Seize the Moment – An Optimized Caliber and the IC Competition

Presented by

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John Hall: A Greater Degree of Perfection

Harpers Ferry

National Park Service
U.S. Department of the Interior

Harpers Ferry National Historical Park

John Hall: A Greater Degree of Perfection

Among those things which appeared to me of the greatest importance and particularly attracted my attention. . ., was that of improvement in firearms regarding their accuracy and dispatch.

-- John Hall, DATE

m1819 Hall's rifle

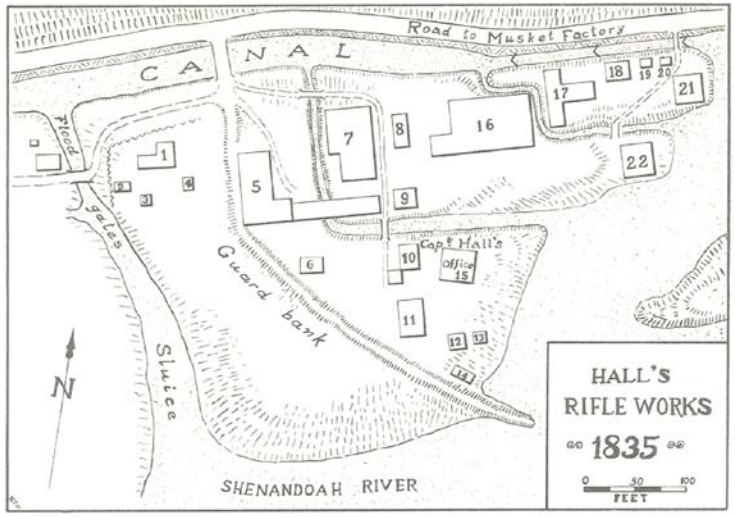
Born in 1781, John H. Hall descended from Yankee stock and grew up around Portland, Maine. He joined the militia at age twenty-two and developed an interest in firearms and technology that would last his entire life. Around 1808 he opened a woodworking business in Portland where he worked as a cooper, cabinetmaker and boatbuilder. In 1811 he designed a breechloading rifle which his attempt to patent were denied due to a conflicting claim. Hall eventually agreed to a joint patent.

Hall invested his personal savings and that of his mother to manufacture and market his rifles. In order to proceed he needed credit and sought a government contract. In 1819 he signed a contract with the War Department to produce 1,000 breechloading rifles. Under the terms of the contract Hall came to Harpers Ferry, where he occupied an old Armory sawmill along the Shenandoah River. The site soon became known as Hall's Rifle Works, and the small island on which it stood was called Lower Hall Island. Hall spent several years tooling new workshops and perfecting precision machinery for producing rifles with interchangeable parts – a boldly ambitious goal for an industry which was traditionally based on the manual labor of skilled craftsmen.

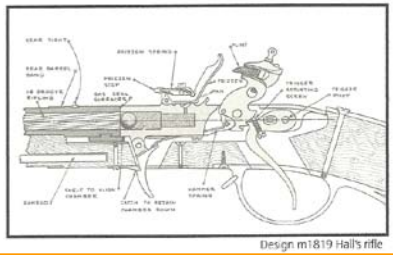
During his two decades at Harpers Ferry, Hall developed and constructed drop-hammers, stock-making machines, balanced pulleys, drilling machines, and special machines for straight-cutting, lever-cutting, and curve-cutting. Hall's straight-cutting machine was the forerunner of today's versatile milling machine, and a critical tool used in the fabrication of precision metal firearm components.

Hall's success at Harpers Ferry was attested to by Colonel George Talcott of the Ordnance Department who wrote in 1832 that Hall's "manufactory has been carried to a greater degree of perfection, as regards the quality of work and uniformity of parts than is to be found anywhere – almost everything is performed by machinery, leaving very little dependent on manual labor."

From 1820-1840, John H. Hall devoted his uncompromising attention to the "uniformity principle" of interchangeable manufacture, laying a solid foundation for America's developing factory system at Harpers Ferry.



Eli Whitney and Simeon North attempted to devise a manner of production that would allow complete interchangeability on a mass scale, acceptable to government needs and contracts, only John Hall met and exceeded the needs and expectations set forth by way of a fully mechanized process; as a result the American military system and the industrial process were forever changed.



Design m1819 Hall's rifle

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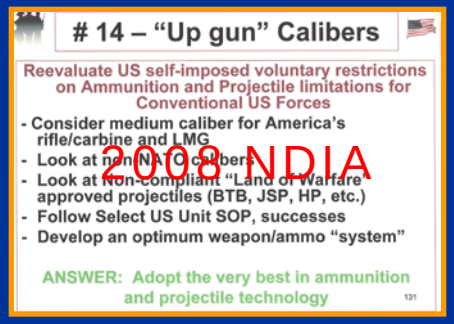
21 May 2011 – 200th Year Anniversary of the Hall Breech-loading Rifle. Hall's "Straight-cutting Machine" (Milling Machine forerunner) and "Uniformity Principle" for fully interchangeable parts.

Purpose

- Propose a alternate approach to guarantee a "substantial and significant improvement" in carbine, rifle, and LMG performance within the current US Army Near – Long Term planning using existing funds.
- Avoid an Individual Carbine competition "fielding failure". Candidates in other than 5.56mm??
- Double the Maximum Effective Range (MER) and substantially increase the Terminal Effectiveness of US small arms for the joint US/NATO/OGA war fighters for year 2012 and beyond.

Caveats

- The author is a proponent not of any particular caliber/cartridge but of an objective Analysis of Alternatives to 5.56mm NATO BEFORE we test, select and field the next generation of weapons.



- The briefing contents are the educated opinions of the author compiled from public domain information.
- The author is an independent and has no stake in the IC competition, financial or otherwise.

The Path Forward

- **Near Term** (2011-2013)
  Field Additional M4/M4A1 Carbines

GOOD IDEA

- **Short Term** (2011-2016) "Dual Path"
  -Enhance the Current Carbine (PIP's)

GREAT!
DO IT!

  -Conduct the IC Competition

ANOTHER 5.56?
Why?

- **Long Term** (2016-2020+)
  Light Weight Ammunition
  & Small Arms (LSAT?) - or not?

MORE 5.56?
Why?
Why Not an OC?

Paradigm Shifting Data - A Game Changer?

- Past and recent "Caliber Studies", such as the Joint Services Wound Ballistics IPT Engineering Study ES-1A-9001 Public Release report dated July 31, 2006 determined that from an overall performance standpoint that the caliber .224"(aka "5.56 mm NATO") IS NOT the best caliber choice for optimum assault rifle/LMG target effects.
- That a caliber between .257" (6.5 mm) and .277" (7.0 mm) is in fact optimum in regards to muzzle and impact energy, recoil impulse vs. system weight, barrier and post-barrier penetration, terminal effectiveness, P(I), P(H) etc. when compared to 5.56mm NATO and 7.62mm NATO.

So why ask for a new Individual Carbine in 5.56mm?

General Caliber Conclusions

- Larger caliber bullets inflict more damage on target.
- Larger calibers provide superior target effects after barrier penetration.
- 6.5mm-7mm target damage is greater than the increase in system weight from 5.56mm to 6.5-7mm
- 7mm equals 7.62mm (by weight) against barriers.
- 6.5mm-7mm (by weight, recoil impulse, combat load) offers the greatest terminal effects compared to 5.56mm and 7.62mm.

We should conduct "Optimized Caliber" (OC) Testing and Selection BEFORE IC release!

We've Been Here Before!

Assault Rifle/LMG Caliber "Sweet Spot" = .257 (6.5mm) - .277 (7mm)

A partial list only!

Photo credit: Anthony Williams

The Problem

Evidence of the need for something more effective than 5.56mm M855/SS109.

- **All current US Army efforts (M4 PIP, IC, LSAT) do not substantially increase the MER or terminal effectiveness of the weapons because they are oriented to caliber .224 and the limitations of the current 5.56mm NATO cartridge and projectile envelopes.**

2002 – USASFC/5th SFG(A) – Enhanced Rifle Cartridge
2006 – Soldier Perspectives on Small Arms in Combat
2006 – JSWB-IPT
2006 – USMC Alternate Ammo Study Phase 1
2007 – TSWG MURG Test Report
2009 – Canadian Forces Wound Ballistics Review
2009 – Taking back the Infantry Half-Kilometer
2009 – NSWC Comparison of Terminal Ballistic Performance (5.56, 6.8, 7.62)
2010 – USMC GEN Mattis "Interest in shifting to a higher caliber assault rifle"
Since 1996 – Development/fielding of M855 LFS/A1/EPR, MK318 SOST, 6.8x43mm, 6.5G, Barnes Brown Tip, UK HP 5.56, etc.
Since 2001 – Fielding of many more 7.62x51mm AR's, LMG's, SDMR's throughout US and NATO
2011 – IC Competition "Non-caliber Specific"

A partial list above. More at the link provided below.

http://www.hkpro.com/forum/showthread.php?t=138175&p=1020038&highlight=#post1020038

The Proof

- NLT 40 important programmatic examples since 2001 of US and NATO efforts to enhance the MER and terminal effects of 5.56mm small arms or replace 5.56mm weapons with 7.62x51mm rifles and LMG's (M14 SDMR, MK17, UK L129A1, HK417, Larue OBR's, SR25 EMC's, MK48's, etc.):

  -Canada, France, Germany, Norway, UK, US, SOCOM, etc.

  -Most recently AUS and NZ as standard issue.

- Threat tactics, efforts - 7.62x54R "Stand-off Shooters" in AFG and PRC 5.8x42mm Improvements, to name just a few.
- "Intermediate" Caliber successes abound - .40 S&W in US SOF & USCG, PIP'd .300 WM/.338 for PSR, 25mm vs. 40mm, 6.8mm & .300 Blackout, 4.6mm and .45 ACP CAP vs. 9mm.
- 5.56mm NATO SS109 "abandonment" in USSOCOM & USMC (SOST), US Army (M855A1), UK/BAE HP 5.56

The Payoff


Like Platforms – 5.56mm & OC

- OC MER and Terminal Effects approaching that of 7.62x51mm/7.62x54R without the excessive:
  - *Recoil Impulse - 140% for an IC vs. 240% for 7.62mm NATO
  - *Combat Load Weight Gain – 150 rounds of an IC vs. 100 rounds of 7.62mm NATO Ball
  - *Weapon System Size/Weight Gain – near 0 in modern designs

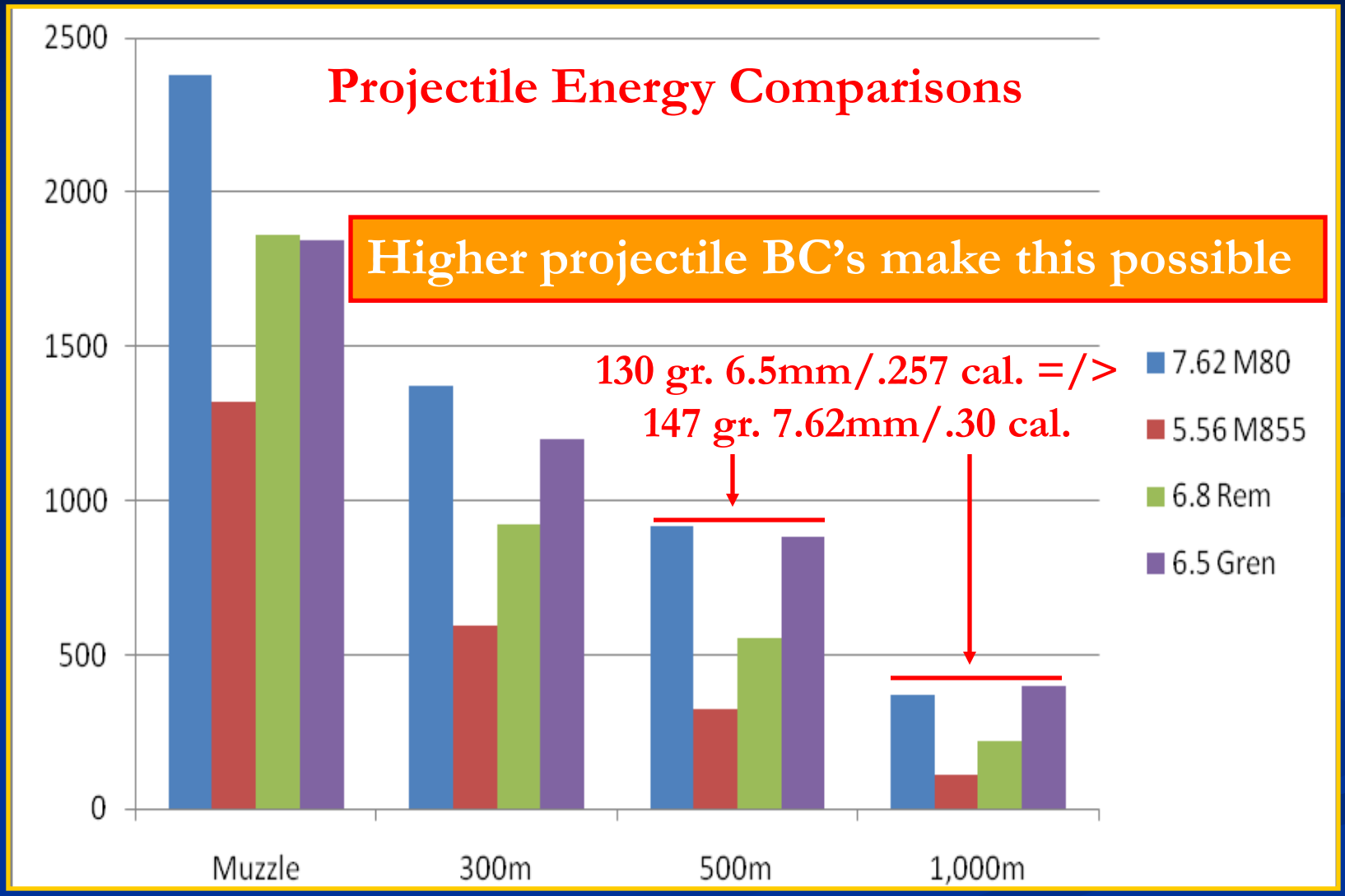
- =/> Performance Increase via Increased:

Projectile Weight = 56-77% (62 vs. 115-140 gr.)

Projectile Diameter = 24% (.224" vs. .277")

Muzzle Energy = 31% (1285 vs. 1855 ft. lbs.)

The Payoff (cont.)



Caveat: Projectile Energy Comparisons are a simple means of cartridge comparison but are not always indicators of overall performance or terminal performance.

Potential Participants

Some Possible Options for a Intermediate/Universal "General Purpose Cartridge" (GPC)

20 inch (508mm) barrels	Bullet weight grains/gm	Muzzle velocity fps/mps	Muzzle energy ft lbs/joules
7.62x51	147 / 9.5	2,700 / 823	2,392 / 3,217
5.56x45	62 / 4.0	3,050 / 930	1,285 / 1,730
6.5mm GPC	115-123 7.45-8.0	2,690-2,600 820-790	1,855 / 2,500
6.8mm GPC	127-135 8.2-8.75	2,560-2,480 780-755	1,855 / 2,500
7mm GPC	133-142 8.6-9.2	2,500-2,420 760-740	1,855 / 2,500

If not a new OC, then why not 7.62mm NATO with improved ammo? (MK316, MK319, M80A1)

The Proposal

1. Continue the M4 PIP Effort

- Already ongoing this effort promises affordable and important enhancements in legacy carbine performance for currently fielded carbines and planned new and final carbine purchases.

However these enhancements will do little to improve the MER or Terminal Performance of the weapon as there is no caliber change planned.

2. Delay the IC Competition

- Submission of improved/alternate calibers by industry is highly unlikely (high cost, high risk, one candidate only permitted). A < 8 lb 7.62mm IC? Show of hands?
- Best Case/Likely Scenario is a functionally improved or < expensive carbine but one with identical down-range performance as the legacy weapon.
- The investment by the US Govt and Industry of $30M's - $100M and 2+ years to determine that IC candidates in 5.56mm DO NOT provide "substantial" or "superior" or "overmatch" performance over that of the 5.56mm M4 or M4A1 or M4 PIP'd is fully predictable.

How would this be justifiable during times of shrinking budgets with numerous IC competition "outs"?

The only option would be to buy more PIP'd M4's in 5.56mm!

3. Convene a Joint Caliber Working Group

- Form a interagency/international JCWG.
- Take the past Caliber Studies as a starting point and develop new performance specs and test metrics for an "Optimized" caliber and cartridge.
- Develop various cartridges as test samples.
- Conduct all necessary testing leading to a down-select.

Many in the IA/intl SME and user community are ready to do this. Industry would support it. It could be done in 6-12 months with available funds.

BUT the U.S. MUST BE THE LEAD on this!

Optimized Caliber/Cartridge Salient Performance Requirements

- Is available as a "family" of ammunition (NLT 9 types) to include conventional ball ammo (UK Hague LofLW concerns)
- Has a MER on point targets of 800 meters (T), 1000 meters (O)
- Performs consistently from 0 – 300/600/800 meters
- Limits penetration to 12"- 18" in 10% ordnance gelatin
- Is "Blind" to Yaw and Barriers
- Exhibits rapid and reliable onset of projectile yaw and upset on impact
- Is accurate enough to engage personnel targets at 600 meters (T), 800 meters (O)
- Continues on its original shot line after penetrating tissue
- Limits Fragmentation
- Should produce recoil impulse < 7.62mm NATO (T)
- Should be adaptable to various weapon platforms (SCW's, Carbines, Rifles, IAR's, SDMR's, LMG's to meet all joint user requirements)
- Must pass all applicable MIL/NATO Test Standards
- Is affordable (< M855A1 & 7.62mm M80 ball in 5.56mm-type volume)

4. Conduct an OC FOA

- Build OC test ammunition and weapon platforms (Carbines, SDMR's, LMG's) and provide them to combat units in theater for user feedback (as is being done with XM25 currently).
- Exploit the extended MER of an OC cartridge with new sighting systems (Multi Functional Optic) and training ("SWEAT", SDMR) being developed.
- Use that data to support the IC competition and LSAT development in an Optimized Caliber.

Develop user/combat data on the effectiveness of an optimized caliber/cartridge against threat capabilities *in the hands of ALL riflemen!*

5. Release IC RFP in "the" OC

- Obtain "substantial" and "significant" new carbine performance by soliciting for candidates in the selected Optimized Caliber to realize real improvements in:

  -Weapon Function, Service Life, Safety, etc.

  -MER & Terminal Effects.

  -A single "Common" rifle, LMG/MMG/SDMR cartridge to reduce the current dual-caliber logistics burden.

Prevent an IC Competition "Fielding Failure".

(4th one since XM8 in 2005, "Increment 1 Family of Weapons" in 2005, "Non-Dev. Carbine" in 2006)

6. Reenergize LSAT "Family" Development in the OC

- Refocus available funding to create telescoped polymer cased rounds in the Optimized Caliber to realize true "Leap Ahead" capability <u>for every war fighter</u>!

- That offers not only lighter weapons and ammo (</= 40% lower combat load weight)

- But also vastly improved MER and Terminal Effects for the battlefield of the future

to counter emerging and unknown threats of future enemies.

The Most Bang for the Buck

We are already planning and budgeted to spend limited funding on new IC's, PIP'd M4's, LSAT Development, and on new LSAT Ammo Production Machinery

WHY NOT get something really superior for our troops for our time, trouble and the vast expense?

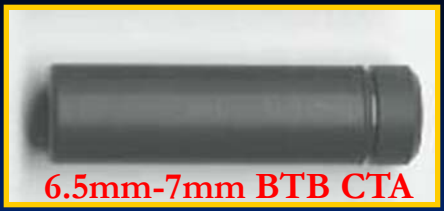
Do we REALLY want to fight the wars of 2020 and beyond with a 250 yard varmint round?

Because that is where we are headed!

The Cost Argument
A Change in Caliber Costs too Much

- XM25, M2010, PSR, MHS, LSAT – caliber and/or cartridge changes required/planned!
- Planned TWSS, Polymer and/or LSAT Ammo, Machinery Changes already being discussed.
- 6.5mm, 6.8mm, 7mm Components (BTB/Yaw projos, cases, propellants) are Readily Available COTS.
- > $120M for LFS/M855A1/EPR development.
- M855 = .38/rd., M855A1 = .50/rd, MK318 = .49/rd, 7.62mm M80 = .66/rd., M118LR = .88/rd. OC/round cost?
- "*Train with 5.56, Fight with OC*".
- Combat Arms w/ OC, Support Troops w/ 5.56mm.
- The Cost to Shoot/Hit the Enemy 2X with 5.56? (1)
- $500,000 SGLI for every soldier KIA

(1) Oct. 2006 "Infantry Magazine" recommendations to troops fighting with 5.56x45mm NATO weapons.



The Performance Potential

- An LSAT-style Lightweight Modular Family of Weapons firing Optimized Caliber telescoped polymer-cased ammo with:
  - A Combat Load up to 40% less than comparable brass-cased 5.56mm NATO legacy weapon systems (versus a comparable brass-cased OC cartridge).
  - A MER =/> 7.62mm NATO & threat 7.62mmR out to 1K m.
  - Recoil Impulse midway between 5.56mm & 7.62mm NATO.
  - Terminal Effects NLT 27% greater than even the very best 5.56mm rounds (SOST, M855A1 EPR) and projectiles.
  - Reduced logistics and combat load burdens by replacing 5.56mm and 7.62mm with a single "Common" OC/cartridge.
  - And at no additional cost to the tax payer than what is currently being planned and purchased!

Summary

- Ongoing efforts to PIP the 5.56mm round are severely limited due to the relatively small capacity of the case, low BC of the projectile, insufficient terminal effects at long range AND bring unwanted attention from the ICRC.
- Continue with the assorted landmark Caliber Studies to develop candidate cartridges for test in IC and LSAT platforms.
- Gather together the requirements and resources of interested partners in the US, NATO, FLEO's and Industry and field a new Optimized Caliber and Intermediate/Universal Round for IC/LSAT.

If not, we will handicap our troops and their children who will one day serve in uniform with substandard 5.56mm performance for decades to come.

Seize the Moment! That Moment is NOW!


Questions?
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Thank you for your time and interest!