

FE Analysis of Firearm Locking Systems

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Abstract: *In a firearm the firing cycle is a high-speed dynamic event, of short duration (a few milliseconds) and highly non-linear - large displacements, plasticity, contact - during which its components are subjected to pulse loads - high-pressure and temperature gas and impact between moving parts. In the design of any firearm choosing the locking (breech) system is the fundamental starting point as this will guarantee that the cartridge case is adequately supported to withstand the tremendous rearward thrust exerted by the powder gases. The breech system consists of a group of high strength components – barrel, bolt, receiver, locking devices, etc. – the task of which is to keep the rear portion of the barrel closed for a certain time period, until the pressure of the powder gases has dropped to an operating limit at which the breech may be opened safely for completing the firing cycle. After this time period an automatic firearm performs the other functions - unlocking of the bolt, extraction and ejection of the spent cartridge case, loading of a fresh cartridge and locking of the bolt - utilizing the impulse of gas pressure to impart a velocity to the movable parts. It is the purpose of the present work to illustrate, through some practical applications, the integration of Test and ABAQUS as a convenient approach for the rational and conscious (numerical) design of the locking system, while indicating the potential and also the limitations both from the mechanical strength and the movable part dynamics points of view.*

Keywords: *Barrel, Breech, Cartridge Case, Combustion, Contact, Firearm, Gas Pressure, Locking Device, Projectile, Propellant, Receiver and Viscoplasticity.*

1. Introduction

In general a firearm during its operating cycle will be subjected to pulse loading generated by high-pressure (500-5.000 bar) and temperature (2.000°K) gases resulting from the combustion of the powder charge in the cartridge. Impacted by the firing pin the primer ignites the propellant and the combustion converts the chemical energy of the charge into kinetic and potential energies of the firearm-ammunition assembly in a very short time period (500-3.000 microseconds). The state of the thermo dynamical system also depends on the projectile movement. At the beginning of ignition the boundary consists of the cartridge case wall and the base of the projectile and then extends to the barrel inner wall (bore). The cartridge case is supported radially by the barrel chamber and axially by the rear closing of the barrel (breech). Detail is seen in Figure 1.