REDUCED RANGE (RR) AMMUNITION

FOR TRAINING AND URBAN COMBAT

2010
MAY 19

Fredrik Erninge
R&D Manager
Nammo Vanäsverken
Karlsborg, Sweden

fredrik.erninge@nammo.com
+ 46 (0)70 321 15 85
TOPICS
DEVELOPMENT OF 7.62 RR
[ Reduced Range Ball Ammunition ]

- Customer Requirements
- Projectile Development
- Tuning Characteristics
- Summary
7.62 RR

- CUSTOMER REQUIREMENTS

- Need for ammunition with reduced safety template
  - Training
  - Combat
- Maximum Range ≤ 1500 m (1640 yds)
- Trajectory match Nato reference @ 200 m (220 yds)
- Accuracy compared to Nato reference @ 100 m (110 yds)
- Meet relevant STANAG requirements
  - Terminal effects
  - Weapon function in complete temperature interval
- Non Toxic (lead- and heavy metal free)

- Price competitive
  - Possible to produce with standard machinery
TRAINING & COMBAT OPERATIONS

- Training
  - MOUT training
  - Firing ranges near populated areas
  - Firing from moving vehicles

- Urban Combat Operations
  - Typical maximum range = 200 m (220 yds)
  - Typical average fighting distances = 15-35 meters (~15-40 yds)
  - 360 Degree awareness, hemispherical (Convoy)
REDUCED RANGE
BASED ON NAMMO NON TOXIC DESIGN

- All Swedish and Norwegian standard ammunition is Non-Toxic
- Non-Toxic = Lead/heavy metal free (primer, propellant & projectile)
- 5.56, 7.62 and 9 mm
  - Ball & Tracer
  - Produced since 2000
- Four Non-Toxic cartridges Nato Qualified
REDUCING THE MAXIMUM FLIGHT RANGE

- Reduce the projectile stability
- $S_g$ – Gyroscopic Stability Factor

1. Reduce muzzle exit stability compared to standard ammunition
2. Reduce stability downrange at a defined distance

\[ S_g = \frac{2 \left( \frac{p}{v} \right)^2 I_x^2}{\pi \rho d^3 I_y C_{M\alpha}} \]
MUZZLE EXIT STABILITY

- BASIC DESIGN

- Different projectile profiles evaluated with Prodas simulation programme

- Decreased stability caused by:
  - Reduced weight & density (Transverse & Axial inertia)
  - Center of Gravity pushed towards tail
  - Drag Center of Pressure pushed forward

- Increased Drag value
MUZZLE EXIT STABILITY

- BASIC DESIGN

PR0DAS Gross Plot

Mach

RR

Reduced Range

SMALL ARMS AMMUNITION
MUZZLE EXIT STABILITY
- BASIC DESIGN

PRODAS Cross Plot

Mach

RR
Reduced Range
SMALL ARMS AMMUNITION
DOWNRANGE STABILITY

- REDUCING SPIN

- Reduce spin by air braking flutes
- Position, number and basic geometry of flutes were optimized
  - First developed with 12.7mm (.50cal)
  - Test firings with Doppler radar measurements
  - Adapted for 7.62 mm
- Design Conclusions:
  - Flutes on projectile tip
  - Three flutes more stable and manufacturable than 4 or 5
  - Flute length maximized for portion outside cartridge case
DOWNRANGE STABILITY

- REDUCING SPIN

- Reduce spin by air braking flutes
- Position, number and basic geometry of flutes were optimized
- First developed with 12.7 mm (.50cal)
- Test firings with Doppler radar measurements
- Adapted for 7.62 mm

- Design Conclusions:
- Flutes on projectile tip
- Three flutes more stable and manufacturable than 4 or 5
- Flute length maximized for portion outside cartridge case

RR 7.62
Reduced Range
SMALL ARMS AMMUNITION

MODEL: 02
CLICK TO ENLARGE

MODEL 01
MODEL 03
TUNING OF CHARACTERISTICS

Accuracy

Flute Depth

Max Range

Weight

Inner Ballistics

Powder & Primer

Velocity

Weapon Function

Ballistic Match

RR 7.62

Reduced Range

SMALL ARMS AMMUNITION
TRAJECTORY & ACCURACY

- Live Firing Tests
- Mean point of impact and Extreme spread
- The square pattern has the side 100 mm (~4 inch)

Ball [reference]
RR [1]
RR [2]
TRAJECTORY & ACCURACY

- Live Firing Tests
- Mean point of impact and Extreme spread
- The square pattern has the side 100 mm (~4 inch)

Ball [reference]
RR [1]
RR [2]
TRAJECTORY & ACCURACY

- Live Firing Tests
- Mean point of impact and Extreme spread
- The square pattern has the side 100 mm (~4 inch)

Ball [reference]
RR [1]
RR [2]

RR 7.62
Reduced Range
SMALL ARMS AMMUNITION

200 M: 220 YDS
400 M: 440 YDS
600 M: 880 YDS
800 M: 1120 YDS
1000 M: 1360 YDS
1200 M: 1600 YDS
1400 M: 1940 YDS
1600 M: 2180 YDS
1800 M: 2480 YDS
2000 M: 2720 YDS
TRAJECTORY & ACCURACY

- Live Firing Tests
- Mean point of impact and
  Extreme spread
- The square pattern has
  the side 100 mm (~4 inch)

Ball [reference]
RR [1]
RR [2]

RR 7.62
Reduced Range
SMALL ARMS AMMUNITION
DECIDING MAXIMUM RANGE

- Maximum Range calculated with a Prodas model
- Non rotation symmetric geometry
  - Physical parameters from CAD model
    - Transverse Inertia
    - Axial Inertia
    - Center of Gravity
- Drag values from shootings with doppler radar measurements
  - Different elevation angles [15-30°]
  - Different projectile velocities
  - Consistent drag values measured (black lines)
  - Drag value in Prodas adapted (purple line)
SPIN DECAY

- Evaluated by test firings with Doppler radar measurements
- V-shapen spin slot
  - Spin signals detected by radar
- Spin decay form factor added to Prodas and compared to radar data
- Pitching moment coefficient, CMₐ, form factored
MAXIMUM RANGE CALCULATION

RR | 7.62
Reduced Range
Small Arms Ammunition

V_{24} MAX
+10 m/s
V_{24} DESIGN VELOCITY
-10 m/s

1470 meter
1608 yds

STANDARD ATMOSPHERIC CONDITIONS
No wind
Temperature +15°C (+59°F) @ sea level
Air Pressure 1.013 bar @ sea level
COMBAT USE

RR 7.62
Reduced Range
SMALL ARMS AMMUNITION
7.62 **RR**
- Core Customer Requirements

- Need for ammunition with reduced safety template
  - Training
  - Combat
- Maximum Range ≤ 1500 m (1640 yds)
- Trajectory match NATO reference @ 200 m (220 yds)
- Accuracy compared to NATO reference @ 100 m (110 yds)
- Meet relevant STANAG requirements
  - Terminal effects
  - Weapon function in complete temperature intervals
- Non Toxic (lead- and heavy metal free)

- Price competitive
  - Possible to produce with standard machinery
SUMMARY

- CARTRIDGE DESIGN

- Cartridge Case: Standard Brass
- Primer: Boxer Non Toxic
- Propellant: Extruded double base Non Toxic
- Projectile: Steel plated jacket covering a steel core

- CHARACTERISTICS

- Significantly reduced safety template
  - Max range < 1500 meters (1640 yds)
- Trajectory match within 0.3 Mils to
- NATO reference @ 200 m (220 yds)
- Accuracy s < 30 mm (1.2 inch) @ 100 m (110 yds)
- Meets all relevant STANAG requirements
- Cost effective design

- A Non-Toxic alternative for training and/or special tactical tasks
RR 7.62
Reduced Range
SMALL ARMS AMMUNITION
QUALIFICATION STATUS

- .50cal Ball RR – Qualified October 2009, In production
- .50cal Tracer RR – Qualified October 2009, In production
- .50cal Dim Tracer RR – Qualified October 2009, In production

- 7.62x51 mm Ball RR – Qualification Q3 2010
- 5.56x45 mm BallL RR – Qualification Q4 2010
- 5.56 and 7.62 mm Tracer & Dim Tracer RR – Qualification 2011
QUESTIONS

AP 7.62 Armor Piercing
RR 7.62 Reduced Range
IR 7.62 Infrared Tracer
BALL 7.62 Non Toxic