TLW2623
TEST REPORT

X-Mark Pro Trigger Structural Comparison

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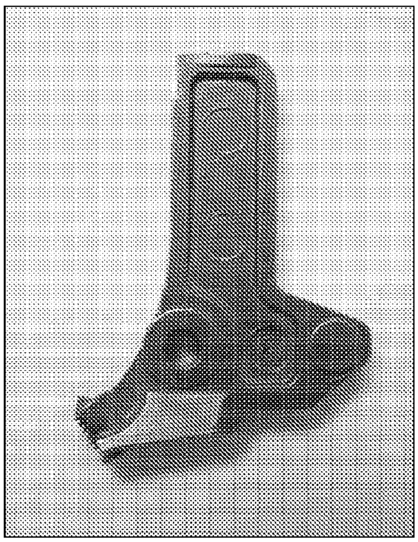
INTRODUCTION:

During testing multiple X-Mark triggers, part number 301463, have failed when subjected to trigger pulls in the 59-75 pound range. The failures occurred along the bottom of the adjustment screw hole near the top of the bow. A linear-static finite element analysis using ANSYS Mechanical was requested to determine the trigger bow breaking strength of the adjustable X-Mark Pro trigger (301463), and to compare it to the non-adjustable version (300688).



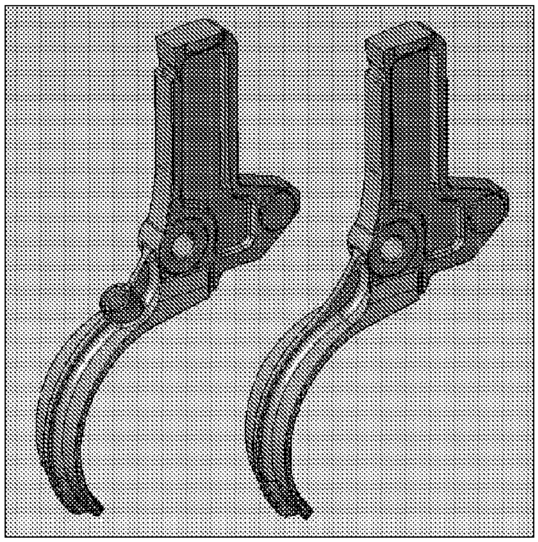


FIGURE 1. Broken X-Mark Pro trigger 301463 and CAD image of 301463 (left) and 300688 (right).

RESULTS SUMMARY:

The finite element model for trigger 301463, with the adjusting set screw removed, indicated a 54 pound trigger pull would be required to reach the trigger's tensile strength and fail. The points of initial fracture were on the underside of the trigger bow on opposite sides of the adjustment hole.

A second iteration of the model for 301463 accounted for the effects of the adjustment set screw. Its peak tensile stress magnitude with a 54 pound trigger pull was 53% of trigger 301463 with no adjustment screw.

Trigger 300688 was subjected to identical loads and constraints. Its peak tensile stress with a 54 pound trigger pull was 41% of 301463.

CONCLUSIONS & RECOMMENDATIONS:

The finite element model predicts a 54 pound trigger pull is required to fail part 301463. Actual triggers have failed when subjected to trigger pulls of between 59 and 75 pounds.

X-Mark Pro trigger 301463 can be made stronger. What maximum force must the trigger be able to withstand?

PROCEDURE:

Surfaces on both triggers were split to allow appropriate sized surfaces for load and constraint application. The trigger pull force was applied to an area on the trigger bow 0.100 inches above and below the origin of the trigger bow arc. A 0.100 inch diameter surface on the forward stop face of each trigger was fixed from any displacement, thus preventing the trigger from rotating. This anti-rotation face corresponded to the contact between the trigger and blocker screw, part 300664.

A cylindrical constraint was applied to the trigger pivot. This constraint allowed all finite element nodes on this surface to rotate about the pivot axis while maintaining a constant distance from the axis. To simulate the effect of the screw, a fixed constraint was added near the top of the adjustment screw hole. This can be seen as constraint “D” in **FIGURE 2** below.

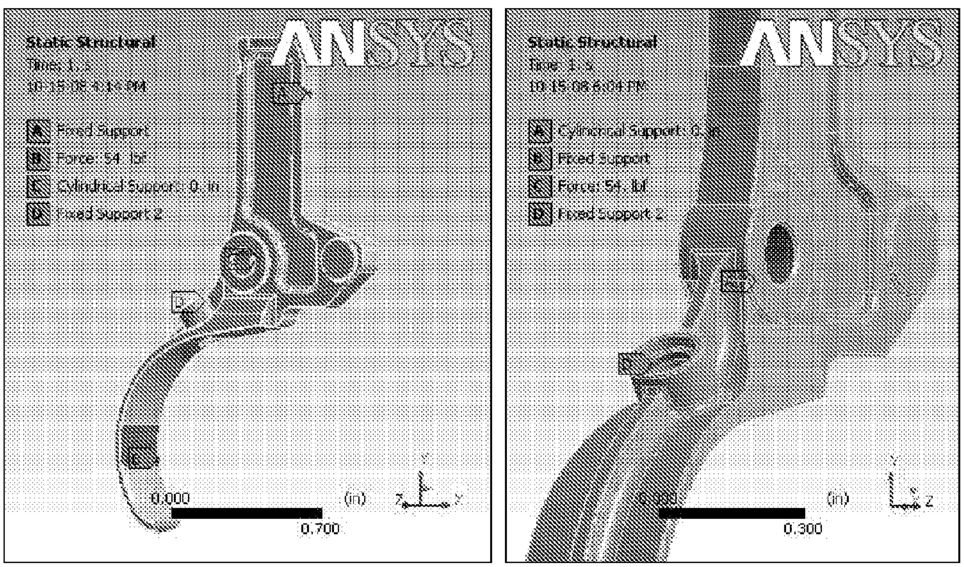


FIGURE 2. Simulation loads and constraints.

Drawings C-300688 and C-301463 list each trigger’s material as MIM-4140. Both drawings can be found in the **APPENDIX**. Their ultimate tensile strength in the area of failure is approximately 240 ksi. Thicker sections will have more ductility and a lower bulk tensile strength. For these simulations, the elastic modulus was set at 2.9e6 psi with a Poisson's ratio of 0.3.

DETAILED RESULTS

All triggers shown below have an applied 54 pound trigger pull. **FIGURE 3** shows the location of peak tensile stress for trigger 301463 with no adjustment screw. This initial failure point matches the location of failure for the one broken trigger sent to Etown for examination. Maximum trigger bow deformation for 301463 with no adjustment screw was 0.036 inches.

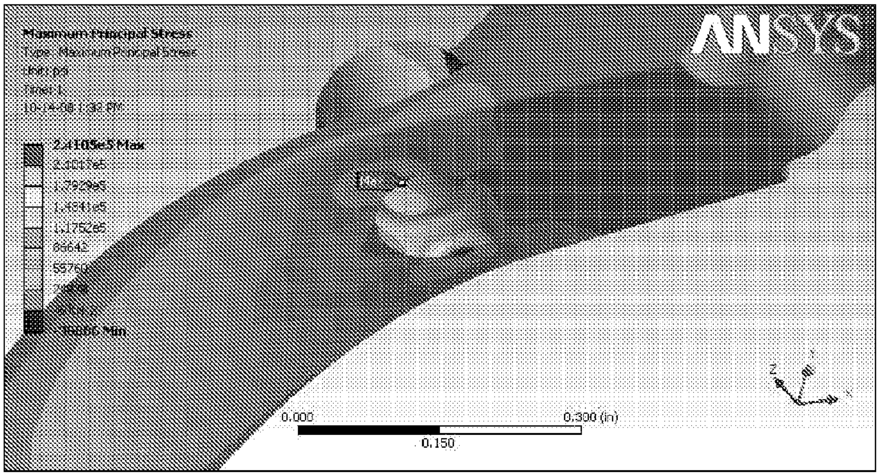


FIGURE 3. Maximum principal stress for trigger 301463 with no adjustment screw.

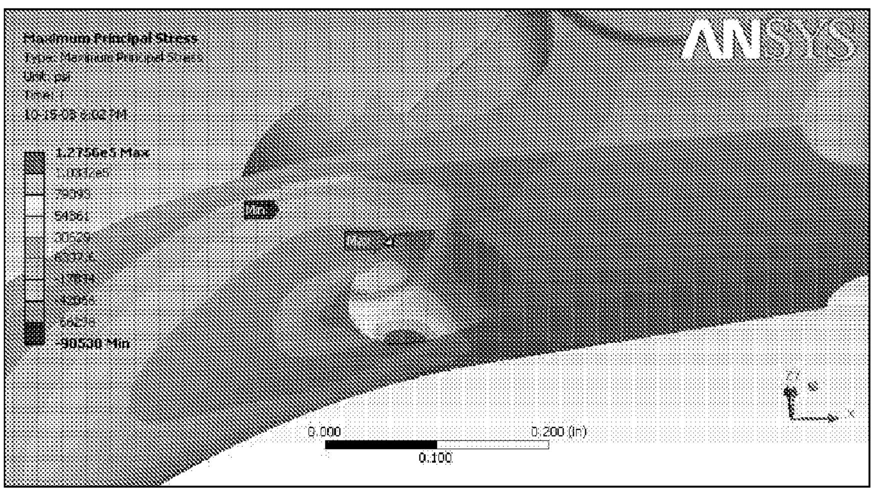


FIGURE 4. Maximum principal stress for trigger 301463 with simulated adjustment screw constraint.

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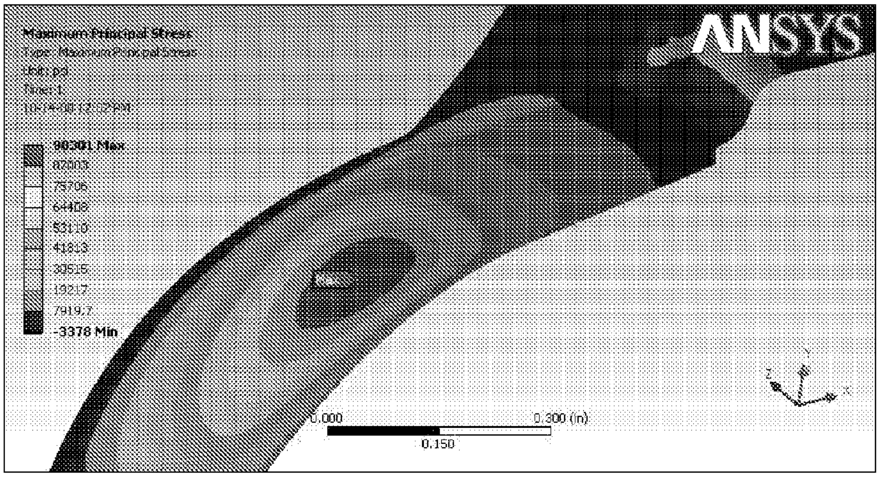


FIGURE 5. Maximum principal stress for trigger 300688.

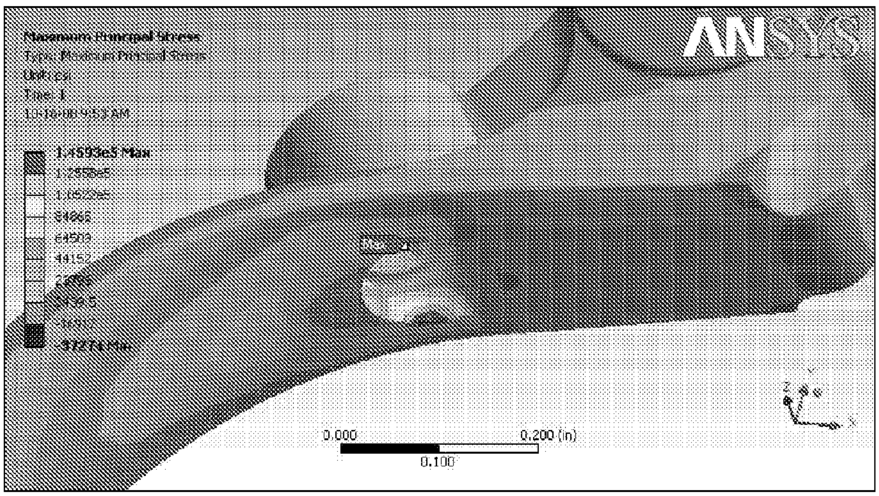
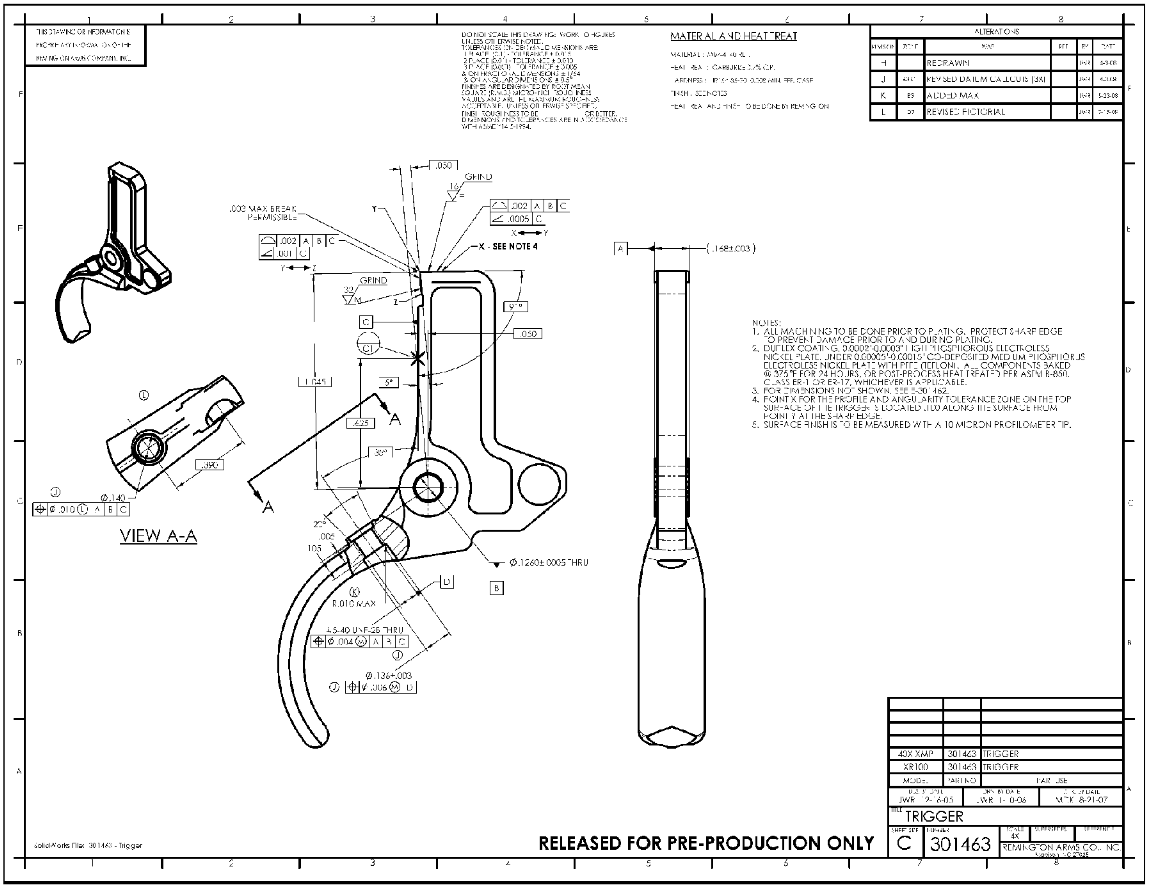


FIGURE 6. Maximum principal stress for trigger 301463 with the OD of the adjustment screw boss increased from 0.168 to 0.220 inches. Adjustment screw not accounted for.

APPENDIX:


MATERIAL AND HEAT TREAT
ALTERATIONS
REDRAWN
ADDED MAX
REVISED PICTORIAL
GRIND
X - SEE NOTE 4
VIEW A-A
A
B
C
D
TRIGGER
301463
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