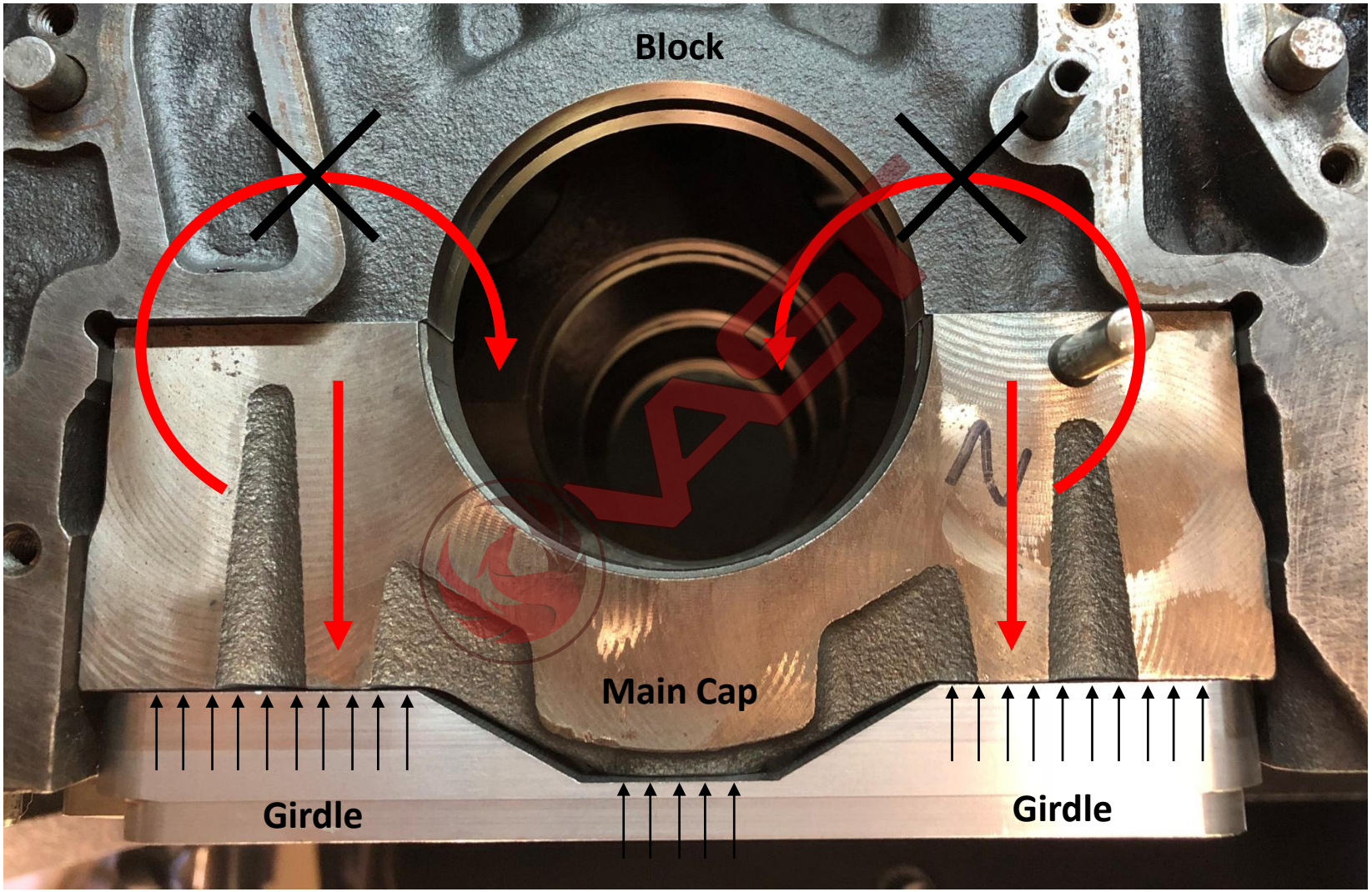


VAST Girdle Helps to Prevent Block Failure

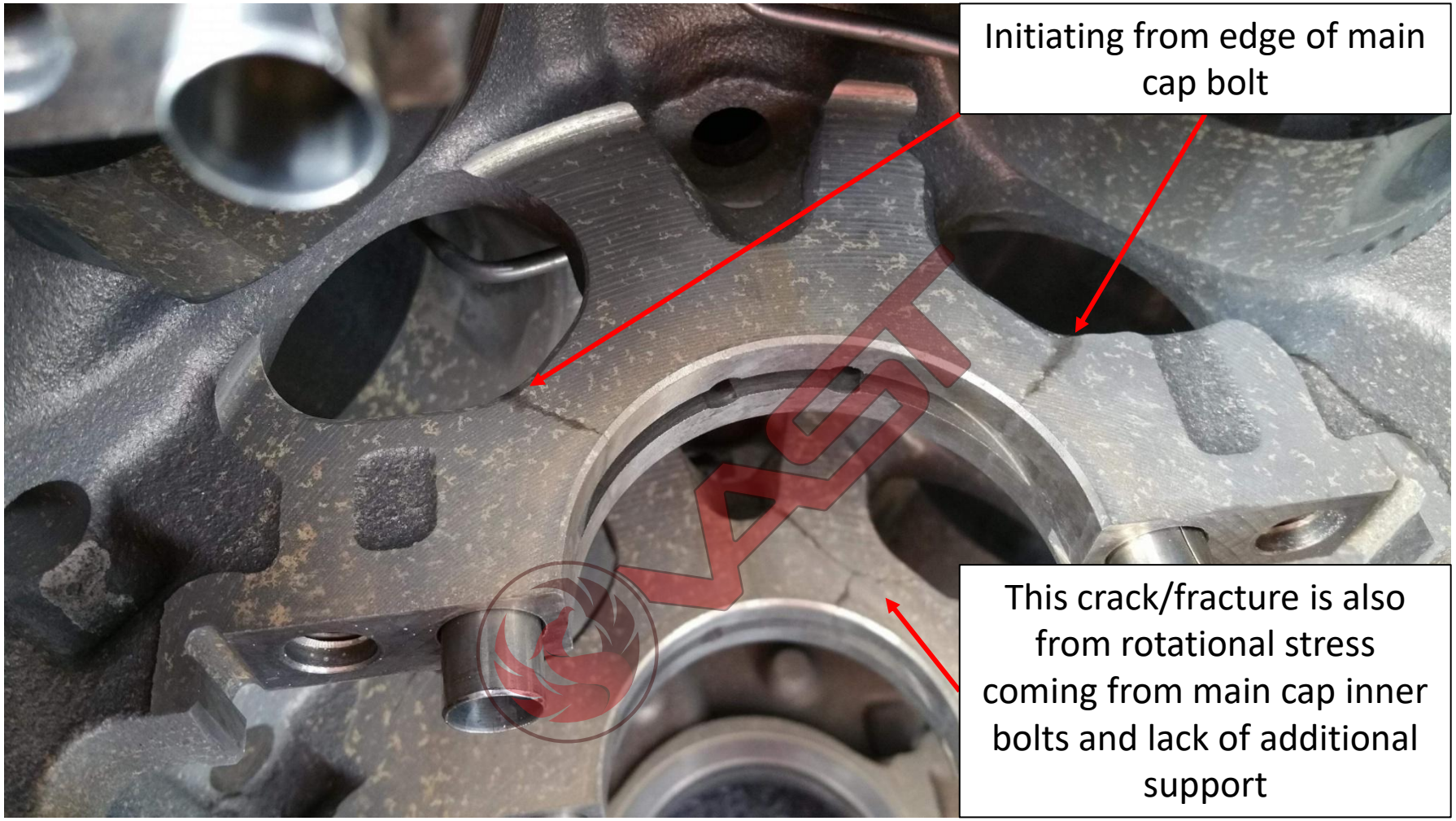


The VAST girdle supports the areas designated with arrows above and prevents flexing of the cap and rotational micro movement of the block webbing. This prevents fatigue initiation and propagation in the areas identified.

VAST Girdle Helps to Prevent Block Failure



Another Block Failure (No Girdle Used)



This block is a failure that occurred a few years ago. It shows the same location of failure initiation at the inner main cap bolts where they come through on the block webbing side. In addition a crack (in the background) is occurring in the area of the oiling hole. The same failure mechanism is occurring here as previously described. As this block stayed together, it is an excellent representation of where the cracking initiates as described in this analysis.