120 mm High Explosive - Tracer (HE-T)
IM Development and Design
The 120 mm HE-T is a direct fire round developed by NAMMO and is in service with the Leopard equipped Swedish Defense Forces. GD-OTS has improved the round to meet the accuracy and survivability requirements typical of USG fielded tank ammo.

The 120 mm HE-T is a “Full Bore” High Explosive round with capabilities against multiple threat targets.
120 mm HE-T

• Americanized by GD-OTS for Abrams Tank
  – St. Marks Hybrid propellant, 6 lbs of PAX-34 Explosive, Propellant bag, Cool primer, Combustible cartridge case and Case base

• Technical Requirements:
  – Direct fire against multiple targets
  – Dual safe fuze with SQ & delay (complaint to MIL-STD-1316)
  – US Army accuracy requirement
  – Direct fire capabilities
  – Indirect fire capabilities
120 mm HE-T Effectiveness

Effectiveness

HE-T

HEAT

KE

Threat Scenarios

GENERAL DYNAMICS
Ordnance and Tactical Systems
HE-T Against a Mini-Bus
• GD-OTS and Nammo have improved the accuracy of the HE-T by redesigning the projectile fin blades. The fin blades are larger and more rigid.

• Testing at NTS was completed Dec. 12-16, 2005.
  - Target Distance: 2000 meters
  - Conditioning Temp: +21ºC
  - Accuracy was significantly improved
PAX 34 Background Information

- Traditional Melt-Cast Explosive Fills
  - Good explosive performance
  - Poor IM performance
  - Low cost, high volume manufacture
  - Multiple LAP options

- IM Improved Melt-cast Explosive Fills
  - Good explosive performance
  - Good to excellent IM performance
  - Combination new/traditional explosive ingredients
  - Low cost, high volume manufacture
  - Multiple LAP options
IM Explosive Ingredients

- DNAN
- TATB
- NTO

BAE MANUFACTURING FACILITY

BAE SYSTEMS
Ordnance and Tactical Systems
Sectioned 120mm PAX-34 Filled Mortar
Sectioned 120mm PAX-34 Filled Mortar
St. Marks HYBRID Propellant

• Initial testing indicates GD-OTS’s HYBRID propellant is an insensitive energetic comparable to JA2

• HYBRID propellant grains are more plasticized than M14 and will not break or crack as easily.

• Nitrocellulose is completely dissolved prior to extrusion.
• Fuze venting sleeve melts prior to reaction temperature of PAX-34, allowing the pressure of the explosive to vent out of the fuze cavity.

• Material is extruded Polycarbonate, very hard plastic able to maintain its structural integrity during ballistic firing.

• Enough area forward of fuze to allow proper venting.
PA171 Ammo Can and Closed Cell Foam Packaging

- Venting windows effectively vent high pressure built up inside of the ammo can during Slow and Fast Cook Off environments.

- Closed cell foam produced at Foam Design once heated to its melting point returns to a resin type state rather than sealing the round causing an additional pressure seal.
Summary of 120 mm HE-T IM Testing

Vulnerability Testing

- M1A1 Bustle Test
- Sympathetic Detonation Test 1
- Sympathetic Detonation Test 2
- Sympathetic Detonation Test 3

Slow Cook Off Test

- Three (3) warhead configurations
M1A1 Bustle Testing

Stowage Configuration in Bustle for HE-T Test

Blowoff Panels

Commander’s/Semi-Ready Side Compartment

1 2 3 4
5 6 7 8
9 10 11 12
13 14 15 16
17 18 19 20
21 22 23 24
25 26 27 28
29 30 31
32 33 34 35
36

Loader’s/Ready-Side Compartment

120-mm HE-T donor cartridge
120-mm KEW-A2 slug cartridges
120-mm HE-T acceptor cartridges
120-mm KEW-A2 inert cartridges

GENERAL DYNAMICS
Ordnance and Tactical Systems
Bustle Test Results

- No sympathetic detonation of acceptor cartridges
- The various features built into the Abrams turret effectively vented the pressure generated during the explosive event.
- Majority of propellant was consumed during the explosive event
- Peak pressure measured within the ammunition compartments was within threshold criteria.
- Results considered successful.
  - It is possible to store HE-T rounds in the Abrams turret ammunition compartment without violating crew survivability criteria.
Sympathetic Detonation Test 1

Setup

Results
Sympathetic Detonation Test 2

Set-up

The test setup included three HE-T warheads, each loaded with 6 lbs of PAX-34 explosive and a PBXN-5 booster pellet. The center warhead was detonated to verify no sympathetic detonation occurs.
No detonation or deflagration to acceptor warheads
Slow Cook-Off (SCO) Test Setup

- Three warhead designs were tested.
  - Design 1: Venting sleeve between F985 fuze and warhead. Venting sleeve made of Polycarbonate.
  - Design 2: Eight (8) 3/8” venting holes surrounding warhead body filled with High Density Polyethylene (HDPE) Plugs.
  - Design 3: Current Nammo warhead design

- All test rounds were full-up cartridges with live F985 Fuze, filled with GD-OTS’ Hybrid Propellant, packaged inside vented PA171 ammo cans.
Design 1: (Fuze Venting Sleeve):

- **Type V Reaction**, burning only
  - HYBRID Propellant burned
  - PAX-34 burned

PA 171 effectively vented the pressure and no explosive event occurred
Design 2 (Venting Plugs):

- **Type V Reaction**, burning only
  - HYBRID Propellant burned
  - PAX-34 burned

PA 171 effectively vented the pressure and no explosive event occurred
Design 3 (Original Design):

- **Type III Reaction**, explosion
  - HYBRID Propellant burned
  - PAX-34 exploded

Fragments after detonation
Conclusions

- The 120 mm HE-T is an effective Multi-purpose High Explosive round, capable of destroying many of the threats in today’s operating environment.

- The aerodynamic design reduces the drag of the HE-T providing the war-fighter with highly effective indirect fire capabilities.

- The improved fin blades the HE-T makes the round exceptionally accurate

- As a goal, the HE-T will be considered an IM compliant HE tank round.