APEX – Armor Piercing with Explosive
The Dual Purpose Round for the F-35

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NAMMO Overview
- A Technology Driven Aerospace & Defense Group

- **Corporate HQ in Norway**
  - Presence in 9 countries
  - 2200 employees
  - Approximately $620 million revenue (2013)
  - 85% defense / 15% civil

- **Nammo Inc HQ in Virginia**
  - Nammo Talley (SSA)
  - Nammo Pocal
  - Nammo Tactical Ammunition
  - Nammo Demilitarization
  - Nammo Composite Solutions

~ 1/3 USA & Americas

~ 1/3 Europe & ROW

~ 1/3 Nordic
Core Business & Technologies

- **Ammunition**
  - Specialty producer of small, medium and large caliber ammunition

- **Shoulder-Launched Munitions**
  - Advanced multi-purpose SLMs for current and emerging warfighter missions

- **Missile Products**
  - Highly engineered rocket motors, warheads, composite/metallic cases and actuation systems

- **Demilitarization**
  - World leader in safe and environmentally responsible recycling of ammunition and energetic materials
The A/C Ammunition Background

- An MP license and data package was acquired by the US DoD in 1981
- Technology activity with USN on A/C ammunition during the last 20 years
- Nammo has a strategic alliance agreement with GD-OTS within the Medium Caliber Ammunition (MCA) segment
25 mm APEX Program Background

- Development and ground qualification funded by NDLO

- The 25 mm APEX is developed to meet RNAF performance requirements and the GD-OTS CIDS

- F-35A SDD (Block III) integration funded 50/50 by the Australian and Norwegian MoD
  - Officially approved by F-35 Lightning II JPO PEO 31 July 2013

- USN NAVAIR FCT contract awarded in 2013

- US designation of the 25 mm APEX is PGU-47/U
25 mm APEX: Multi Role Dual Purpose Round

- APEX capabilities:
  - Safe arming distance and safe separation distance
  - Detonation inside target: blast, fragmentation, incendiary effects
  - Penetration capability
  - Graze impact function (82.5° NATO in sand)
  - Suppressive effects
  - Low drag
25 mm PGU-47/U APEX Projectile Design

- Plastic Sealing Disc
- Sintered Steel Driving band
- Steel Shell body
- Steel Support disc
- Aluminum Nose Cap
- Tracer Compositions
- Zr
- PBXW-11 Explosive
- PBXN-5 Booster
- Fuze
- Cobalt Free Tungsten Carbide Penetrator
25 mm PGU-47/U APEX Basic Data

- Muzzle velocity at +21°C: 970 m/s (3182 ft/s)
- Projectile mass: 223 g
- Cartridge mass: 535 g
- Tracer burn time: 3 s
- Ammunition dispersion: < 0.5 mills (single barrel)
- Fuze (FMU-171/U) function:
  - Dual safety
  - Min. arming distance: 10 m
  - Detonation delay: 0.4 ms (at 2 mm DurAl plate)
  - Sensitivity: 2 mm DurAl plate in 45° NATO @ 2750 m (9000 ft) from A/C with 283 m/s (550 KTS) aircraft speed
APEX: Multi Role Dual Purpose Round

2 mm DURAL Target plate 0º NATO

20 mm Armour Steel Target plate 45º NATO

50 mm Armour Steel Target plate 0º NATO
0.08 in, 2 mm Al Multi-Array Target Plate @ 0 deg. NATO

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Flash X-ray Pictures of the Fragmentation
Armored Targets

Tungsten Carbide penetrator

Tungsten Carbide Fragments and blast
0.8in, 20mm RHA Target Plate @ 45 deg. NATO
20 cm, 8 in Double Reinforced Concrete Target
Firing PGU-47/U (APEX) at a F-5 Tail
Firing PGU-47/U (APEX) at a F-5 Tail Pictures

Entrance side

Exit side
Firing PGU-47/U (APEX) at a F-5 Tail Pictures

Fragments in the aircraft body
Firing PGU-47/U (APEX) at a F-5 Tail - Pictures

Fragments in the left air intake tunnel

Fragments in the wing
Firing PGU-47/U (APEX) at a F-5 Cockpit
Firing PGU-47/U (APEX) at a F-5 Cockpit
Firing PGU-47/U (APEX) at a F-5 Fuel Tank
Grace Impact Angle in Sand: 7.5°
Status Ground Qualification

- Ongoing ground qualification tests
  - More than 600 rounds fired after environment testing, more than 99.5% function reliability
25mm PGU-47/U APEX A/C Integration

F-35A:
- JPO management, 50/50 funded by Australia and Norway
- The USAF at Eglin AFB will facilitate APEX A/C Integration
  - NNMSB Safety review -> Certification for UASF Aircraft (F-35 A) and pilots
  - LFT&E program
  - Integration flights 2015 – 2016 timeframe

F-35B/C:
- USN (FCT) will perform delta qualification of the APEX
  - Supporting FISTRP and WSESRRB Safety Board reviews
  - Final type qualification end 2014
  - F-35B/C FoT&E -> Certification 2017

- APEX is the only war shot planned certified for all three F-35 versions
# 25mm APEX Schedule

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<td>2005~R&amp;D and ground qualification (GQ)</td>
<td>Integration flights</td>
<td>Live fire test &amp; evaluation (LFT&amp;E)</td>
<td>F-35A Initial Operational Capability</td>
<td>USN FCT testing and qualification</td>
<td>F-35B/C Final Type Qualification</td>
<td>F-35B/C FOT&amp;E Certification</td>
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25 mm TP-RRR – Cost Effective Training Round

In air-to-ground training there is always a risk that ricochets from ground can hit your own aircraft.

TP-RRR:
- Reduced Ricochet Risk
- Reduced Danger Zone
The Dual Purpose Round for the F-35