Falex Litigation Technical Investigations

Small Arms Bench-Scale Testing Protocols

Falex Litigation Technical Investigations has devised a unique small arms testing methodology that first uses bench-scale testing to identify the key technical issues in a failure of intellectual property dispute, sometimes followed by a limited amount of full-scale weapons testing. Full-scale testing of small arms is extremely time-consuming because the weapon has to be unjammed every time there is a failure, it has to be periodically cleaned, and thousands of rounds have to be fired. Full-scale testing also has numerous variables for which there is no well-founded way to select a value. An especially important variable is how quickly the weapon is fired. In actual use, it is sometimes fired one round at a time and at other times, it is fired in bursts. The firing speed and burst duration imposes a significant temperature range that components of the weapon experience, and impact how much kinetic energy is available to withdraw the just fired round and feed and chamber the next round.

Another extremely limiting aspect of full-scale testing is that the weapon contains many components that move. All of the surfaces are involved in the full-scale test, which requires that each failure be examined to determine the cause. This, more than anything, makes full-scale testing very time-consuming.

Falex Litigation Technical Investigations utilizes an approach using modified ASTM methods with standard bench-scale test equipment that simulates a specific aspect of a weapon. This allows us to benefit from the extensive knowledge base that exists for the various ASTM methods, utilize equipment that is proven to be reliable, and allow others to replicate our testing and results.

Our methods and equipment have been shown to provide efficient and effective screening of numerous materials with widely divergent properties. Abrasive wear and adhesive wear can be measured for both unidirectional and oscillatory motion. Abrasive wear can be measured for two-body and three-body geometries, and a wide variety of abrasives can be used. Abrasive wear with lubrication can be compared to abrasive wear without lubrication. The coefficient of friction can be measured as a function of temperature. The consistency of the test methods and the diversity of test conditions provide a broad array of consistent data.

A weapon has many moving components and many types of motion such as sliding, rolling, engagement/disengagement, reciprocation, oscillation, etc. We are unique in using a systematic framework for categorizing the motion and interaction of surfaces and for selecting bench-scale testing, as provided by the tribological aspect number, which is a four-digit code in which each of the four digits represent a key parameter. The first (most significant) digit indicates the type of motion, the next digit indicates the contact geometry, the next indicates the contact pressure, and the final (least significant) digit

indicates entry angle. We developed the following table to identify an appropriate test framework for virtually any aspect of small arms.

Weapon Component	Type of Wear	TAN	Bench Test	ASTM Standard
Bolt				
Engagement Teeth	Sliding	1531	Unidirectional 3 Pad on Disk	Modified G99
Gas Rings	Sliding	2211	Oscillating Piston Ring Test	Modified G133
Side Walls	Sliding	2511	Oscillating 3 Pad on Disk Conformal Block on Ring	Modified G99 Modified G77
Extractor	Sliding	2211	Oscillating Piston Ring Test Block on Ring	Modified G133 Modified G77
Cam Pin	Sliding	2414/2514	Oscillating Cylinder on Flat Oscillating cylinder on Ring	Modified G133 Modified G77
Firing pin	Sliding	2518	Oscillating Cylinder on Flat Oscillating Block on Ring	Modified G133 Modified G77
Bolt Carrier				
Slides	Sliding	2514	Oscillating 3 Pad on Disk Oscillating Linear Area Contact Test	Modified G99 Modified G133
Inner Diameter	Sliding	2518	Conformal Block on Ring	Modified G77
Hammer				
Flats	Sliding	2514	Oscillating 3 Pad on Disk Oscillating Linear Area Contact Test	Modified G99 Modified G133
Trigger				
Flats	Sliding	2528	Oscillating Block on ring	Modified G77
Barrel				
Inner Diameter	Sliding	1516	3 Pad on Disk	Modified G99
Receiver				
Inner Diameter	Sliding	2514	Oscillating 3 Pad on Disk Oscillating Cylinder on Flat	Modified G99 Modified G133

Bench-scale testing may be all that is needed. It allows the key issues in a litigation or intellectual property dispute to be quickly determined, which is essential to achieve early resolution. If full-scale testing is needed, our methodology of first using bench-scale testing allows a very limited and practical amount to be used.