GENERAL DYNAMICS

105mm LAV III Artillery Weapon System

Light , Lethal, and Deployable!

SBCT SPH Requirement

- The US Army's mandate for Stryker – Provide lethal and mobile fire support for the six Stryker Brigades
  - A dilemma and an unfunded requirement
  - Stryker ORD and O&O outline a need for a very capable, C-130 deployable self-propelled howitzer
  - Use of 155mm towed howitzer (M198 for SBCTs 1-4 and M777 for SBCTs 5-6) is ***at best*** only an interim fix – provides sufficient lethality but cannot match Stryker's mobility or maneuverability
- GDLS sought to address the SBCT field artillery requirement
- Looked at all major artillery providers around the world
  - Bofors
  - Giat
  - Santa Barbara
  - Denel
  - UDLP
  - Soltam

SBCT SPH Requirement (cont'd)

- Only one potential provider had a total system solution for a truly transformational expeditionary artillery weapon

That provider was DENEL of South Africa!

That system was the 105mm Lightweight Experimental Ordnance (LEO) Demonstrator!

Denel Products

G-6

G6-52

G-5

T-6 Turret

105mm LEO Towed Howitzer

- Firing since 1999
- Included:
  - Navigation system
  - Radio
  - Automatic laying system
  - Hydraulic powered elevation and traverse with manual back-up
  - Electrical system

The Denel 105mm Advantage

- 24-30 km range ammunition, 960 m/s launch
- Modular charge system (MCS) like the 155mm MACS
- Fragmentation lethality BETTER than 155mm HE
- Ammunition weight of 48 pounds
- Fires all current US 105mm artillery projectiles
- Muzzle brake is 60% efficient
- Same armament for both towed and self-propelled versions
- System (cannon, projectiles, and propellant) tuned to provide the most efficient and effective solution

Appeared to Offer an Efficient, Lethal and Light Weight Solution

LEO Became the Baseline

- 2003 - Teaming Agreement made with Denel
- May 03 - Decision made to design and build a functional 105mm LAV III SPH as a risk mitigator and marketing demonstrator
  - GD Artillery Team assembled to make it happen
  - Team goals
    - Mar 04 – Exhibit at AUSA Midwinter Symposium ✓
    - Apr 04 – Live fire testing in US ✓
    - Apr 04 – C-130 Transportability Demo ✓

The General Dynamics Artillery Team

- GD Land Systems (GDLS)
  - Systems Engineering - GDLS
  - Prime Movers - GDLS Canada
- GD Ordnance and Tactical Systems (GDOTS)/Denel-Naschem/Denel-Somchem
  - 105mm Projectiles and Modular Charge System
- GD Armament and Technical Products (GDATP)/Western Design/Vista Controls
  - Projectile and Propellant Ammunition Handling Systems
- GD Canada
  - Digital Fire Control System and Interface with AFATDS
- Benét Laboratories
  - Barrels, Breeches and Other Special Materials
- Denel-LIW
  - 105mm Cannon and Turret
- Curtiss Wright
  - Gun Drives/Rammer
- Honeywell
  - Inertial Navigation System (INS)
- Northrop Grumman
  - Vehicle Intercom System (VIS)
- Raytheon
  - 105mm Medium Range Missile
- GDATP/Israeli Aircraft Industries
  - LAHAT Laser Guided Missile

GENERAL DYNAMICS
105mm Transformational Artillery Team
Land Systems
Land Systems - Canada
Ordnance and Tactical Systems
Armament and Technical Products
GD Canada

Operation Iraqi Freedom Lessons Learned

- Deliver HE with high precision
- Shoot long range
- Limit collateral damage
- Increase rate of fire
- Reduce logistics tail

Accuracy

OIF: Deliver HE with high precision ✓

105mm LEO Howitzer Accuracy Data

CEP
227% Better
Than M549
at 30 km

- Boat Tail (<24,000 meters) $PE_{(R)} < 0.3\%$
  $PE_{(D)} < 1mil$
  CEP < 80 meters
- Base Bleed (<30,000 meters) $PE_{(R)} < 0.4\%$
  $PE_{(D)} < 1.5mil$
  CEP < 120 meters
- NLOS-C (26,000 meters) PE(R) =0.55
  CEP= 143 meters (required)

<u>The Payoff -</u>

- Better CEP equals fewer rounds expended to attack target
- Better lethality equals fewer rounds needed to destroy, neutralize or suppress target
- Logistical efficiency is enhanced requiring < 1/2 the tonnage / volume of ammunition

Range

US 105mm vs. GD / Denel 105mm

OIF: Shoot long range ✓

M119
With M2020 PFF HE

M1 HE
11.5 Km

M760 HE
14.4 Km

15.5 Km
Boat Tail

18.4 Km
Base Bleed

M913 HERA
19.5 Km

GD / Denel 105mm

BT = Boat Tail
BB = Base Bleed

24 Km BT
M2020 PFF HE
M2019 HE
M0101 Smoke
M0102 Illum
M0102 Prac

30 Km BB
M2020 PFF HE
M2019 HE
M0101 Smoke
M0102 Illum
M0102 Prac

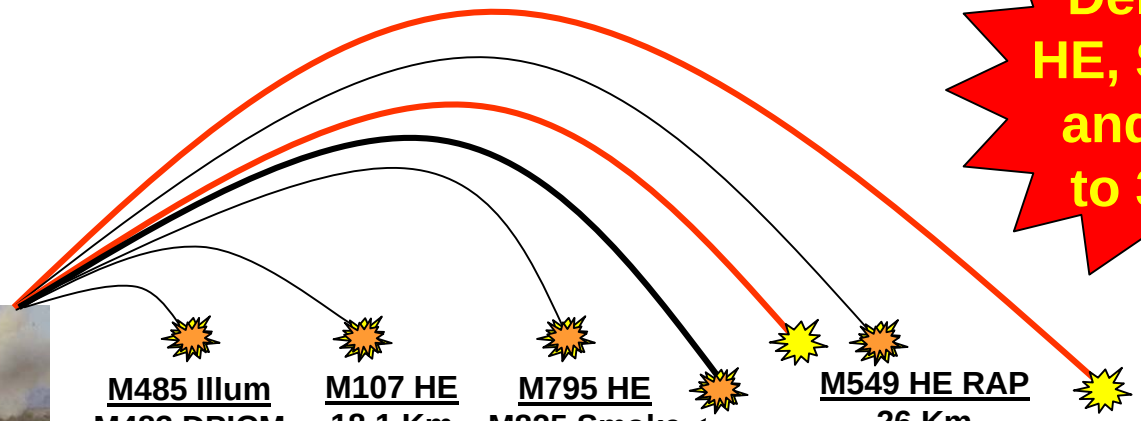
Range Increase Without Rocket Assist

Range

GD / Denel 105mm vs. NLOS-C

OIF: Shoot long range ✓

Delivers HE, Smoke and Illum to 30 km



M864 ER-DPICM
23 Km

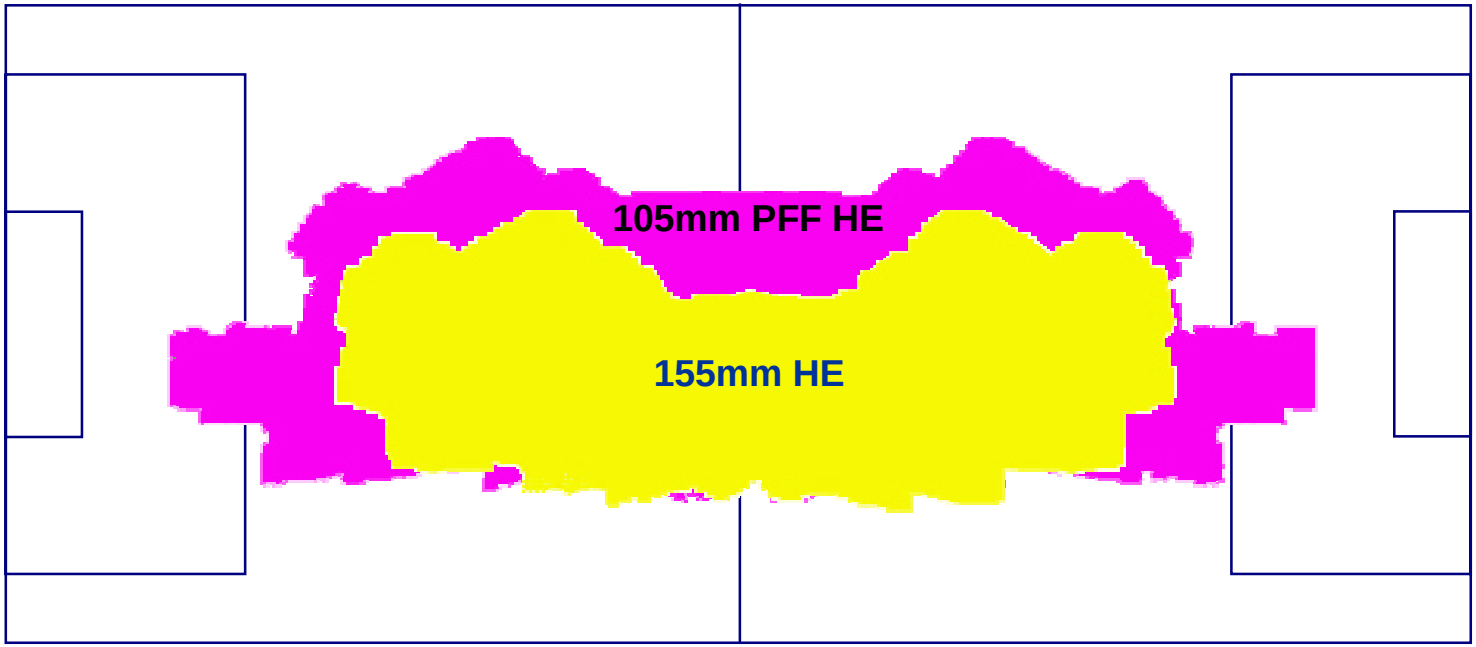
BT = Boat Tail
BB = Base Bleed

24 Km BT	30 Km BB
M2020 PFF HE	M2020 PFF HE
M2019 HE	M2019 HE
M0101 Smoke	M0101 Smoke
M0102 Illum	M0102 Illum

57-caliber 105mm outranges the proposed 38-caliber NLOS-C 155mm howitzer – and delivers all 105mm projectiles to 30 kilometers!

Lethality

US 155mm vs. GD / Denel 105mm



100% LETHAL AREA:	1,015 m^2	1,684 m^2
	155mm	105mm

66% Greater Lethal Area for 105mm PFF

Fire Support

US 155mm vs. GD/Denel 105mm

78% Less Danger Area

	155mm M107	105mm PFF HE
Lethality	36 m	46 m ✓
Danger Area	1300 m / 900 m	800 m / 435 m ✓

Lethality Area

Peacetime Safety Distance No Fragments

Reduced Safety Distance (Chance of Fragments 1/10,000 to 1/1,000,000)

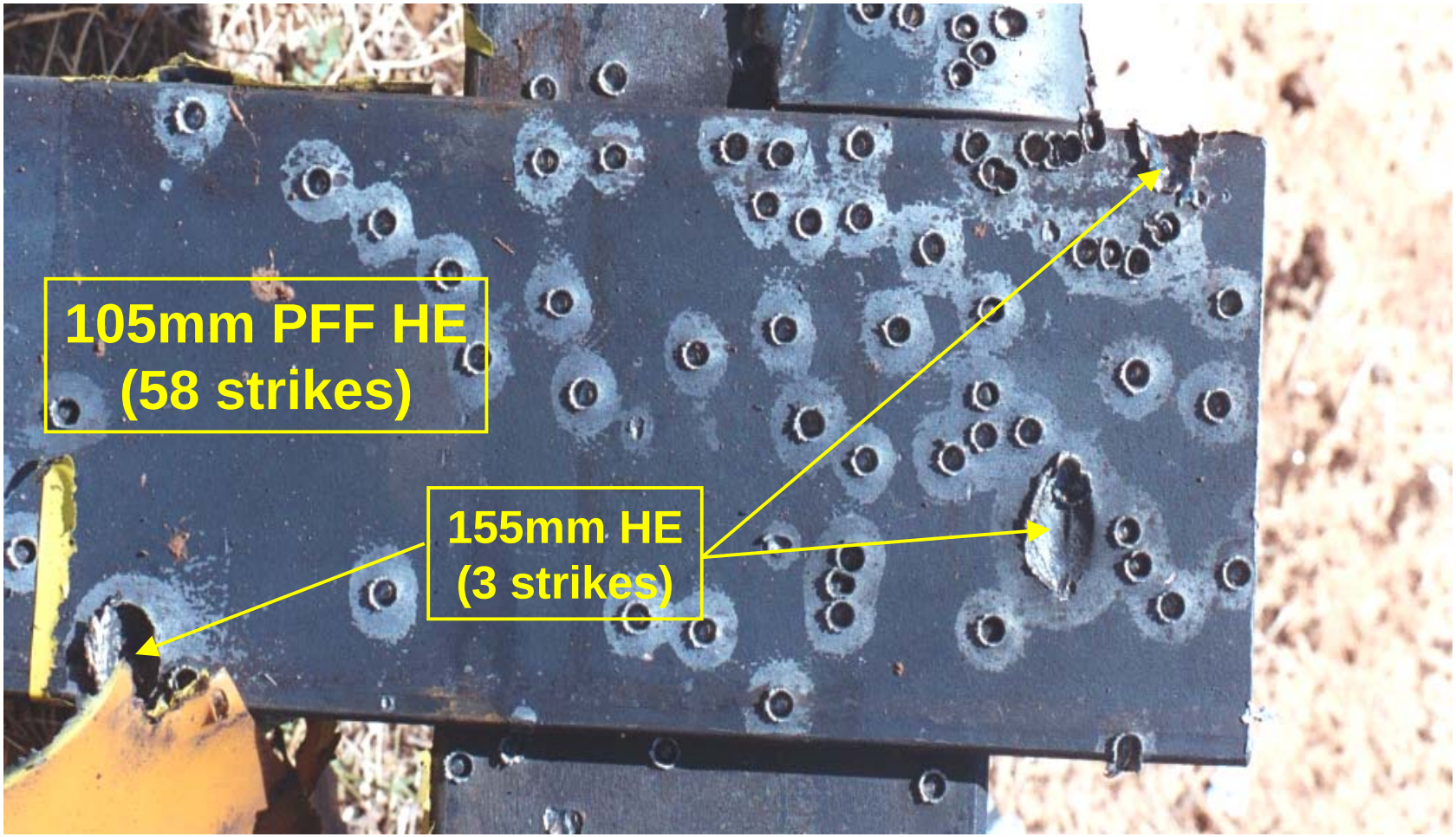
✓

OIF: Limit collateral damage

Denel 105mm PFF HE

Better lethality + smaller danger & collateral damage footprints = BETTER FIRE SUPPORT!

Greater Lethality Against Personnel and Light Skinned Vehicles



Unparalleled performance against "soft" targets!

Operational and Logistical Advantages

- ***Operationally***
  - M2020 PFF HE is TWICE as lethal as 155mm HE against personnel and soft skinned targets
  - 105mm smoke and illum IR capabilities not available in 155mm
  - Every 105mm round can be delivered to maximum 30 km range
  - Boat Tails and Base Bleed motors are field interchangeable, enhancing the commander's ability to meet range requirements
- ***Logistically***
  - Increased effectiveness allows firing 50% less rounds for the same efficiency with less that 20% of the tonnage (80% less tonnage required)
  - Enables a positive logistical impact on the battlefield by minimizing the commander's restrictions on basic load

OIF: Reduces the logistics tail ✓

105mm IGALA Ammunition Suite

- Ammunition developed by Denel
- All projectiles are ballistically matched
- All projectiles go 24 km with boat tail and 30 km with base bleed
- High Explosive projectiles available in both natural and prefragmented styles
- Illumination is visual or infrared (IR)
- Smoke is visual and IR
- Available with Insensitive Munitions

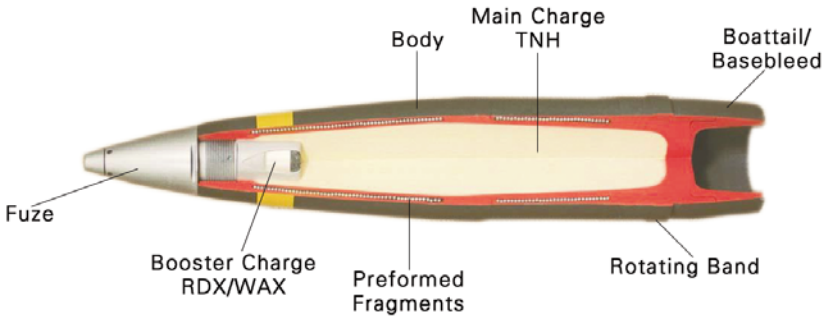
Only one firing table needed for all projectiles!

M2019 High Explosive | M2020 PFF High Explosive | M2019 Practice

M0101 Smoke | M0102 Illumination

M2020 PFF High Explosive (XM0125)
Description and Comparison

M2020
PFF High
Explosive



M2020 PFF HE

Technical Characteristics

	Unassisted	Assisted
Total mass unfuzed (kg)	15.1 ± 0.15	15.1 ± 0.15
Length unfuzed (mm)	455	455
Explosive type	TNH	TNH
Explosive mass (kg)	2	2
Design pressure (MPa) (projectile base)	400	400
Rotating band diameter (mm)	107.3	107.3
Fuze cavity	STD NATO	STD NATO
Qualification temperature (°C)	-46 to +63	-46 to +63

Mean Sea Level Ballistic Performance at 21°C

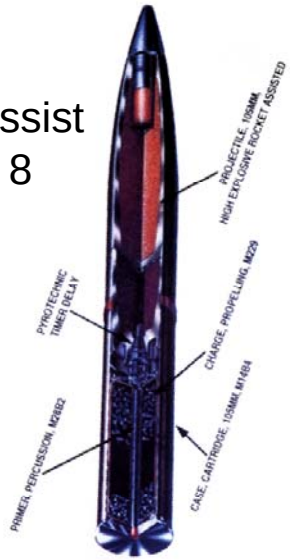
	Unassisted	Assisted
Muzzle velocity (m/s)	950	960
Chamber pressure (MPa)	350	350
Maximum range (m)	24,000	30,000

Comparison / Benefits

- Part of ballistically matched family
- Compares to M1 or M913
- Much more lethal than US M1, M913 105mm HE shells, and M795 and M107 155mm shells
- Unique preformed fragment body
- 7800 Tungsten Balls
- **NO US EQUIVALENT**
- **Insensitive Munition**

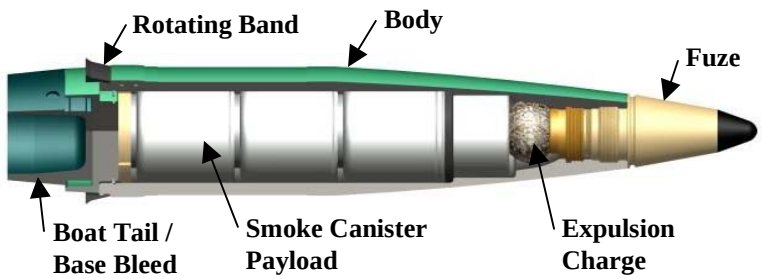
M913 Key Characteristics

Type: 105mm HE Rocket Assist
Prop Charges: M229, Zone 8
Weight: N/A
Fill Material: 2.27 kg TNT
Max Velocity: N/A
Max Pressure: N/A
Range: 19 km in M119



105mm Projectiles

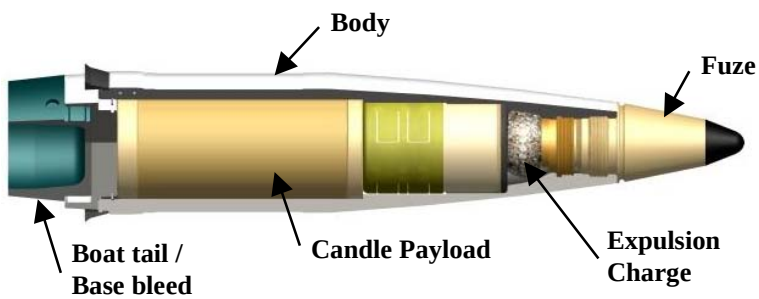
M0101 Bi-Spectral Screening Smoke



Comparison / Benefits

- Part of ballistically matched family
- Greater range than M84 round
- **Bi-spectral** smoke screen – **NO US EQUIVALENT**
  - 450-750 nm (visual)
  - 750-950 (near infrared)
  - 1-14 µm (infrared)

M0102 and M0235 IR Illumination

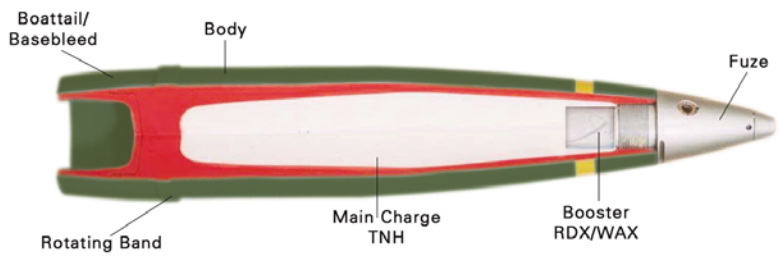


Comparison / Benefits

- Part of ballistically matched family
- Greater range than M314A3
- Improved light output
- Part of ballistically matched family
- **Visual or infrared** illumination – **NO US IR EQUIVALENT**

105mm Projectiles

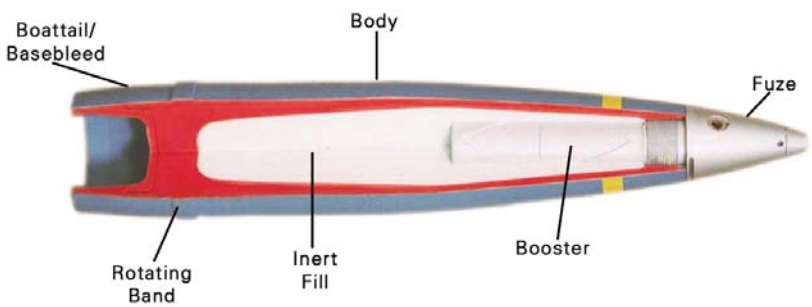
M2019 and M0203 IM Natural Frag High Explosive



Comparison / Benefits

- Part of ballistically matched family
- Compares to M1, M913
- Lower cost than M2020 HE PFF, with less lethality

M2019 Practice



Comparison / Benefits

- Part of ballistically matched family
- Compares to M67 TP-T
- Can be used with all charge zones,
- Can be completely inert or contain a supplementary charge for marking

Under the Foreign Comparative Test Program these projectiles are being safety certified and type classified for use in US Army 105mm howitzers.

LEO Fires All US 105mm Projectiles

US 105MM Projectiles

Cartridge	US MAX Charge/ Zone	US Ammo Max Range	Denel MCS Charge	Max Range	Range Increase with Denel Cannon
M1	M67 / 7	11.5 km	4	17.5	**6 km**
M927	M67 / 7	15 km	4	21.5	**6.5 km**
M314	M67 / 7	11.5 km	4	17.5	**6 km**
M444	M67 / 7	11.5 km	4	17.5	**6 km**
XM916	M67 / 7	10.5 km	4	17.5	**7 km**
M84	M67 / 7	11.5 km	4	17.5	**6 km**
M60	M67 / 7	11.5 km	4	17.5	**6 km**
M760	M200 / 8	14 km	5	21	**7 km**
M913	M200 / 8	19 km	5	29	**10 km**
M915	M200 / 8	14 km	5	21	**7 km**

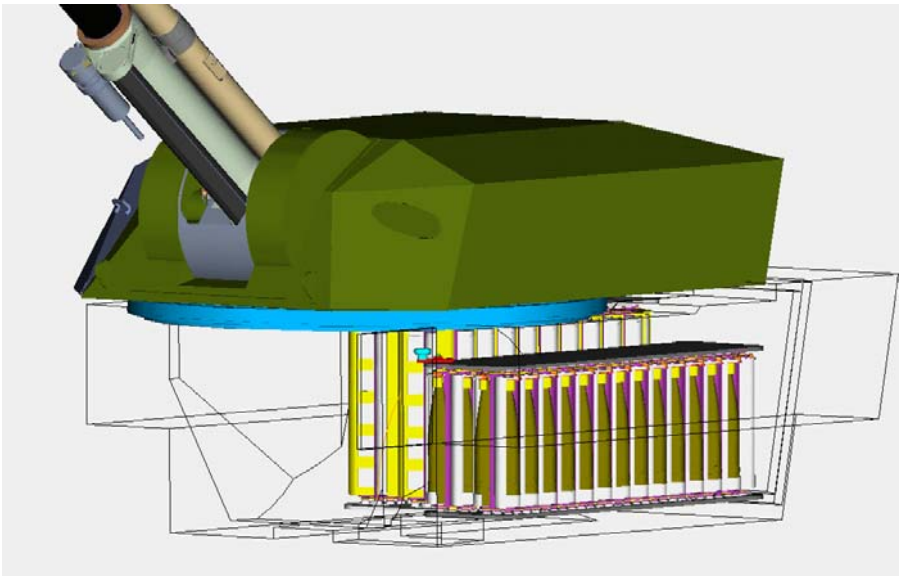
Ranges for ALL Denel Projectiles

Charge Zone	**M/V (m/s)**	**Elevation @ 200mils (km)**	**Elevation @ 800mils (km)**
#3 Boat-tail	642	8.671	15.5
#4 Boat-tail	806	11.55	20
#5 Boat-tail	970	14.4	24
#5 Base-bleed	975	16	30

105mm Modular Charge System (MCS)

- Modular charge developed by Denel-Somchem
- Unitary charge for maximum zone tests and demonstrations
- Five increments for tactical use
- Completed development testing
- Ready for qualification
- Based on 155mm MCS in production in South Africa
- All components currently in production for 155mm

56x42 Capacity Semi-Automated AHS



- Features
  - One 56-round projectile magazine centered in hull
  - One 42-charge propellant magazine in left sponson

- **Advantages**
  - C-130 transportable with full ammo load
  - Permits crew ingress/ egress thru rear of vehicle
  - Magazines easily removed or serviced
  - Ease of ammo reloading
  - Can work with the existing load arm design
  - Available room for storage (ammo/supplies)

NOT CURRENTLY ON DEMONSTRATOR

105mm LAV III SPH Demonstrator

Modified LAV III Chassis
DENEL 105mm Cannon
GDOTS/Denel Ammunition Suite (NDI)
DFCS Interface with AFATDS
Inertial Navigation System (INS)
3-Man Crew
56 Rounds On-Board In Semi-Automated Mode
6 rpm Rate of Fire
Meets C-130 Requirements - 17.5 tons
Chassis road tested in January 2004
Cannon proof fired January 2004
Turret fired 9-11 February 2004
Displayed at AUSA 3-6 March 2004

105mm Howitzer Demonstrator

- Howitzer arrived Eglin on 8 March
- Test Fired at Eglin AFB during the period 8-16 April 2004
- All objectives met!

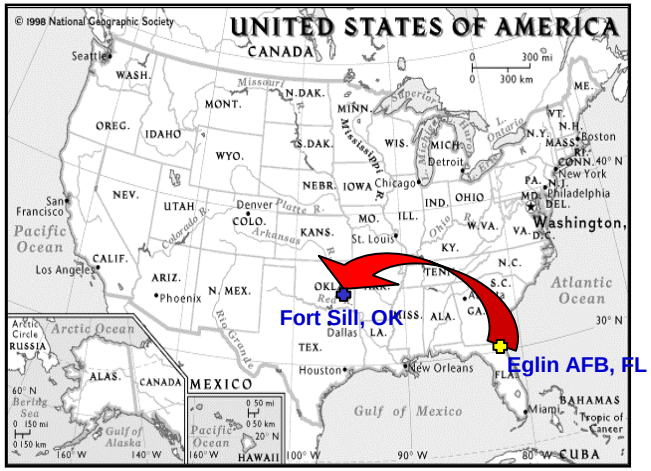
Howitzer Firing At Eglin

Demonstrated
-4 to 1239 mil
Elevation
+530 to -530 mil
Traverse
<u>No Spades</u>
<u>Required</u>

105mm LAV III SPH Demonstrator

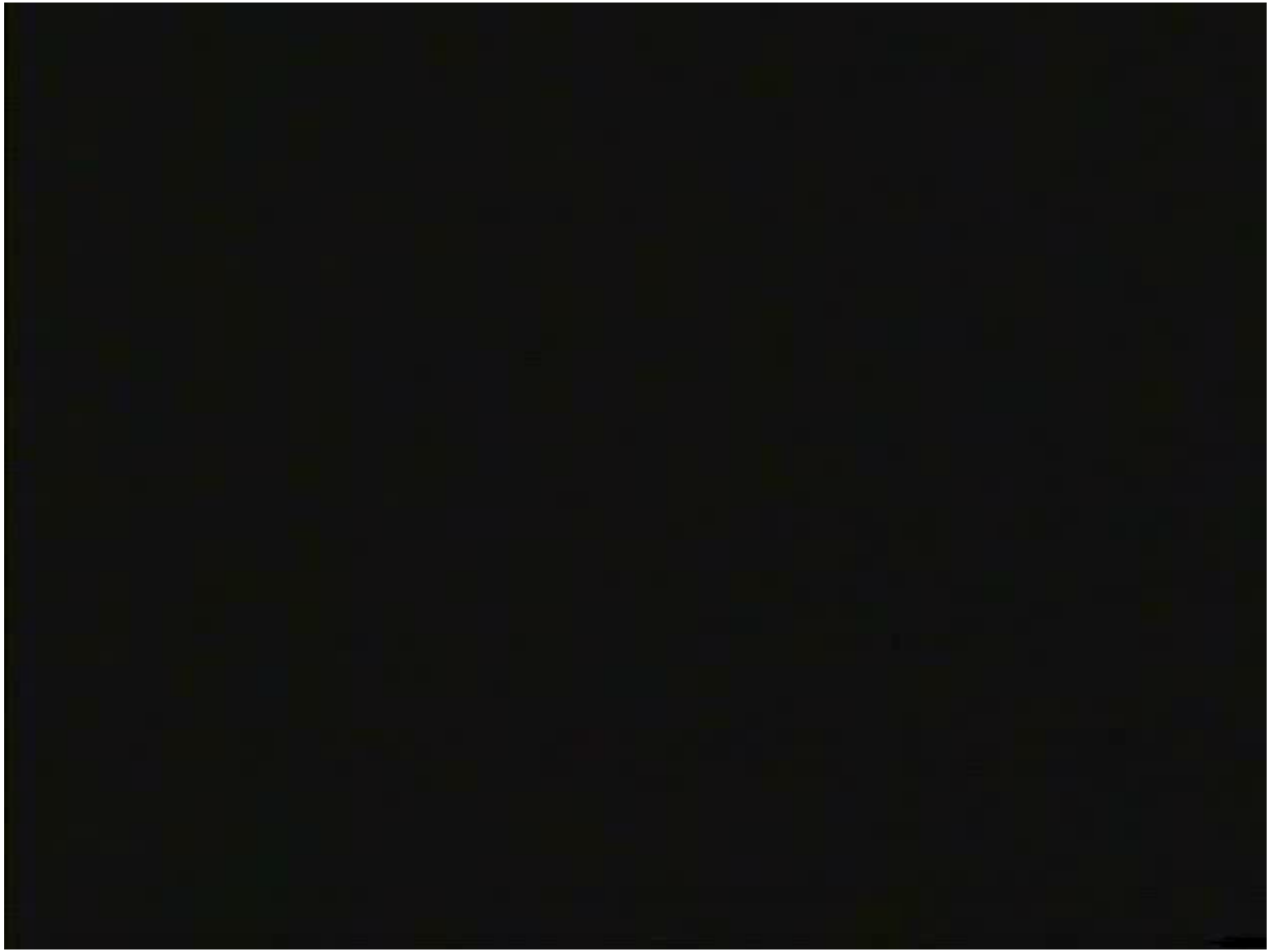
C-130 Transportability Demo, 19 Apr 04, Fort Sill, OK

25 minutes from ramp down to firing at Mow-Way House!



900+ miles from Eglin AFB, FL to Fort Sill, OK

Firing, Mobility and Transportability Demonstrations



LAV III 105H SPH Advantages

- **Meets C-130 transportability requirements (18.3 tons)**
  - 56 rounds & 42 propelling charges
  - Half-full fuel tank
- **Lethality exceeds current 155mm HE projectiles (66% greater lethal area) – provides precision effects for target suppression**
- **Ranges greater than or equal to current 155mm systems**
  - *All projectiles achieve 24 km with Boat Tail*
  - *All projectiles achieve 30 km with Base Bleed*
    - Screw-on base bleed can be added anywhere in supply chain
    - Gives commander round-by-round, mission-by-mission flexibility
- **Accuracy equals or exceeds all current artillery**
  - *120 CEP at 30 km*
- **Mobility equal to supported force**
- **Commonality with LAV III family of vehicles**
- **105mm logistical tail 80% less than 155mm**

Solution to OIF Lessons Learned

The Chief of Artillery's Vision

*Excerpts from **FA Journal**, March-June 2004:*

"*Stryker Brigades* currently use the M198, a dependable and effective cannon. But as a towed system, it does not match the survivability and mobility of the formation it supports. The … M777 lightweight 155-mm cannon with towed artillery digitization (TAD) added … is an interim solution. But we will continue to pursue a self-propelled cannon for the Stryker Brigade with a better 6400-mil capability … deployable in a C-130."

BG David P. Valcourt
Chief of Artillery

The 105mm LAV III SPH meets the needs of the Stryker Brigades today!

The Chief of Artillery's Vision

*Excerpts from **FA Journal**, March-June 2004:*

"The NLOS-C will share the same chassis as the infantry and armor FCS variants it will support. For the *first* time, our guns will have the same survivability, mobility, operational maneuver and sustainability as the maneuver forces they support – that is *significant*."

BG David P. Valcourt
Chief of Artillery

The 105mm Stryker SPH can do that today!

The Chief of Artillery's Vision

*Excerpts from **FA Journal**, March-June 2004:*

"Just as other services have moved to smaller diameter bombs and increased precision, we, too, seek to shrink our logistics tail with increased precision while sustaining our current lethality and range in smaller, lighter, more deployable systems."

BG David P. Valcourt
Chief of Artillery

The 105mm LAV III SPH can do the same for the Field Artillery!

The Artillery's Dilemma

- *Currently, US Artillery is outnumbered and outranged around the world*
- *How to reconcile the seemingly divergent requirements for rapid deployability, longer range, greater lethality and a smaller logistical footprint*

There is only one logical way to resolve the dilemma – the US must acquire <u>integrated cannon systems</u> with outstanding deployability, longer range, greater lethality, and a smaller logistical tail!

The 105mm LAV III SPH is the ideal starting point!

Light, Lethal, Mobile and Air Transportable

Not your father's 105mm!