Extreme Dust Test

Purpose of Test

- *Objective*: Provide information to TRADOC on the reliability performance in severe dust conditions of various 5.56 mm carbine designs for use in future requirements generation. Specifically, determine the reliability of weapons within their service life that receive a minimal maintenance regimen in severe dust conditions.
- *Engineering* test originally designed to detect minor differences in lubricant performance. Extreme nature of test (number of rounds and minimal maintenance in severe dust environment) is not representative of a weapon's realistic experience in an operational environment.
- Applicability: This test did *not* address…
  - Reliability in typical operational conditions
  - Reliability in harsh environments other than severe dust
  - Weapon parts service life (although some insights can be made)
  - Life cycle maintenance costs
  - *Any other aspects of weapon effectiveness, suitability, or survivability other than reliability performance in severe dust conditions*

Dust Test Design

M4 (gas tube)	**10 weapons**	**6,000 rounds/weapon**
XM8 (piston)	**10 weapons**	**6,000 rounds/weapon**
MK16 (piston)	**10 weapons**	**6,000 rounds/weapon**
HK416 (piston)	**10 weapons**	**6,000 rounds/weapon**

- Initial inspection of new weapons and magazines; includes 120 round test fire
- Fired in 120 round dusting cycles; wipe and re-lubricate every 600 rounds, full clean and re-lubricate every 1200 rounds
- Lubrication with CLP IAW manufacturers' specifications (light vs. heavy application, and which parts)

Sample size sufficient to draw statistically sound conclusions with a high degree of confidence.

Controls: dust application, temperature, lubricant application, cleaning

Test Flow Chart

TEST CYCLE

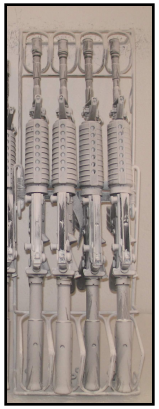
Step #1

Weapons loaded in Chamber

Step #2

Dusting Process

Step #3



Weapons fully exposed to Dust

Step #4

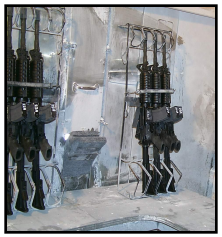
120 rnds Firing

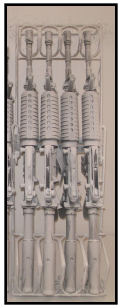
Repeat Steps #1-4 Five Times

Step #5

Wipe down and Lube Application @ Every 600 rnds

Repeat Steps #1-4 Five Times





Step #6

Detail Weapons Cleaning @ Every 1200 rnds

Wipe and re-lube every 600 rounds; full cleaning and re-lube every 1200 rounds

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Test Context

- Extreme dust test is a technical test NOT an operational test
  - Laboratory environment
  - Extreme conditions
  - Systems pushed to technical limits
  - Control of variables

- During extreme dust test each weapon:
  - Exposed to 25 hrs of dusting
  - Fired 6000 rds (equivalent of ~29 basic loads) and life of weapon
    - 50 x 120 rd cycles
    - Wipe and lube every 600 rds
    - Full cleaning and lube every 1200 rds

Test addresses a single aspect of technical performance that could inform development of future requirement that does not exist today

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Carbine Extreme Dust Test

	Malfunction Class/ Weapon	Class 1&2 Weapon Stoppages	Class 1&2 Magazine Stoppages	Total Class 1&2 Stoppages	Total Class 3 Stoppages
Summer 07 →	M4 Test 2	148	148	296	11
Fall 07	M4 Test 3	624	239	863	19
	XM8	98	18	116	11
	HK 416	210	9	219	14
	MK16	191	19	210	16

NOTE: Stoppages per 60,000 rounds fired per weapon system

Continuing to analyze test disparity

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5.56mm Carbine Dust Test

Failure Mode and Reliability Summary – Weapon Only

Weapon	No. of Class I & II EFF Stoppages								Total
	FFD	FTC	FFR	FXT	FEJ	BLR	FBR	OTH	
M4	253	53	9	271	33	1	3	1	624
XM8	43	8	4	9	33	0	1	0	98
H&K 416	141	7	5	3	49	0	3	2	210
MK16 SCAR	113	17	7	1	53	0	0	0	191

FFD – Failure to Feed
FTC – Failure to Chamber
FFR – Failure to Fire
FXT – Failure to Extract
FEJ – Failure to Eject
BLR – Bolt locked to the rear
FBR – Failure of Bolt to lock to the rear
OTH - Other

Weapon	No. of Wpns	Rds Fired per Wpn	Total Rds Fired	No. of Class I & II EFFs
M4	10	6,000	60,000	624
XM8	10	6,000	60,000	98
H&K 416	10	6,000	60,000	210
MK16 SCAR	10	6,000	60,000	191

Raw data from Fall 2007 Extreme Dust Test

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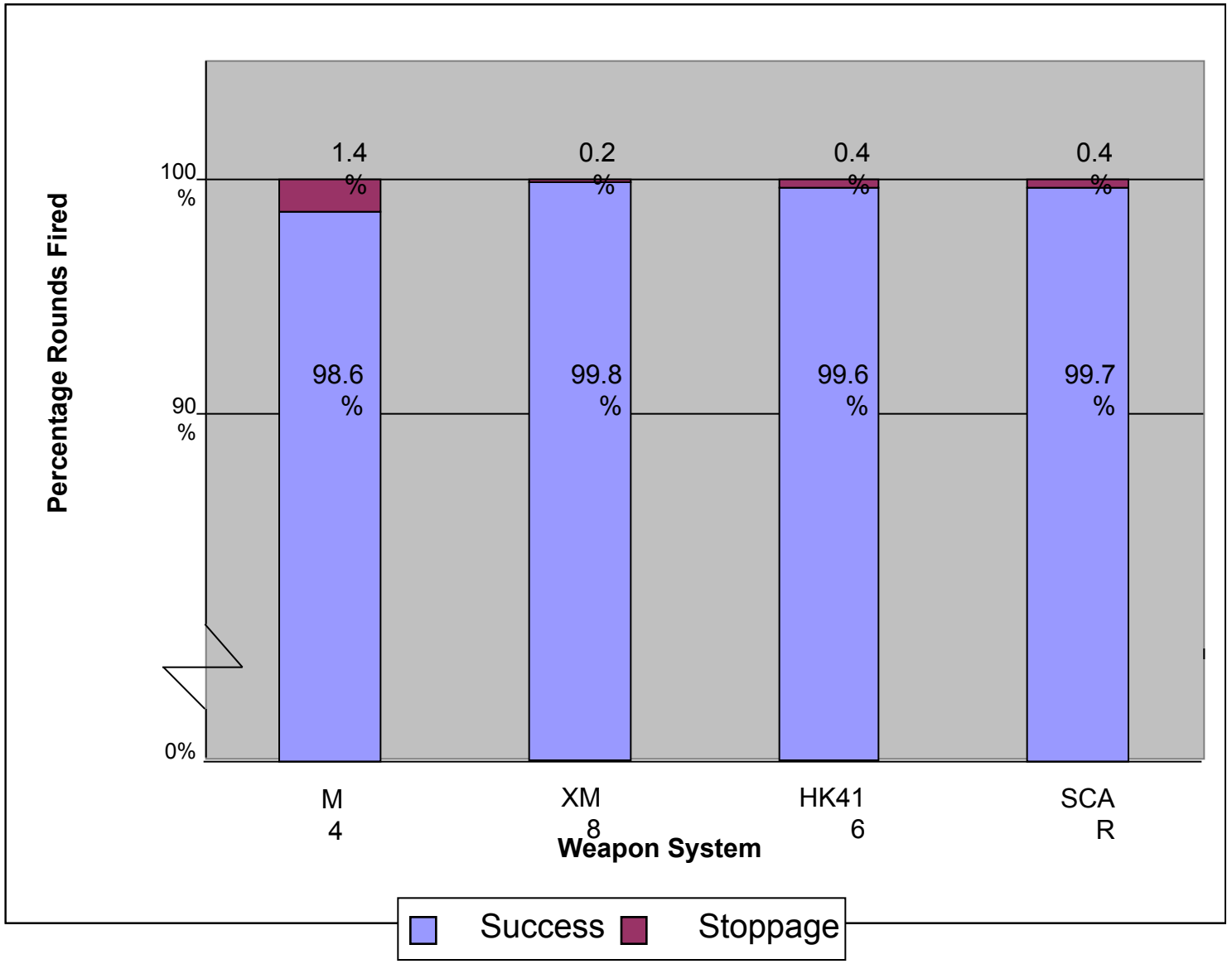
Test Results



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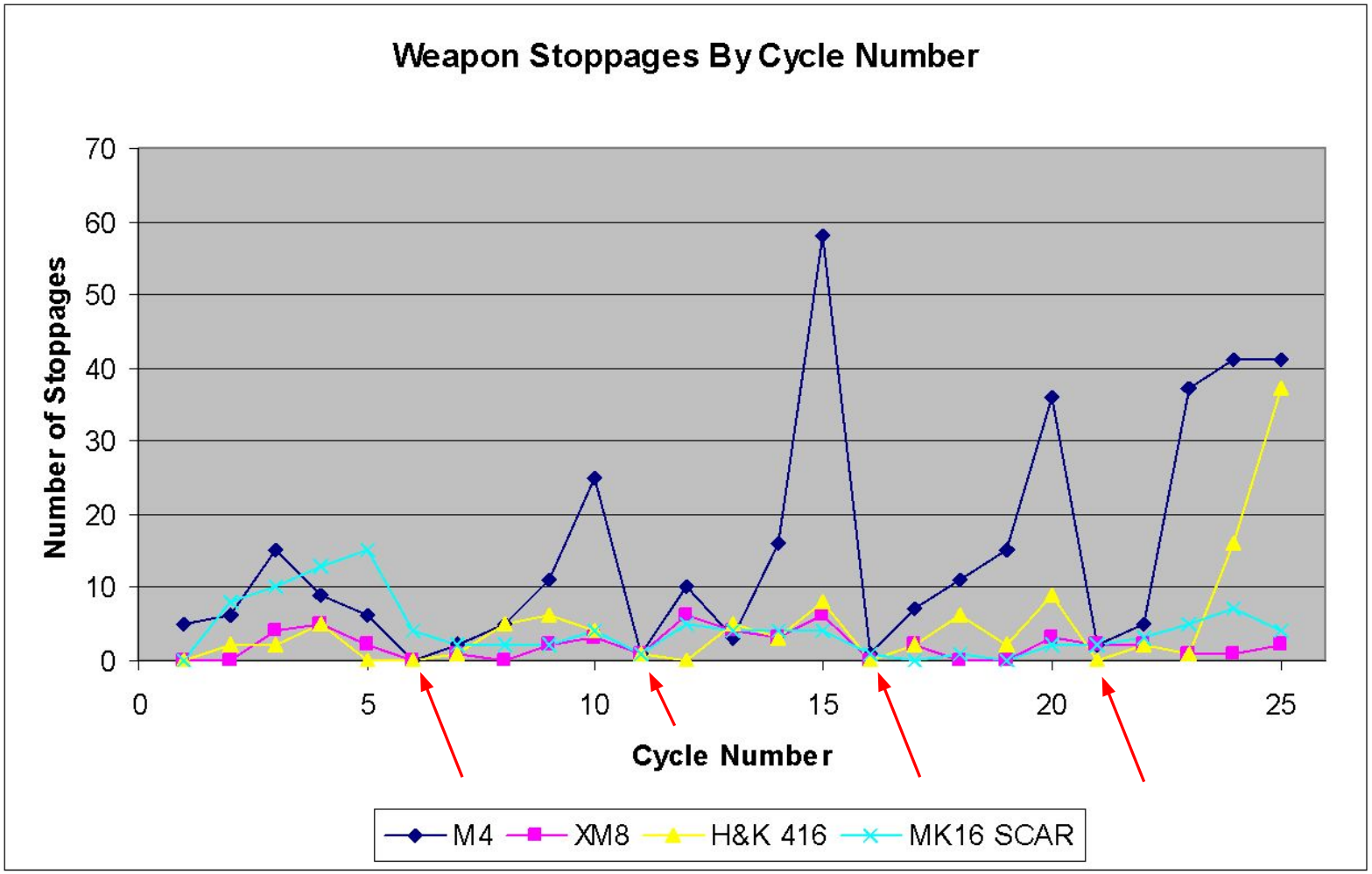
Impact of Cleaning on Reliability



Detailed cleanings (after cycle 10, 20, etc.) and “wipe and lube” cleanings (after cycle 5, 15, etc.) seem to have positive impact on weapon reliability!

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Other Observations

- All weapons exceeded their headspace limit by end of test.
  - This condition caused ruptured cartridge cases to occur on several weapons towards the end of test.

Number of Occurrences

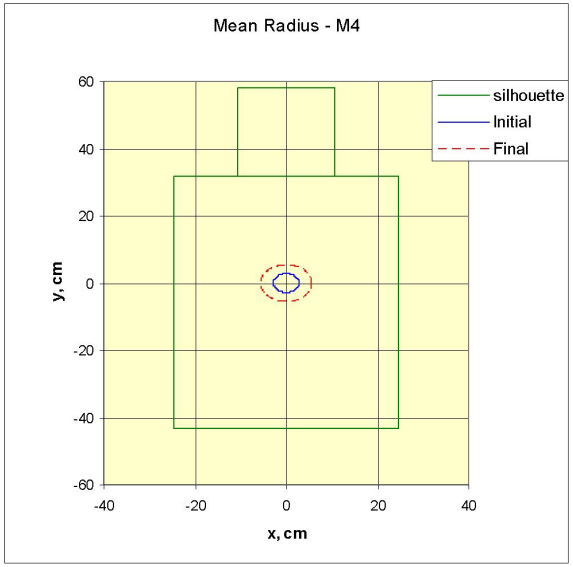
- **M4: 1**
- **XM8: 10**
- **H&K416: 3**
- **MK16 SCAR: 7**

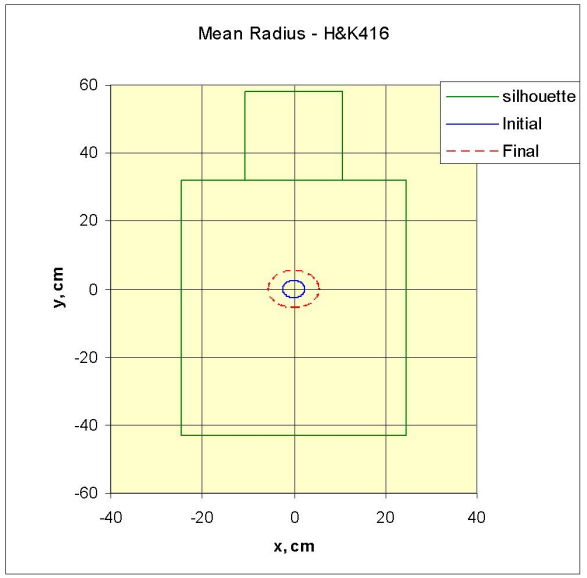
Safety Issue!

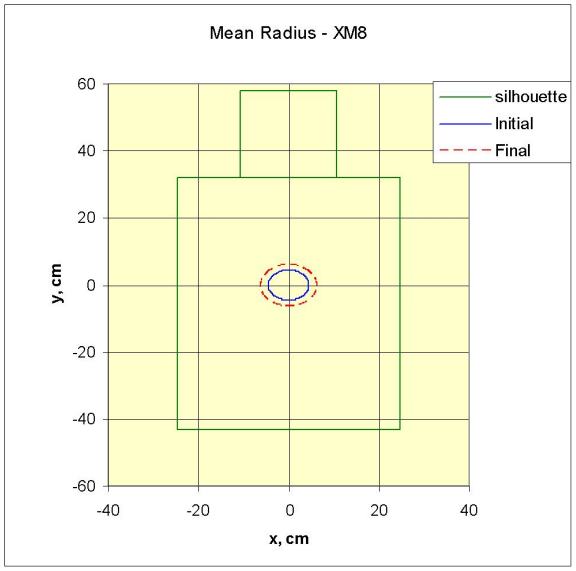
Condition requires the bolt to be replaced. Occurs at or before 6,000 rounds under extreme dust test conditions.

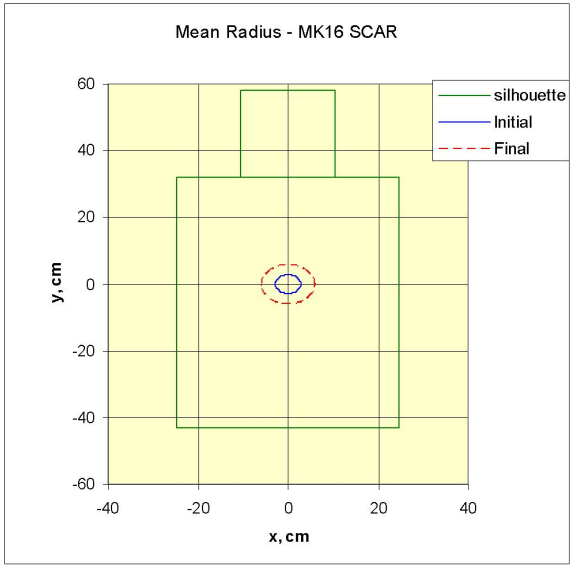
No significant difference in head space loss between weapon types!

Dispersion Patterns









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What We Know

- All weapon types performed very well during this extreme dust test
  - Each weapons type experienced ~1% or less stoppages of total rounds fired
  - Cleaning and heavy lubrication resulted in fewer stoppages for all weapons
- All weapons exhibited significant wear that rendered them unsafe for firing beyond 6000 rounds without replacement of barrel and/or bolt.
- Significant difference between EDT II and EDT III in results for M4
  - 296 stoppages (EDT II) vs 863 stoppages (EDT III)
  - This indicates that test protocol may not be repeatable
  - Interaction of technical variables not fully understood at this point in time
- Data continues to be analyzed
  - Are test results repeatable?
  - Can the data inform development of future requirement that is testable?
  - Does data suggest areas to improve design?
  - What is the state of the art and maximum possible technical performance envelope?

Operational Context

- Extreme Dust Test does not incorporate typical Soldier use or replicate operational conditions
  - Soldiers clean and lubricate their weapons much more frequently than the test protocol
  - Soldiers normally carry
    - 1 x basic load = 210 rounds in 7 aluminum magazines (~7 lbs)
    - 2 x basic load = 420 rounds in 14 aluminum magazines (~14 lbs)
  - Soldiers expend less than one basic load in a typical engagement

Voice of the Soldier

- 2607 soldiers surveyed by Center of Naval Analysis; 917 assigned the M4 and used it in combat
  - Soldier confidence:
    - 816, or 89%, reported overall satisfaction with the M4
    - 734, or 80%, reported confidence that the M4 will fire without malfunction in combat
    - 761, or 83%, reported confidence that the M4 will not suffer major breakage or failure that necessitates repair before further use.
  - Stoppages:
    - 743, or 81%, of Soldiers assigned the M4 did not experience a stoppage while engaging the enemy.
    - 74, or 19%, of Soldiers assigned the M4 did experience a stoppage while engaging the enemy.
    - 143, or 16%, of Soldiers who experienced a stoppage reported a small impact to their ability to engage the enemy after performing immediate or remedial action to clear the stoppage.
    - 31, or 3%, of Soldiers who experienced a stoppage reported an inability to engage the enemy during a significant portion or the entire firefight after performing immediate or remedial action to clear the stoppage

What we also know- 89% overall Soldier satisfaction of M4 Carbine

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Voice of the Soldier

The M-4 was an extremely dependable weapon system. We operated at extreme elevations (10,000 ft) along with extreme climate changes from one end of the spectrum to the other. We carried 210 rounds per man and the average magazine count on our contacts were 4 to 5 magazines. I can not remember any occasions where an M-4 malfunctioned, or failed to perform. Like 1-32, the only change we would have made would have been to use ACOGs vs CCOs. Most of our engagements in OEF were from 300 meters and beyond.

CSM Delbert Byers
BDE CSM 10th MTN Div Afghanistan 06

101st has no issues with the M-4 and as a matter of fact the soldiers of all MOS's to include cooks, mechanics, admin clerks, and Nurses are getting very proficient with the M-4 to include the lasers and optics as a system. Changing this weapon will be a detriment and a major setback in basic marksmanship especially with our non stop rotation to combat. Timing is not appropriate at this time and not once I have heard or seen any negative comments or action from soldiers about the M-4. We are receiving a lot of equipment at a fast rate which serves only as band aid approach, what is the end state?? What are we trying to achieve? What, how quickly can we get the parts in the system? Please give our units time to breath and focus on other major challenges like Troops to Tasks and bonuses for our soldiers so they can stay in. Air Assault

CSM Vincent F Camacho
101st Division CSM

Way Ahead

- Complete the full data analysis and provide the results to TRADOC to inform the development of any future requirement
- Determine repeatability of test results and study variables for understanding
- Continue to support the Army with the M4 Carbine and use test results to improve the current force carbine where possible (the next ECP will be # 396)
- Compete M4 design in 2009 or conduct a performance based competition if developed technical performance requirements differ significantly from existing requirements

Test addresses a single aspect of technical performance that could inform development of a future requirement

Questions?