

# **GENERAL DYNAMICS**

## Ordnance and Tactical Systems

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### IM HE-T Final Hazard Classification

Insensitive Munition and Energetic Materials Technology Symposium  
Seville, Spain

Jason Sebastian  
October 22<sup>nd</sup>, 2019

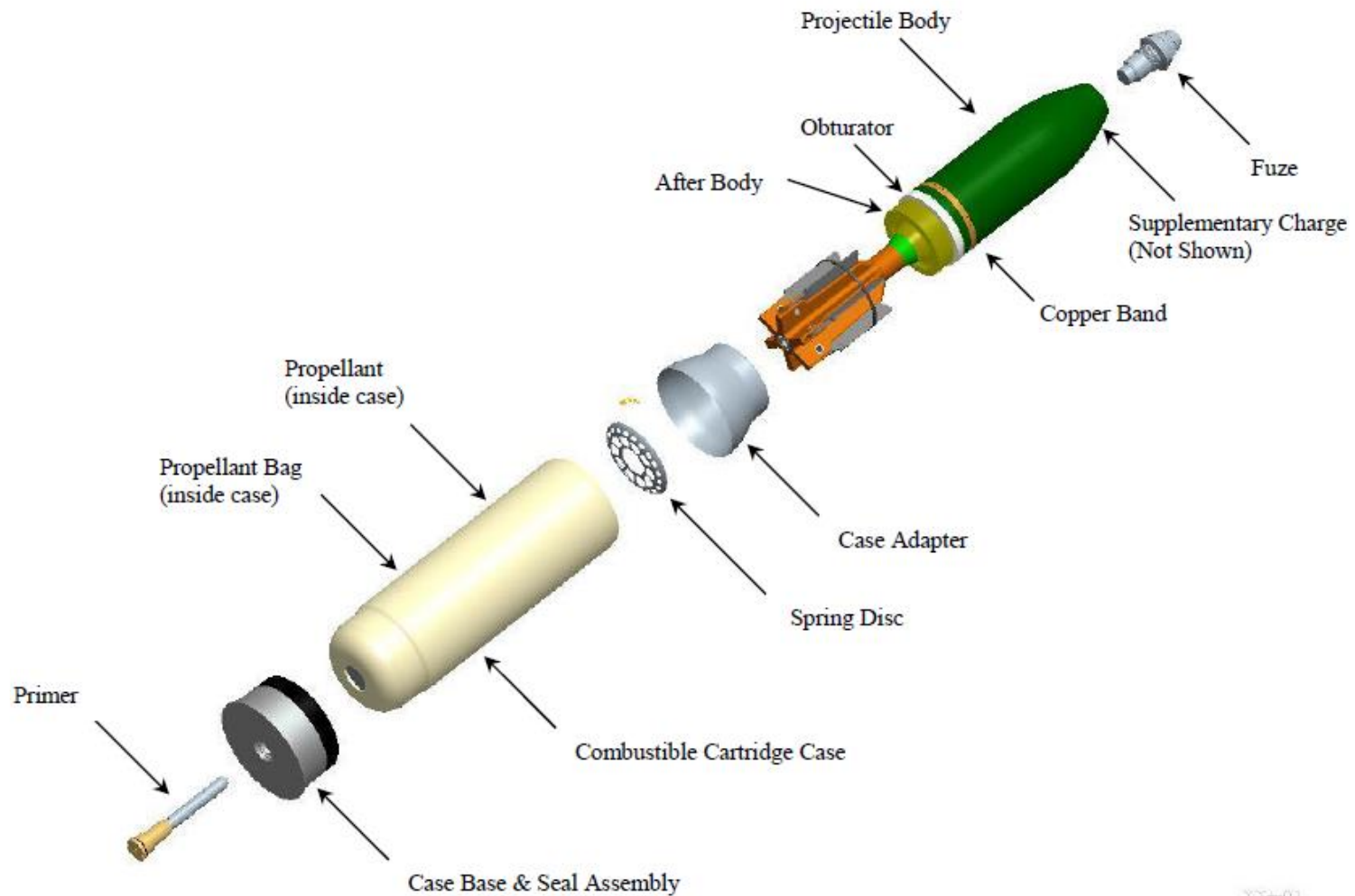
# IM HE-T Background

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- Developed as a joint effort between General Dynamics- Ordnance and Tactical Systems and Nammo
- Based on Nammo 120mm Mk 1 HE-T round, fielded by Swedish Defense Forces in 1998
- Currently qualified for both the L44 gun system in the Leopard II tank and the M256 gun system in the M1A1/A2 Abrams tank
- Capability against a target set that includes bunkers, reinforced concrete walls, light armor, and personnel
- In production by GD-OTS for both FMS and DCS efforts



# IM HE-T<sup>®</sup> Cartridge



3024-01

# USG Final Hazard Classification

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- Final Hazard Classification testing was performed by the USG in 2013
- Testing performed in accordance with UN Series tests per 49 CFR and the Joint Technical Bulletin (TB) 700-2, 30 Jul 2012, Department of Defense Ammunition and Explosives Hazard Classification Procedures

Test	Standard	Results
Thermal Stability	UN Series 4 (a)	Performed
12-meter drop	UN Series 4 (b) (ii)	Performed
Single Package	TB 700-2	Not Performed
Sympathetic Reaction	TB 700-2	Performed
Liquid Fuel/ External Fire	TB 700-2	Performed

# USG Sympathetic Reaction Test

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# Final Hazard Classification



U.S. Department  
of Transportation

Pipeline and Hazardous  
Materials Safety Administration

The US Department of Transportation  
Competent Authority for the United States

East Building, PHH-32  
1200 New Jersey Avenue, Southeast  
Washington, D.C. 20590

## CLASSIFICATION OF EXPLOSIVES

Based upon a request by the DEPARTMENT OF DEFENSE EXPLOSIVES SAFETY BOARD, 4800 Mark Center Drive Suite 16E12, Alexandria, VA, USA the following item is classed in accordance with Section 173.56, Title 49, Code of Federal Regulations (49 CFR). This Classification is valid only when the item is transported or offered for transportation by, or under the direction or supervision of, a component of the U. S. Department of Defense. A copy of the application, all supporting documentation, and a copy of this Classification must be retained by the applicant and made available to DOT upon request.

U.N. PROPER SHIPPING NAME AND NUMBER:  
Cartridges for weapons, [with bursting charge], UN0006

U.N. CLASSIFICATION CODE: 1.1E

REFERENCE NUMBER  
EX2015050079

PRODUCT DESIGNATION/PART NUMBER  
CARTRIDGE, 120MM, IM HE-T IN PA171  
METAL CONTAINER P/N GD41001426

NOTES: None

This approval as revised supersedes all previous versions.

DATED: 05/08/2015

Dr. Magdy El-Sibaie  
Associate Administrator for Hazardous Materials Safety

- The DDESB reviewed the results of the testing and assigned the IM HE-T® a Hazard Classification of 1.1E
- Expectation was 1.2E based on IM HE-T® Hazard Classification for GD-OTS Canada and Nammo by their cognizant transportation authorities
- SMS consulted to perform additional testing specific to Stack/Sympathetic Reaction in an effort to receive 1.2E

# Series 6 Testing Summary

- Additional testing recommended by SMS was performed in two phases: one initial Stack Test in the first phase; followed by a Single Package Test and two more trials of the Stack Test with an altered pallet configuration in the second phase
- DOT provided feedback prior to initial testing and following the results of the first phase

Test	Conditions and Results	Pass/Fail
UN Series 6 (a) Single Package	<ul style="list-style-type: none"><li>• Reaction effects were not contained within the packaging</li><li>• Reaction effects could cause propagation of adjacent packages as evidenced by a crater at the test site, a hole in the witness plate, measurement of a blast, and disruption and scattering of the confining material.</li></ul>	FAIL (mass explosion of the warhead)
UN Series 6 (b) Stack	<ul style="list-style-type: none"><li>• Craters were not appreciably larger than from a single package</li><li>• Damage to the witness plates beneath the stack was not appreciably greater than that from a single package</li><li>• Measurement of blasts did not significantly exceed that from a single package</li><li>• In the last two trials there was not a violent disruption or scattering of most of the confining material.</li><li>• In the first trial, there was violent disruption and scattering of most of the confining material since the test was conducted on a thicker witness plate with the donor cartridge higher up in the stack</li></ul>	Pass (no evidence of explosion of the contents of more than one package)



# UN Series 6 (a) Single Package Test

- To be performed for comparison to the results of the Stack Test for the witness plate, pressure, and distances of debris including UXO
- Donor cartridge placed directly on the witness plate with 5 sand-filled PA171 metal containers around the donor
- Covered with loose earth with a minimum thickness of confinement in every direction of 0.5 meters
- Donor initiated into the main explosive charge of the warhead





# UN Series 6 (a) Single Package Test

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# UN Series 6 (b) Stack Test- Trial 1

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- Three trials of the UN Series 6 (b) Stack Test were conducted
- First trial was performed to determine the feasibility of reducing the hazard classification
- A donor was surrounded by 4 adjacent acceptors above, below, and one to each side





# UN Series 6 (b) Stack Test- Trial 1



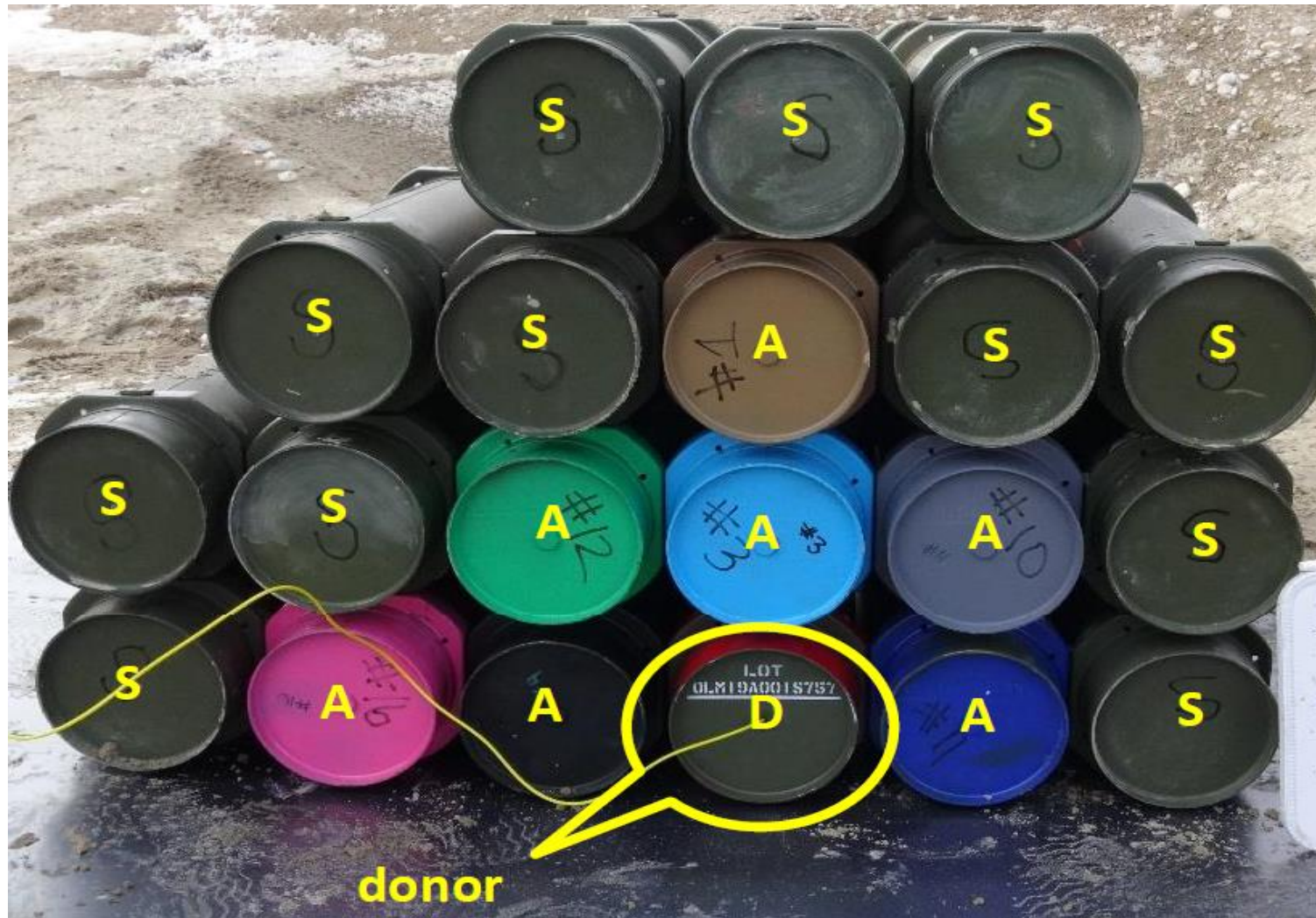
# UN Series 6 (b) Stack Test- Trial 2 & 3

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- Following completion of the first trial, a second and third trial were proposed with some modifications from SMS and DOT input
- Cartridges and ammo cans were painted different colors to discern the pallet position of recovered debris
- The donor was placed directly on a thinner witness plate than the initial trial to better assess the reaction in comparison with the single package test
- Blast overpressure was also recorded at 30, 40, and 50 feet for comparison to the single package test
- The quantity of acceptors was increased from four to seven
- Acceptors were placed in every position surrounding the donor and an additional two rounds placed two pallet positions away to determine if the reaction would lessen as the distance from the donor increased



# UN Series 6 (b) Stack Test- Trial 2 & 3





# UN Series 6 (b) Stack Test- Trial 2 & 3





# UN Series 6 (b) Stack Test- Trial 2 & 3

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- The reactions of Trial 2 and 3 were very similar in the deformation of the witness plate and the distances, quantity, and condition of recovered debris
- The furthest any debris was recovered from on either trial was approximately 40 feet
- Pressure sensor readings for both trials did not exceed that of the single package test
- Cartridges two positions away from the donor were mostly still intact in their ammo cans with the exception of the burning of the propelling charge and combustible cartridge case

# UN Series 6 Test Summary

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Explosion of the contents of more than one package did not occur instantaneously when initiating the warhead as evidenced by the following:

- There was not a crater at the test site appreciably larger than that given by a single package
- Damage to the witness plate beneath the stack was not appreciably greater than that from a single package
- Measurement of the blast did not significantly exceed that from a single package
- There was not a violent disruption or scattering of most material

# Final Hazard Classification



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## CLASSIFICATION OF EXPLOSIVES

Based upon a request by General Dynamics-OTS, Inc, 11399 16th Ct N Ste 200, Saint Petersburg, FL 33716-2322, US, the following items are classed in accordance with Section 173.56, Title 49, Code of Federal Regulations (49 CFR). A copy of your application, all supporting documentation and a copy of this approval must be retained and made available to DOT upon request.

An EX approval is non-transferable in any merger, acquisition, sale of assets, or other business transaction. For more information, please visit:  
[<https://www.phmsa.dot.gov/registration/faq-mergers-acquisitions-and-legal-status-changes-pdf>]

### U.N. PROPER SHIPPING NAME AND NUMBER:

Cartridges for weapons, with bursting charge, UN0321

### U.N. CLASSIFICATION CODE: 1.2E

### REFERENCE NUMBER:

EX2019072063

### PRODUCT DESIGNATION/PART NUMBER:

CARTRIDGE, 120MM, IM HE-T (P/N: 41001426)

### NOTES:

The following packaging method is assigned:  
Outer Packaging - UN 1A2 steel drum (e.g. PA171 Container), each containing one (1) cartridge.

**DATED:** August 23, 2019

for William Schoonover  
Associate Administrator for Hazardous Materials Safety

- Results of the testing initially performed by the USG along with UN Series 6 (a) and (b) testing performed by SMS was submitted to DOT
- The IM HE-T<sup>®</sup> cartridge as packaged in the PA171 ammo can was assigned a 1.2E Hazard Classification by US DOT on August 23<sup>rd</sup>, 2019

# Lessons Learned

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- Stack/Sympathetic Reaction Testing setup is open to interpretation and input from the approving authority
- Test Plans to be reviewed and agreed upon by all involved parties prior to testing
- Mark acceptors with different colors to better determine effects of reaction
- Perform Single Package Test in advance for comparison
- Perform initial trial in advance before committing resources to testing

# Thanks to SMS & Tooele

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Troy Gardner- Testing & Classifications Manager, SMS  
Jason Ford- Test Site/Equipment Manger, SMS  
Rusty Christensen- Manufacturing Engineer, SMS  
Roger Hale- Test Director, TEAD