LUBRICATION'S CONTRIBUTION TO AMMUNITION FAILURE

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Rumors and general assumptions of "how things work" passed down anecdotally over the years are often taken as gospel without understanding, or knowing if they are indeed correct. Many times these rumored-facts are based on truths, or partial truths, but make false assumptions in place of technical understanding. Generating higher chamber pressures as a result of lubricating your ammunition is one of them.

A cartridge case rupture during testing spawned a red team to investigate the cause of case rupture. The work conducted by Army engineers and test agencies determined that significant lubrication inside the chamber of a conventional weapon systems has a high probability of creating excessive case head deformation and potentially case rupture. It was determined that the lubrication did not increase the chamber pressure at all. Rather the reduction in friction between the case and the chamber walls resulted in a substantially increase in bolt face forces during ignition. This increase in bolt face force leads to a host of additional material failure conditions, ultimately resulting in a critical system failure.

The paper and corresponding presentation walks through the steps taken to evaluate the failures, apply computational modeling to capture the physics behind the failure, and coordinate the results of modeling with testing to conclude the evaluation. The path to rule out suspects such as case defects, propellant induced pressure spikes, and geometric tolerance, was quite extensive. This effort is a fine example of a collaborating test data with computational M&S, using each to assist the other as the project unfolds. Lagrangian Finite Element Analysis using LS-Dyna was completed according to a crawl, walk, run philosophy where simple models were used to answer initial questions, more complex models being developed as the analysis began to focus on more minute issues.