

ARCHIVED REPORT

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Tank Gun Ammunition

Outlook

- Combined output of European manufacturers, averaging 265,000 rounds per year, is currently under severe strain due to ongoing Ukraine support requirements
- Russian producers are reportedly unable to keep up with Russian Army demand
- Combined output of non-U.S. and non-European manufacturers will average 16,000 rounds per year
- Ukraine support and U.S. Army resupply will necessitate an increased base sustainment level of U.S. production averaging 72,200 rounds of 120mm tank gun ammunition per year

Orientation

Description. Tank gun ammunition.

Sponsor. In the European and international markets, individual contractors and various governments sponsor the development of tank gun ammunition.

The U.S. Army sponsors the development and U.S. procurement of tank gun ammunition.

Licensees. Numerous firms and state-owned organizations produce European- and U.S.-pattern tank gun ammunition, with and without license.

Status. Development through serial production.

Total Produced. Through 2023, we estimate the various European contractors produced at least 27.8 million rounds of tank gun ammunition since 1980 inclusive.

We estimate the various non-U.S. and non-European contractors produced over 10.67 million rounds of tank gun ammunition during the same period.

We estimate that U.S. contractors produced at least 13.0 million rounds of 105mm and 120mm tank gun ammunition during the same period.

Application. Destruction of enemy armor. These munitions can also provide direct-fire support for the other maneuver arms.

Price Range. In 2024 U.S. dollars, the estimated unit prices for European tank gun munitions range from \$56.27 for 75mm HE rounds to \$3,954 for the DM53 APFSDS round.

In 2024 U.S. dollars, the estimated unit prices for tank gun ammunition on the international market ranges from \$50.74 for the 75mm HE round to \$4,931 for the Israeli 120mm APFSDS round.

According to U.S. Army FY24 budget request documentation (March 2023), U.S. tank gun ammunition types carry the following unit prices:

- 105mm TPDS-T M724A2: \$2,538.33
- 120mm APFSDS-T M829A4: \$20,000.00
- 120mm TPCSDS-T M865: \$3,147.72
- 120mm TPMP-T M1002: \$2,739.72
- 120mm HEMP-T XM1147: \$7,300.00

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Contractors

Prime

BAE Systems, Platforms & Services, Munitions	http://www.baesystems.com , Radway Green, Nr Crewe, Cheshire, Cumbria, United Kingdom, Tel: + 44 1270 882 261, Fax: + 44 1270 866 666, Email: media@baesystems.com , Prime
China North Industries Corp (NORINCO)	http://www.norinco.cn , 12A Guang An Men Nan Jie, PO Box 100053, Beijing, China, Tel: + 86 10 6352 9988, Fax: + 86 10 6354 0398, Email: norinco@norinco.cn , Prime
Denel SOC Ltd	http://www.denel.co.za , Nellmapius Dr, Irene, South Africa, Tel: + 27 12 671 2700, Fax: + 27 12 671 2751, Email: marketing@denel.co.za , Prime
Diehl Defence GmbH & Co KG, Werk Röthenbach a d Pegnitz	http://www.diehl.com/defence/en/ , Fischbachstrasse 16, Röthenbach, Germany, Tel: + 49 911 957 0, Fax: + 49 911 957 2510, Email: info@diehl-bgt-defence.de , Prime
Elbit Systems Land, (IMI Systems Ltd)	http://elbitsystems.com/products/land-systems/ , PO Box 1044, Bialik St 64, Ramat HaSharon, Israel, Tel: + 972 3 548 5222, Fax: + 972 3 548 6125, Email: imimrktg@imi-israel.com , Prime
Federal State Unitary Enterprise, Rosoboronexport, Rosoboronexport State Corp	http://www.roe.ru , 27/3 Stromynka St, Moscow, Russian Federation, Tel: + 7 495 534 6183, Fax: + 7 495 534 6153, Prime
Fiat SpA	http://www.fcagroup.com , Via Nizza 250, Turin, Italy, Tel: + 39 011 006 1111, Fax: + 39 011 006 3798, Email: mediarelationbs@fiatindustrial.com , Prime
General Dynamics European Land Systems, Santa Bárbara Sistemas	http://www.gdels.com , Via de los Poblados 3, PE Cristalia Edificio 7/8, Madrid, Spain, Tel: + 34 91 585 04 55, Fax: + 34 91 585 02 18, Email: info.sbs@gdels.com , Prime
General Dynamics Ordnance and Tactical Systems	http://www.gd-ots.com , 100 Carillon Parkway, St. Petersburg, FL 33716 United States, Tel: + 1 (727) 578-8100, Fax: + 1 (727) 578-8119, Email: mediacontact@gd-ots.com , Prime
General Dynamics Ordnance and Tactical Systems Canada, (formerly SNC Technologies Inc)	http://www.gd-otscanada.com , 5 Montée des Arsenaux, Le Gardeur, Quebec, Canada, Tel: + 1 (450) 581-3080, Fax: + 1 (450) 585-7302, Email: info@ca.gd-ots.com , Prime
Heliopolis Co for Chemical Industries, Factory 81	Haikstep, PO Box 11, Cairo-Heliopolis, Egypt, Tel: + 20 2 281 0898, Fax: + 20 2 281 0828, Email: kahachem@soficom.com.eg , Prime
Hellenic Defence Systems (EAS) SA, (EBO-PYRKAL)	1 Ilioupoleos Ave, Hymettus, Athens, Greece, Tel: + 30 210 979 0900, Fax: + 30 210 979 0800, Email: info@eas.gr , Prime
Industria de Material Belico do Brazil, IMBEL	http://www.imbel.gov.br , Avenida 15 de Marco, Casa 1, Portao de Limeira, Piquete, Brazil, Tel: + 55 12 3156 9042, Fax: + 55 12 3156 9028, Email: comercial.sp@imbel.gov.br , Prime
L3Harris - Electrodynamics Inc	http://www.l3harris.com , 3975 McMann Rd, Cincinnati, OH 45245-2395 United States, Tel: + 1 (513) 943-2000, Fax: + 1 (513) 943-2317, Email: fos.cincinnati@l-3com.com , Prime
Nexter Munitions	http://www.nexter-group.fr , Route de Villeneuve, La Chapelle, Saint-Ursin, France, Tel: + 33 02 48 68 71 71, Fax: + 33 02 48 68 70 54, Prime
Northrop Grumman Defense Systems, Armament Systems	http://www.northropgrumman.com , 3309 N Reseda Circle, Mesa, AZ 85215 United States, Tel: + 1 (480) 324-8600, Fax: + 1 (480) 324-8758, Prime
Poongsan Defense	http://www.poongsan.co.kr , Poongsan Bldg, 23 Chungjeong-ro, Seoul, Korea, South, Tel: + 82 2 3406 5114, Fax: + 82 2 3406 5400, Email: jwkang@poongsan.co.kr , Prime
Posco Daewoo, (Daewoo International Corp)	http://www.daewoolife.com , 541 5-Ga Namdaemunno, Chung-gu, Seoul, Korea, South, Tel: + 82 2 759 2114, Fax: + 82 2 753 9489, Prime
Rheinmetall	http://www.rheinmetall.com/en , Rheinmetall Platz 1, Düsseldorf, Germany, Tel: + 49 211 473 01, Fax: + 49 211 473 4727, Email: info@rheinmetall-defence.com , Prime

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Singapore Technologies Land Systems Ltd, (ST Land Systems)	http://www.stengg.com , 249 Jalan Boon Lay, Singapore, Singapore, Tel: + 65 6265 1066, Fax: + 65 6261 6932, Email: comms.kinetics@stengg.com , Prime
Thales Australia, Armaments & Ammunition	http://www.thalesgroup.com , 7 Murray Rose Ave, Sydney Olympic Park, New South Wales, Australia, Tel: + 61 2 9562 3333, Email: communications@thalesgroup.com , Prime

Contractors are invited to submit updated information to Editor, International Contractors, Forecast International, 75 Glen Road, Suite 302, Sandy Hook, CT 06482, USA; rich.pettibone@forecast1.com

Technical Data

As is common in military technology, the field of tank gun ammunition maintains its own, often confusing, series of acronyms. These serve to delineate the type and function of various munitions. The following table presents the most common tank gun ammunition acronyms:

<u>Acronym</u>	<u>Definition</u>
AP-T	Armor Piercing - Tracer
APC-T	Armor Piercing Capped - Tracer
APDS-T	Armor Piercing Discarding Sabot - Tracer
APERS	Anti-Personnel
APFS	Armor Piercing Fin Stabilized
APFSDS	Armor Piercing Fin Stabilized Discarding Sabot
APFSDS-T	Armor Piercing Fin Stabilized Discarding Sabot - Tracer
HE	High Explosive
HE-T	High Explosive - Tracer
HEAD	High Explosive Air Defense
HEAT	High Explosive Anti-Tank
HEAT-MP-T	High Explosive Anti-Tank - Multipurpose - Tracer
HEAT-T	High Explosive Anti-Tank - Tracer
HEAT-TP-T	High Explosive Anti-Tank - Target Practice - Tracer
HEMP	High Explosive Multipurpose
HEP-T	High Explosive Plastic - Tracer
HEP-TP	High Explosive Plastic - Target Practice
HVAP-DS-T	Hyper Velocity Armor Piercing - Discarding Sabot - Tracer
HVAP-T	Hyper Velocity Armor Piercing - Tracer
KE	Kinetic Energy
MP	Multipurpose
STAFF	Smart Target Activated Fire and Forget
TPCSDS-T	Target Practice Cone Stabilized Discarding Sabot - Tracer
TPDS-T	Target Practice Discarding Sabot - Tracer
TPMP	Target Practice Multipurpose Tracer
WP	White Phosphorus

Tank Gun Ammunition

Europe

<u>Caliber</u>	<u>Designation</u>	<u>Type</u>
<u>Manufacturer - BAE Systems</u>		
76mm	L24	High Explosive
76mm	L25	High Explosive - Practice
76mm	L29	High Explosive Squash Head
76mm	L32	Smoke
76mm	L33	Canister
76mm	L40	Squash Head - Practice
76mm	L42	Illumination
90mm	RO 907	High Explosive Anti-Tank
90mm	RO 924	High Explosive - Tracer
90mm	RO 925	White Phosphorous Smoke
90mm	RO 932	White Phosphorous Smoke - Tracer
90mm	RO 929	High Explosive Squash Head - Tracer
90mm	RO 933	Canister
90mm	RO 940	High Explosive Anti-Tank - Target Practice - Tracer
90mm	RO 964	Armor Piercing Fin Stabilized Discarding Sabot - Tracer
105mm	H6/62	Armor Piercing Fin Stabilized Discarding Sabot - Tracer
105mm	L35 series	High Explosive Squash Head
105mm	L38	Squash Head - Practice
105mm	L39	Hexachlorethane Smoke
105mm	L52 series	Armor Piercing Discarding Sabot
105mm	L63	Discarding Sabot - Practice
105mm	L64A4	Armor Piercing Fin Stabilized Discarding Sabot - Tracer
105mm	Excalibur	Armor Piercing Fin Stabilized Discarding Sabot - Tracer
120mm	L15	Armor Piercing Discarding Sabot
120mm	L20A1	Discarding Sabot - Practice
120mm	L23	Armor Piercing Fin Stabilized Discarding Sabot
120mm	L26 (CHARM 2)	Armor Piercing Fin Stabilized Discarding Sabot
120mm	L27 (CHARM 3)	Armor Piercing Fin Stabilized Discarding Sabot
120mm	L28	Armor Piercing Fin Stabilized Discarding Sabot
120mm	L31	High Explosive Squash Head
120mm	L32A6	Squash Head - Practice
120mm	L34	White Phosphorus Smoke
<u>Manufacturer - Diehl BGT Defence GmbH & Co KG</u>		
105mm	DM13	Armor Piercing Fin Stabilized Discarding Sabot - Tracer
105mm	DM23	Armor Piercing Fin Stabilized Discarding Sabot - Tracer
105mm	DM33	Armor Piercing Fin Stabilized Discarding Sabot - Tracer
105mm	DM63	Armor Piercing Fin Stabilized Discarding Sabot - Tracer
105mm	DM68	High Explosive Anti-Tank - Target Practice - Tracer
105mm	DM148	Target Practice Fin Stabilized Discarding Sabot - Tracer
<u>Manufacturer - Duna-Rit (Rosoboronexport)</u>		
100mm	OF-412	High Explosive
125mm	3VBK18M	High Explosive Anti-Tank - Fin Stabilized
<u>Manufacturer - Rheinmetall Defence (Eurometaal Holding NV)</u>		
90mm	M318	Armor Piercing - Tracer
90mm	M353A1	Target Practice - Tracer
105mm	Unknown	Armor Piercing Discarding Sabot
105mm	Unknown	Armor Piercing Fin Stabilized Discarding Sabot
105mm	Unknown	Discarding Sabot Practice - Tracer
105mm	Unknown	Squash Head
105mm	Unknown	Squash Head - Practice
105mm	Unknown	High Explosive
105mm	Unknown	Target Practice - Tracer
120mm	Unknown	Armor Piercing Fin Stabilized Discarding Sabot
120mm	Unknown	High Explosive Anti-Tank - Practice

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Caliber	Designation	Type
<u>Manufacturer - Fiat SpA (BPD Difesa e Spazio)</u>		
90mm	M71	High Explosive
90mm	M82	Armor Piercing - Tracer
90mm	M313	White Phosphorous Smoke
90mm	M431	High Explosive Anti-Tank - Tracer
105mm	M456	High Explosive Anti-Tank - Tracer
105mm	Unknown	High Explosive Anti-Tank - Tracer - Multipurpose
105mm	Unknown	Armor Piercing Fin Stabilized Discarding Sabot - Tracer
105mm	Unknown	Target Practice - Tracer
<u>Manufacturer - Fiat SpA (Simmel Difesa)</u>		
90mm	M82	Armor Piercing Capped - Tracer
90mm	M71	High Explosive
90mm	M313	White Phosphorus Smoke
90mm	M394	Blank
90mm	M431	High Explosive Anti-Tank - Tracer
105mm	M393	High Explosive Plastic - Tracer
105mm	M456A1	High Explosive Anti-Tank - Tracer
<u>Manufacturer - Nexter Munitions</u>		
90mm	ODR 90 F1	Canister
90mm	ODR 90 F2	Canister
90mm	OE 90 F1	High Explosive - Fin Stabilized
90mm	OE 90 F2	High Explosive
90mm	OE 90 S G1	High Explosive
90mm	OCC 90-62	High Explosive Anti-Tank - Fin Stabilized
90mm	OCC 90 F1	High Explosive Anti-Tank - Tracer
90mm	OCC 90 F2	High Explosive Anti-Tank - Tracer
90mm	BSCC 90 F1	Inert
90mm	BSCC 90 F2	High Explosive Anti-Tank - Target Practice - Tracer
90mm	OFUM PH 90 F1	White Phosphorus Smoke
90mm	OFUM F2	White Phosphorus Smoke
90mm	OFL 90 F1	Armor Piercing Fin Stabilized Discarding Sabot
90mm	M645	Armor Piercing Fin Stabilized Discarding Sabot - Tracer
90mm	M664	Fin Stabilized Discarding Sabot - Target Practice - Tracer
105mm	OCC 105 F2	High Explosive Anti-Tank - Tracer
105mm	OC 105 F3	High Explosive
105mm	OCC 105	High Explosive Anti-Tank
105mm	OE 105 Mle 60	High Explosive
105mm	OE 105 F1	High Explosive
105mm	OE	High Explosive
105mm	OECL 105 F1	Illumination
105mm	OFL 105	Armor Piercing Fin Stabilized Discarding Sabot - Tracer
105mm	OFL 105 E2	Armor Piercing Fin Stabilized Discarding Sabot - Tracer
105mm	OFL 105 F2	Armor Piercing Fin Stabilized Discarding Sabot - Tracer
105mm	OFL 105 F1	Armor Piercing Fin Stabilized Discarding Sabot
105mm	OFL 105 F3	Armor Piercing Fin Stabilized Discarding Sabot
105mm	OFL 105 Mle G1A	Armor Piercing Fin Stabilized Discarding Sabot - Tracer
105mm	OFL 105 G2	Armor Piercing Fin Stabilized Discarding Sabot - Tracer
105mm	Excalibur	Armor Piercing Fin Stabilized Discarding Sabot - Tracer
105mm	OFL 105 G3	Armor Piercing Fin Stabilized Discarding Sabot
105mm	OPFH 105 F1	White Phosphorus Smoke
105mm	OFUM	White Phosphorus Smoke
105mm	OFUM 105 Mle F2	White Phosphorus Smoke
105mm	OFUM 105 Mle F3	White Phosphorus Smoke
105mm	OFUM PH 105 F1	White Phosphorus Smoke
105mm	BSCC	High Explosive Anti-Tank - Target Practice - Tracer
120mm	BSCC 120 F1	High Explosive Anti-Tank - Target Practice - Tracer
120mm	OECC 120 F1	High Explosive Anti-Tank - Tracer
120mm	OFL 120 E2	Armor Piercing Fin Stabilized Discarding Sabot
120mm	OFL 120 F1	Armor Piercing Fin Stabilized Discarding Sabot - Tracer
120mm	OFL 120 F2	Armor Piercing Fin Stabilized Discarding Sabot - Tracer

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<u>Caliber</u>	<u>Designation</u>	<u>Type</u>
120mm	OFL 120 G1	Armor Piercing Fin Stabilized Discarding Sabot
120mm	OFL 120 FA	Armor Piercing Fin Stabilized Discarding Sabot
120mm	PROCIPAC	Armor Piercing Fin Stabilized Discarding Sabot - Tracer
120mm	POLY-NG	Smart High Explosive Anti-Tank
120mm	Unknown	High Explosive

Manufacturer - Luchaire (Nexter Munitions)

Note: Since 1991, Luchaire has operated as a subsidiary of Giat Industries (now Nexter Munitions). However, because ammunition bearing the Luchaire name is still available worldwide, we continue to list the Luchaire product line separately.

75mm	OE	High Explosive
75mm	PL/PN	High Explosive - Practice
75mm	FUM-PH	White Phosphorous Smoke
75mm	PRAC	Anti-Tank - Practice
75mm	POT-PCOT	Armor Piercing
75mm	Unknown	Dummy
90mm	SCC F1	High Explosive Anti-Tank - Practice
90mm	OE 90 F1	High Explosive - Fin Stabilized
90mm	FUM 90 F1	White Phosphorus Smoke
90mm	SSC 90 F3	High Explosive Anti-Tank - Practice
90mm	OE 90 F3	High Explosive - Fin Stabilized
90mm	FUM PH 90 F3	White Phosphorus Smoke
90mm	Unknown	Dummy
105mm	SCC	High Explosive Anti-Tank
105mm	FUM	White Phosphorus Smoke
105mm	OE	High Explosive
105mm	SCC	High Explosive Anti-Tank
105mm	OE	High Explosive
105mm	FUM	White Phosphorus Smoke
105mm	ECL	Illumination

Manufacturer - Hellenic Defence Systems (EAS) SA (EBO-PYRKAL)

75mm	M48	High Explosive
90mm	M71	High Explosive
90mm	M71A1	High Explosive - Tracer
90mm	M431A2	High Explosive Anti-Tank - Tracer
105mm	M456A1	High Explosive Anti-Tank - Tracer
105mm	M735	Armor Piercing Fin Stabilized Discarding Sabot
105mm	TP-7 (M467)	Target Practice - Tracer

Manufacturer - MECAR SA

76.2mm	M329	High Explosive Squash Head - Tracer
76.2mm	M331	High Explosive Squash Head - Target Practice - Tracer
90mm	M71	High Explosive - Tracer
90mm	M313	White Phosphorous Smoke - Tracer
90mm	M400	High Explosive Anti-Tank - Tracer - Practice
90mm	M404/3	High Explosive - Tracer - Practice
90mm	M431	High Explosive Anti-Tank - Tracer
90mm	M600	High Explosive Anti-Tank - Tracer
90mm	M601/3	High Explosive - Tracer
90mm	M602/3	White Phosphorous - Titanium Smoke - Tracer
90mm	M603	Armor Piercing Fin Stabilized Discarding Sabot - Tracer
90mm	M607/3	Canister
90mm	M612/1	White Phosphorous Smoke - Tracer
90mm	M616	High Explosive - Tracer
90mm	M616A1	High Explosive - Tracer
90mm	M617	High Explosive Anti-Tank - Tracer
90mm	M618	White Phosphorus Smoke - Tracer
90mm	M618A1	White Phosphorus Smoke - Tracer
90mm	M620	High Explosive Anti-Tank - Tracer
90mm	M620A1	High Explosive Anti-Tank - Tracer
90mm	M621	Canister

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<u>Caliber</u>	<u>Designation</u>	<u>Type</u>
90mm	M622	High Explosive Anti-Tank - Tracer - Practice
90mm	M623A1	High Explosive Anti-Tank - Tracer - Practice
90mm	M624	High Explosive Anti-Personnel - Fragmentation
90mm	M625	High Explosive Squash Head - Tracer
90mm	M625A1	High Explosive Squash Head - Tracer
90mm	M626	High Explosive Anti-Tank - Tracer
90mm	M627	High Explosive
90mm	M628	White Phosphorous Smoke - Tracer
90mm	M629	Canister
90mm	M630	High Explosive Anti-Tank - Tracer
90mm	M631A1	High Explosive - Tracer
90mm	M632	White Phosphorous Smoke - Tracer
90mm	M633A1	Fin Stabilized Discarding Sabot Target Practice - Tracer
90mm	M635	Target Practice - Tracer (subcaliber)
90mm	M636	Canister
90mm	M637	High Explosive Practice - Tracer
90mm	M638	High Explosive Practice - Tracer
90mm	M639	Smoke - Tracer
90mm	M641	High Explosive Anti-Tank - Target Practice - Tracer
90mm	M642	Smoke - Tracer
90mm	M643	Target Practice - Tracer
90mm	M644	High Explosive Anti-Tank - Tracer
90mm	M650	Blank
90mm	M652	Armor Piercing Fin Stabilized Discarding Sabot - Tracer
90mm	M652A1	Armor Piercing Fin Stabilized Discarding Sabot - Tracer
90mm	M653	Fin Stabilized Discarding Sabot - Target Practice - Tracer
90mm	M655A1	High Explosive Squash Head - Target Practice - Tracer
90mm	M656	High Explosive Squash Head - Tracer
90mm	M660	Smoke - Tracer
90mm	M670	Armor Piercing Fin Stabilized Discarding Sabot - Tracer
90mm	M671	High Explosive Anti-Tank - Tracer - Practice
90mm	M672	High Explosive Squash Head - Tracer
90mm	M690A2	Armor Piercing Fin Stabilized Discarding Sabot - Tracer
90mm	M691A2	High Explosive Squash Head - Tracer
90mm	M692A2	High Explosive Squash Head - Target Practice - Tracer
90mm	M693A2	White Phosphorus Smoke
90mm	M1000A1	Armor Piercing Fin Stabilized Discarding Sabot - Tracer
90mm	M1004	High Explosive-Canister
90mm	M1006	White Phosphorous Smoke - Tracer
90mm	M1007	High Explosive Anti-Tank - Fin Stabilized
105mm	M393A2	High Explosive Squash Head - Tracer
105mm	M456A2	High Explosive Anti-Tank - Tracer
105mm	M416	White Phosphorus Smoke
105mm	M468	High Explosive Squash Head - Target Practice -Tracer
105mm	M490	High Explosive Anti-Tank - Target Practice -Tracer
105mm	M494	Anti-Personnel - Tracer
105mm	M724A1	Target Practice Discarding Sabot - Tracer
105mm	M1001	Armor Piercing Fin Stabilized Discarding Sabot - Tracer
105mm	M1008	Illumination
105mm	M1009	White Phosphorous Smoke
105mm	M1010	High Explosive
105mm	M1050	Armor Piercing Fin Stabilized Discarding Sabot - Tracer
105mm	M1053	High Explosive Squash Head - Tracer
105mm	M1056	Fin Stabilized Discarding Sabot - Target Practice - Tracer
105mm	M1057	Fin Stabilized Discarding Sabot - Target Practice - Tracer
105mm	M1060	Armor Piercing Fin Stabilized Discarding Sabot - Tracer
105mm	M1060A1	Armor Piercing Fin Stabilized Discarding Sabot - Tracer
105mm	M1060A2	Armor Piercing Fin Stabilized Discarding Sabot - Tracer
105mm	M1061	High Explosive Anti-Tank - Tracer

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<u>Caliber</u>	<u>Designation</u>	<u>Type</u>
115mm	Unknown	Armor Piercing Fin Stabilized Discarding Sabot - Tracer
120mm	M1080	Armor Piercing Fin Stabilized Discarding Sabot - Tracer
<u>Manufacturer - Rheinmetall Defence</u>		
105mm	DM16	Illumination
105mm	DM78	High Explosive Squash Head - Practice
105mm	DM512	High Explosive Squash Head
105mm	DM43	Armor Piercing Fin Stabilized Discarding Sabot - Tracer
105mm	DM128 (LKL)	Target Practice Fin Stabilized Discarding Sabot - Tracer
105mm	Unknown	High Explosive Anti-Tank - Tracer
105mm	DM68	High Explosive Anti-Tank - Target Practice
120mm	DM12A1	High Explosive Anti-Tank - Tracer
120mm	DM18	High Explosive Anti-Tank - Target Practice -Tracer
120mm	Unknown	High Explosive Fragmentation
120mm	DM33	Armor Piercing Fin Stabilized Discarding Sabot - Tracer
120mm	DM43 (LKE I)	Armor Piercing Fin Stabilized Discarding Sabot - Tracer
120mm	DM53 (LKE II)	Target Practice Fin Stabilized Discarding Sabot - Tracer
120mm	DM38 (LKL)	Target Practice Fin Stabilized Discarding Sabot - Tracer
<u>Manufacturer - Russian State Munitions Factories (Rosoboronexport)</u>		
125mm	3VP6/3P6	Target Practice Fin Stabilized Discarding Sabot
125mm	3VBM3/3BM9	Armor Piercing Fin Stabilized Discarding Sabot
125mm	3VBM6/3BM12	Armor Piercing Fin Stabilized Discarding Sabot
125mm	3VBM7/3BM15	Armor Piercing Fin Stabilized Discarding Sabot
125mm	3VBM8/3BM17	Armor Piercing Fin Stabilized Discarding Sabot
125mm	3VBM9/3BM22	Armor Piercing Fin Stabilized Discarding Sabot
125mm	3VBM13/3BM32	Armor Piercing Fin Stabilized Discarding Sabot
125mm	3VBM17/3BM42	Armor Piercing Fin Stabilized Discarding Sabot
125mm	Unknown/3BM44	Armor Piercing Fin Stabilized Discarding Sabot
125mm	3BVK7/3BK12M	High Explosive Anti-Tank - Fin Stabilized
125mm	3BVK10/3BK14	High Explosive Anti-Tank - Fin Stabilized
125mm	3BVK16/3BK18M	High Explosive Anti-Tank - Fin Stabilized
125mm	3BVK17/3BK21B	High Explosive Anti-Tank - Fin Stabilized
125mm	3BVK25/3BK29M	High Explosive Anti-Tank - Fin Stabilized
125mm	Unknown/3BK37	High Explosive Anti-Tank - Fin Stabilized
125mm	3OF19	High Explosive Fragmentation - Fin Stabilized
125mm	3OF36/3OF26	High Explosive Fragmentation - Fin Stabilized
125mm	3VP5/3P11	High Explosive Anti-Tank - Fin Stabilized - Practice
125mm	3VP6/3P81	Armor Piercing Fin Stabilized Discarding Sabot - Practice
125mm	3BVK25IN/3BK29IN	High Explosive Anti-Tank - Inert
125mm	4X33	Blank
<u>Manufacturer - General Dynamics Santa Bárbara Sistemas</u>		
90mm	ME-431	High Explosive Anti-Tank - Tracer
90mm	Unknown	Armor Piercing Fin Stabilized Discarding Sabot - Tracer
105mm	OCC-105-F2	High Explosive Anti-Tank
105mm	OE-105-60	High Explosive
105mm	OE-105-F2	High Explosive
105mm	SCC-105-F2	Target Practice - Tracer
105mm	OFPH-105-F2	White Phosphorus Smoke
105mm	C-437	Armor Piercing Fin Stabilized Discarding Sabot - Tracer
105mm	OWC	High Explosive Anti-Tank - Tracer
105mm	HWC	High Explosive Anti-Tank - Tracer
105mm	CH-105-MZ	High Explosive Anti-Tank - Tracer
<u>Manufacturer - Vazov Engineering Plant (Rosoboronexport)</u>		
73mm	PG-15V	High Explosive Anti-Tank - Fin Stabilized
73mm	PG-15VN	High Explosive Anti-Tank - Fin Stabilized
73mm	PG-15NT	High Explosive Anti-Tank - Fin Stabilized
73mm	OG-15V	High Explosive Fragmentation
73mm	OG-15VM	High Explosive Fragmentation
73mm	OG-15BG	High Explosive Fragmentation

Tank Gun Ammunition

<u>Caliber</u>	<u>Designation</u>	<u>Type</u>
73mm	OG-15BG1	High Explosive Fragmentation
100mm	3UBK10-1	Gun-Launched Guided Missile
100mm	BK-5M	High Explosive Anti-Tank - Fin Stabilized
100mm	UBR-412D	Armor Piercing Capped Tracer

International

<u>Caliber</u>	<u>Designation</u>	<u>Type</u>
<u>Manufacturer - Thales Australia (formerly ADI Ltd)</u>		
105mm	L64	Armor Piercing Fin Stabilized Discarding Sabot
105mm	L52	Armor Piercing Discarding Sabot
105mm	L35	High Explosive Squash Head
105mm	L39	Base Eject Smoke
105mm	TC800	Canister
<u>Manufacturer - China North Industries Corporation (NORINCO)</u>		
85mm	Unknown	High Explosive Anti-Tank - Fin Stabilized
100mm	Type 73	Armor Piercing Discarding Sabot
100mm	Type 86	Armor Piercing Discarding Sabot
100mm	Type 73	High Explosive Anti-Tank - Fin Stabilized
100mm	Type 73	High Explosive Fin Stabilized
100mm	AP100-2	Armor Piercing Fin Stabilized Discarding Sabot - Tracer
100mm	Type 73	High Explosive - Tracer
100mm	Unknown	Armor Piercing Fin Stabilized Discarding Sabot - Tracer
105mm	105-I	Armor Piercing Fin Stabilized Discarding Sabot - Tracer
105mm	105-II	Armor Piercing Fin Stabilized Discarding Sabot - Tracer
120mm	120-I	Armor Piercing Fin Stabilized Discarding Sabot - Tracer
120mm	120-II	Armor Piercing Fin Stabilized Discarding Sabot - Tracer
125mm	125-I	Armor Piercing Fin Stabilized Discarding Sabot - Tracer
<u>Manufacturer - Daewoo Ammunition Corporation</u>		
90mm	M431A2	High Explosive Anti-Tank -Tracer
90mm	K241	Armor Piercing Fin Stabilized Discarding Sabot - Tracer
105mm	M456A1	High Explosive Anti-Tank
105mm	K270	Armor Piercing Fin Stabilized Discarding Sabot - Tracer
105mm	K273	Armor Piercing Fin Stabilized Discarding Sabot - Tracer
<u>Manufacturer - Denel SOC Ltd</u>		
76.2mm	Unknown	Armor Piercing Fin Stabilized Discarding Sabot - Tracer
76.2mm	Unknown	High Explosive - Tracer
76.2mm	Unknown	Canister
76.2mm	Unknown	Fin Stabilized Discarding Sabot - Tracer
76.2mm	Unknown	Practice
105mm	Unknown	High Explosive Anti-Tank
105mm	Unknown	High Explosive Squash Head
105mm	Unknown	Armor Piercing Discarding Sabot - Tracer
105mm	Unknown	White Phosphorous Smoke
120mm	Unknown	Armor Piercing Fin Stabilized Discarding Sabot - Tracer
120mm	Unknown	Target Practice
<u>Manufacturer - Heliopolis Company for Chemical Industries</u>		
85mm	O-365	High Explosive
85mm	O-365K	High Explosive - Fragmentation
85mm	BR-365	Armor Piercing
85mm	BK-2M	High Explosive Anti-Tank - Fin Stabilized
90mm	Unknown	Armor Piercing High Explosive
100mm	53OF412Zh	High Explosive
100mm	53BR412B	Armor Piercing High Explosive - Tracer
100mm	53OF412	High Explosive Fragmentation
100mm	Unknown	Armor Piercing Practice
100mm	Unknown	Training - Inert
100mm	M724A1	Target Practice Discarding Sabot - Tracer

Tank Gun Ammunition

<u>Caliber</u>	<u>Designation</u>	<u>Type</u>
100mm	M735	Armor Piercing Fin Stabilized Discarding Sabot - Tracer
100mm	H/6-62	Armor Piercing Fin Stabilized Discarding Sabot
100mm	M456A1	High Explosive Anti-Tank - Tracer
100mm	M490	Target Practice - Tracer
105mm	Unknown	High Explosive
105mm	Unknown	Training
115mm	BD/36-2	Armor Piercing Fin Stabilized Discarding Sabot
115mm	3UBM-5	Armor Piercing Fin Stabilized Discarding Sabot
115mm	3OF18	High Explosive Fragmentation - Fin Stabilized

Manufacturer - Industria de Material Belico do Brasil (IMBEL)

90mm	NR478A2	High Explosive Anti-Tank - Tracer
90mm	NR501A2	High Explosive Tracer
90mm	NR502A3	White Phosphorous Tracer
90mm	NR503A3	High Explosive Squash Head - Tracer
90mm	Unknown	Armor Piercing Fin Stabilized Discarding Sabot - Tracer
90mm	Unknown	Canister

Manufacturer - Israel Military Industries Ltd (IMI)

60mm	HVMS	Armor Piercing Fin Stabilized Discarding Sabot - Tracer
75mm	Unknown	Armor Piercing - Tracer
75mm	Unknown	High Explosive
75mm	Unknown	White Phosphorous Smoke
90mm	Unknown	Armor Piercing Fin Stabilized Discarding Sabot
105mm	M111	Armor Piercing Fin Stabilized Discarding Sabot - Tracer
105mm	M156	High Explosive Squash Head
105mm	M413	Armor Piercing Fin Stabilized Discarding Sabot - Tracer
105mm	M152/3	High Explosive Anti-Tank - Tracer
105mm	M426	Armor Piercing Fin Stabilized Discarding Sabot - Tracer
105mm	CL-274	Target Practice Fin Stabilized Discarding Sabot - Tracer
105mm	CL-3234	Target Practice Fin Stabilized Discarding Sabot - Tracer
105mm	APAM	High Explosive Dual Purpose (submunition dispensing)
120mm	Unknown	Armor Piercing Fin Stabilized Discarding Sabot - Tracer
120mm	CL-3105 (M325)	High Explosive Anti-Tank
120mm	CL-3139 (M324)	Target Practice Fin Stabilized Discarding Sabot - Tracer
120mm	Unknown	High Explosive - Tracer
125mm	CL-3254 (M711)	Armor Piercing Fin Stabilized Discarding Sabot - Tracer
140(?)mm	Unknown	Armor Piercing Fin Stabilized Discarding Sabot - Tracer

Manufacturer - Poongsan Defense

90mm	KM71	High Explosive
90mm	K241	Armor Piercing Fin Stabilized Discarding Sabot
90mm	KM353A2	Target Practice - Tracer
90mm	M431A2	High Explosive Anti-Tank - Tracer
90mm	M835	Armor Piercing Fin Stabilized Discarding Sabot
105mm	KM456A1	High Explosive
105mm	KM456A2	High Explosive Anti-Tank - Tracer
105mm	K270	Armor Piercing Fin Stabilized Discarding Sabot - Tracer
105mm	K273	Armor Piercing Fin Stabilized Discarding Sabot - Tracer
105mm	K490	Target Practice - Tracer

Manufacturer - Singapore Technologies Kinetics Ltd

75mm	Unknown	Armor Piercing Fin Stabilized Discarding Sabot - Tracer
75mm	Obus Explosif	High Explosive
75mm	FUM-PH	White Phosphorous Smoke
75mm	POT-PCOT	Armor Piercing
75mm	Unknown	Armor Piercing Fin Stabilized Discarding Sabot
75mm	Unknown	Canister
76.2mm	Unknown	Armor Piercing Fin Stabilized Discarding Sabot - Tracer

Tank Gun Ammunition

<u>Caliber</u>	<u>Designation</u>	<u>Type</u>
<u>Manufacturer - General Dynamics Ordnance and Tactical Systems Canada (SNC Technologies Inc)</u>		
76.2mm	L29	High Explosive Squash Head
76.2mm	C-69	Squash Head Practice
105mm	FP105/C-76	Armor Piercing Fin Stabilized Discarding Sabot - Tracer
105mm	M1A4	Blank
105mm	C-62	Spinning Tubular Projectile - Tracer
105mm	C-71	Target Practice Fin Stabilized Discarding Sabot
105mm	C-72	Squash Head Practice
105mm	C-74	Target Practice Discarding Sabot - Tracer
105mm	C-76	Armor Piercing Fin Stabilized Discarding Sabot - Tracer
105mm	C-127	Armor Piercing Fin Stabilized Discarding Sabot - Tracer
105mm	C-148	Target Practice Discarding Sabot - Tracer

United States

<u>Designation</u>	<u>Caliber</u>	<u>Type</u>	<u>Remarks</u>
M968	35mm	PRAC	Subcaliber practice round
M319	76mm	HVAP-T	
M320	76mm	TP-T	Training equivalent for M319
M331A1	76mm	HVAP-DS-T	
M331A2	76mm	HVAP-DS-T	
M339	76mm	AP-T	
M340	76mm	TP	Training equivalent for M339
M340A1	76mm	TP	Training equivalent for M339
M352	76mm	HE	
M355A2	76mm	Blank	Cartridge only
M361	76mm	Smoke WP	
M361A1	76mm	Smoke WP	
M363	76mm	Canister	
M464	76mm	APFSDS-T	Private development; used by Denmark
M496	76mm	HEAT-T	
M12	90mm	Dummy	
M71	90mm	HE	
M71A1	90mm	HE-T	
M77	90mm	AP-T	
M82	90mm	APC-T	
M313	90mm	Smoke WP	
M313C	90mm	Smoke WP	
M318	90mm	AP-T	
M318A1	90mm	AP-T	
M332A1	90mm	HVAP-T	
M336	90mm	Canister	
M348	90mm	HEAT	
M348A1	90mm	HEAT	
M353	90mm	TP-T	
M377	90mm	Canister	
M394	90mm	Blank	Cartridge only
M580	90mm	APERS-T	
M392	105mm	APDS-T	British manufacture
M392A2	105mm	APDS-T	U.S. manufacture
M393	105mm	HEP-T	
M393A1	105mm	TP-T	
M393A3	105mm	HEP-T	
M416	105mm	Smoke WP-T	
M431	105mm	HEAT-T	
M456	105mm	HEAT-T	
M456A2	105mm	HEAT-MP-T	
M457	105mm	Dummy	

Tank Gun Ammunition

<u>Designation</u>	<u>Caliber</u>	<u>Type</u>	<u>Remarks</u>
M467A1	105mm	HEP-TP	
M489	105mm	TP-T	
M490	105mm	TP-T	
M490A1	105mm	TP-T	
M494	105mm	APERS-T	
M724	105mm	TPDS-T	British manufacture
M724A1E1	105mm	TPDS-T	U.S. manufacture
M728	105mm	APDS-T	
M735	105mm	APFSDS-T	Licensed in Japan by Daikin Industries
M737	105mm	TPDS-T	
M774	105mm	APFSDS-T	Replaced M735 in production
M833	105mm	APFSDS-T	
XM872	105mm	KE	Rocket-assisted round; in development
M900	105mm	APFSDS-T	
M901	105mm	TPCSDS-T	
M829	120mm	APFSDS-T	
M829A1	120mm	APFSDS-T	
M829A2	120mm	APFSDS-T	Developed version of the M829A1
M829A4	120mm	APFSDS-T	Further developed version of the M829A2
M830	120mm	HEAT-MP-T	U.S. version of German DM12A1
M830A1	120mm	HEAT-MP-T	Developed version of the M830
M831 Series	120mm	HEAT-TP-T	
XM832	120mm	TPFSDS-T	
XM859	120mm	HEAT-MP-T	
M865	120mm	TPCSDS-T	U.S. version of the German DM38
M866	120mm	TPFSDS-T	
XM908	120mm	HEDP	Provides a "secondary capability" for the M1 Abrams
XM943	120mm	HEAT	Smart Target Activated Fire and Forget (STAFF)
M1002	120mm	TP-T	
XM1007	120mm	APFS	Rocket-boosted and guided (TERM, formerly X-ROD)
M1028	120mm	Canister	Provides anti-personnel "secondary capability" for M1 Abrams
XM1111	120mm	Unspecified	Mid-Range Munition (guided dual-mode munition)
XM1147	120mm	HEMP-T	
M409	152mm	HEAT-MP-T	
M411	152mm	TP-T	
M579	152mm	APFSDS-T	
M596	152mm	Dummy	
M625A1	152mm	Canister	
M657	152mm	HE-T	

Tank Gun Ammunition



120mm M829A3 APFSDS-T Round for the M1A2 Abrams Main Battle Tank

Source: U.S. Department of Defense

Variants/Upgrades

Variants. Not generally applicable. To achieve the highest degree of product differentiation, the contractors usually give upgraded or modified tank gun munitions new designations.

Modernization and Retrofit Overview. Not generally applicable. Contractors usually integrate enhancements of a specific munition as production cut-ins.

Program Review

Background. Tank gun ammunition facilitates the primary mission of the main battle tank: to destroy enemy tanks. To this end, the various ammunition-producing organizations have developed a variety of chemical (high explosive) and kinetic energy (armor piercing) munitions. Tank gun munitions must also be capable of providing direct-fire support against secondary unarmored targets and enemy personnel.

Organizations continue to develop increasingly sophisticated munitions to enhance the performance of existing tank armament.

Europe

Note: *Throughout this report, repeated references are made to the Krauss-Maffei Wegmann Leopard 2 main battle tank and its Rheinmetall Defence 120mm Rh 120 main gun.*

Rh 120: Industry Standard

The Rh 120 is clearly becoming the international industry standard for 120mm smoothbore tank gun technology. For more information on the Rh 120 and its impact on the international market, see Forecast

International's "Rh 120/M256 120mm Tank Gun" report. Also of interest in terms of this topic is the "Leopard 2" report in FI's *Military Vehicles Forecast*.

The following European organizations are currently the most active in the tank gun ammunition market:

Belgium

MECAR SA. This firm produces a vast range of 90mm tank gun ammunition for use with its 90/28 Light Gun system, the KEnerga 90/46, and the Cockerill series (Mk II, III, and VII) of tank guns. In 1987, MECAR secured a contract worth more than \$100 million to supply ammunition to an undisclosed Asian country (apparently Pakistan) for use with its T-54/T-55/Type 59 and M47/M48 tanks. MECAR also secured a major 1999 contract with a Middle Eastern customer (reportedly Saudi Arabia) for 90mm ammunition.

Among at least five similar contracts, the U.S. Army awarded MECAR a Foreign Military Sales contract worth \$130 million in March 2002 to supply Saudi Arabia with tank munitions. This represented the largest single contract in the firm's history.

Tank Gun Ammunition

MECAR Enters 120mm M1080 Market

MECAR entered the 120mm market segment in the 1990s with the introduction of its M1080 Armor Piercing Fin Stabilized Discarding Sabot (APFSDS) round, featuring an advanced-design tungsten penetrator. In 1995, the firm began development of an enhanced version of the M1080. The round became available in 1999.

France

Nexter Munitions. The Giat Industries Etablissement d'Etudes et de Fabrications d'Armement à Bourges facility developed the French Army's 120mm CN-120 Lisse tank gun and its advanced ammunition, albeit with some German assistance. In addition, the contractor has developed enhanced 90mm and 105mm rounds.

105mm Excalibur Introduced

One of the contractor's 105mm Armor Piercing Fin Stabilized Discarding Sabot-Tracer (APFSDS-T) rounds is the Excalibur, produced under a joint program with Primex Technologies (now General Dynamics) and RO Defence (now a component of BAE Systems). The contractors claim the Excalibur exhibits performance equivalent to that of first-generation 120mm penetrator rounds. While the contractor manufactures its products primarily for the French Ministry of Defense, the firm actively pursues export contracts for its tank guns and ammunition.

120mm OFL 120 E2

Another recent development is the 120mm OFL 120 E2 APFSDS round for the CN-120 Lisse gun of the Leclerc tank. Flying in the face of European environmental concerns, this new round features a depleted uranium (DU) penetrator. A similar 105mm round, the OFL 105 E2, is in advanced development.

120mm POLY-NG Introduced

The contractor has long been involved in the development of 105mm and 120mm guided tank munitions. The contractor's 120mm anti-helicopter round (a proximity-fuzed fragmentation munition) has reportedly reached an advanced stage of development. In 2002, Giat revealed that it was developing the 120mm POLY-NG, a sensor-fuzed round with an advanced-design shaped-charge warhead (designated CGN 3-D). The POLY-NG will supposedly be capable of tank-kills out to 8,000 meters (8,749 yd). At present, the status of the POLY-NG program remains unclear. Another new round is an impact-fuzed 120mm High Explosive round, optimized for use in urban operations.

Corporate Restructuring

In October 2006, Giat Industries approved a reorganization and an associated name change to Nexter. Under the restructuring, the group was organized into four core operations:

- Nexter Systems
- Nexter Munitions
- Nexter Electronics
- Nexter Mechanics

The move reportedly better prepared the firm for consolidation with another corporate entity.

In 2015, Krauss-Maffei Wegmann and Nexter signed an agreement on a merger plan.

As part of the process, the two companies contributed their shares to a newly incorporated joint holding company based in the Netherlands. They each received 50 percent of the shares of this company, which became the sole shareholder in KMW and Nexter. The merger of KMW and Nexter was completed in January 2016.

The newly merged firm is the third-largest land defense contractor in the world, behind General Dynamics and BAE Systems. Ownership is split between the French government's Giat Industries holding company and KMW parent the Wegmann Group (controlled by Germany's Bode family). At time of merger, the single entity employed around 6,000 people and had an order book of approximately EUR9 billion (\$9.9 billion), with turnover of around EUR2 billion.

Luchoire. Before it became a subsidiary of Giat Industries, Luchoire produced a range of 75mm, 90mm, and 105mm tank gun ammunition, principally for the AMX-13 light tank. Because the AMX-13 remains popular outside Europe, Nexter Munitions continues to offer the Luchoire product line for export.

Germany

In 1999, Krauss-Maffei Wegmann and Diehl Stiftung teamed up with the Russian KBP Instrument Design Bureau to develop the Spear, a 105mm anti-tank guided missile compatible with the L7, Rh 105, and M68 tank guns.

Leveraging Russian Technology

Based on the technology of the Russian 9M117M tandem-warhead guided missile system, the Spear features an effective range of 5,500 meters (6,014.8 yd). The Spear team plans to offer the system as a depot-level retrofit package. Development is ongoing. The contractors have successfully test-fired a number of Spear rounds.

Tank Gun Ammunition

Diehl BGT Defence GmbH & Co KG. The Ordnance Division of the Diehl Group has designed, developed, and produced tank gun ammunition since the late 1950s. The Diehl DM13 was the first kinetic energy round fielded for the 105mm Rh 105 tank gun. The DM33 has become the standard 105mm round. Diehl has also developed a newer 105mm APFSDS-T round, based on the Israeli M426. This munition has yet to achieve significant sales.

105mm DM148 Developed

In conjunction with Israel Military Industries, Diehl has developed the 105mm Target Practice Fin Stabilized Discarding Sabot-Tracer (TPFSDS-T) round. This round is currently in production by Diehl (as the DM148) and IMI (as the CL-274).

Rheinmetall Defence. Rheinmetall Defence produces 105mm and 120mm operational ("hot" or warload) and target practice ammunition.

105mm DM128 and 120mm DM38

The kinetic energy target practice ammunition employs Rheinmetall's Lochkegelleitwerk ballistic principle, featuring a cone base pierced by holes that produce significant drag after a range of about 2,000 meters. Rheinmetall offers both 105mm (DM128) and 120mm (DM38) versions of this target practice round.

This product has proven particularly successful for the contractor. In 1986, the German Army (Bundeswehr) awarded Rheinmetall a contract worth DEM134 million for 135,000 rounds. Additional large orders have followed.

120mm DM12A1 Provided to Bundeswehr

Rheinmetall has also provided the Bundeswehr with a large quantity of the 120mm DM12A1 High Explosive Anti-Tank - Tracer (HEAT-T) round and the equivalent training round, the DM18.

U.S. Procurement

The U.S. Department of Defense has adopted several Rheinmetall 120mm tank munitions, with U.S. contractors producing the munitions under license.

LKE Program Launched

Rheinmetall's development and production of 120mm penetrating munitions coincided with the development and fielding of its 120mm Rh 120 tank gun. More recently, Rheinmetall teamed with Giat Industries (now operating as Nexter Munitions) to develop two new penetrating rounds for the Rh 120 and CN-120 "Lisse" tank guns. The overall program operates under the Leistungsgesteigerte Kinetische Energie (LKE) title.

The first stage of this program yielded the DM43, or LKE I. Although the Bundeswehr declined to adopt this round, the French Army has procured it under the designation OFL 120 FA. Also, China North Industries (NORINCO) is marketing what is apparently an unlicensed direct copy of the DM43.

Rather than adopt the DM43, the Bundeswehr waited for the fourth-generation munition, the DM53 APFSDS-T round (also known as the LKE II), to reach production. The DM53 is optimized for employment with the newer Rh 120/55 tank gun. From this armament, the DM53 can achieve a muzzle velocity of 1,752 meters (5,747.96 ft) per second, making this gun/round combination the most potent anti-armor weapon on Earth. The Netherlands and Switzerland also produce the DM53 under license.

Rheinmetall Defence has developed a new 120mm High Explosive Fragmentation (HE-Frag) round for the Leopard 2 main battle tank, responding to interest in such a round from the German and Dutch governments. Operational tests began in 2002.

Greece

Hellenic Defence Systems (EAS) SA. This firm operates three main production facilities (in Hymettus, Lavrion, and Elefsis) for the production of 75mm, 90mm, and 105mm tank gun munitions, primarily for domestic procurement. Hellenic Arms Industry SA (EBO) also enjoys moderate export sales of its tank gun munitions.

Feeding the Leopard 2 HEL

With Greece's selection of the Leopard 2 main battle tank, we expect EAS to initiate licensed production of 120mm ammunition. The contractor is seeking an international partner to produce the ammunition. Greece will need 35,000 APFSDS-T rounds over the next several years. The requirement for training rounds will be even higher.

Corporate Evolution

In 2004, EBO merged with Greek Powder & Cartridge Company SA (PYRKAL) to form Hellenic Defence Systems (EAS) SA. However, the more familiar EBO brand name is still in common use throughout the European market.

Italy

Despite its long-standing domestic production capability, Italy has imported large quantities of tank gun ammunition from France, Germany, the Netherlands, Spain, and the United States. In July 2002, Italy announced that it would procure 2,700 CL-3143 APFSDS-T rounds and 2,100 CL-3105 HEAT-T rounds from Israel Military Industries. In late 2002, Italy issued

Tank Gun Ammunition

a requirement for 6,000 rounds of 120mm Target Practice-Tracer (TP-T) rounds. Diehl, Nexter Munitions, IMI, Poongsan, and Rheinmetall were on Italy's short list to address the requirement.

Fiat SpA - BPD Difesa e Spazio. This Fiat subsidiary runs several fully integrated facilities for the production of a wide range of ammunition. The firm also operates extensive research and development facilities.

Licensed Production

BPD Difesa e Spazio has produced U.S.-pattern 90mm ammunition for the now-retired M47 and M48 Patton tanks, as well as 105mm ammunition for the Leopard 1 and M60 tanks.

Fiat SpA - Simmel Difesa. Another subsidiary of Fiat, this firm has long produced tank gun ammunition, mainly for domestic use. Recent information suggests that Simmel Difesa has acquired the tank gun ammunition business of BPD Difesa e Spazio. Simmel Difesa has a history of acquiring tank gun ammunition components from other sources, such as Chamberlain and Rheinmetall.

Netherlands

Eurometaal Holding NV. Now operating as a component of Rheinmetall Defence, this Dutch contractor produces a wide variety of tank ammunition, mostly under license from the U.S. and Germany. In the past, Eurometaal produced the U.S.-pattern 90mm M353A1 TP-T round. The firm's production emphasis, however, has been on a variety of 105mm munitions (APDS, APFSDS, HESH, TP-T) for the L7 and M68 guns, as well as HE and TP-T rounds for the CN-105/57 gun of the AMX-13.

Licensed 120mm DM53

Eurometaal also held a license from Rheinmetall (prior to its acquisition by that German firm) for the production of all types of 120mm ammunition for the Rh 120 tank gun. In 1998, Eurometaal reached an industrial agreement with (then) Rheinmetall DeTec for licensed production of the formidable 120mm DM53 APFSDS-T round. Production began in 2001.

Russian Federation

FSUE Rosoboronexport. As the Russian defense industry continues its evolution from a state-run organization to a system of private and semi-private entities, Rosoboronexport acts as the primary conduit between the Russian defense industry and the international market. Thus, all Russian defense contractors effectively operate under the auspices of Rosoboronexport.

Old and New

The Russian State Factories have been concentrating on the production of several types of 125mm tank gun rounds. However, vast stocks of 76.2mm, 85mm, 100mm, and 115mm tank munitions remain available.

Eye on Export Sales

As the Russian Federation has long been in desperate need of cash revenue, strong efforts to export tank gun ammunition were the norm. These efforts paid off back in 1996, with a sale of 25,000 125mm APFSDS rounds to India. With the Indian selection of the T-90 tank, additional sales of this ammunition are fairly certain.

However, current combat requirements in Ukraine are reportedly overwhelming Russian munitions producers, to the extent that Russia is being forced to seek alternate and supplemental sources of war materiel.

In the long term, the Russian Federation is developing larger (140mm) tank guns. The Russian Army may begin fielding a 140mm tank gun by the end of the forecast period – depending, of course, on the health of Russia's Ministry of Defense budget.

Spain

In 1999, Spain began to rationalize its long-diverse tank inventory by procuring the Krauss-Maffei Leopard 2. With this procurement, Spain no longer needed to import large quantities of 90mm and 105mm tank gun ammunition from France, Germany, and the United States. Further, the procurement of the Leopard 2 provided long-absent impetus to indigenous Spanish munitions production.

General Dynamics Santa Barbara Sistemas. Since 2001, Santa Barbara Sistemas has been a subsidiary of General Dynamics. A component of General Dynamics European Combat Land Systems, GD-SBS continues as-needed production of French-pattern 105mm ammunition for the CN-105-F1 gun on the Spanish Army's remaining AMX-30 tanks.

Supporting the Leopard 2A5

In December 1998, SBS secured a license-production agreement worth \$2.23 billion with Krauss-Maffei Wegmann for Spanish production of 219 Leopard 2A5 main battle tanks. Service deliveries under this contract began in January 2003. The Forecast International Weapons Group believes General Dynamics Santa Barbara Sistemas may have begun licensed production of Rheinmetall 120mm ammunition (including possibly the DM53 munition) to support the Spanish Leopard 2A5 force.

Tank Gun Ammunition

United Kingdom

BAE Systems Land & Armaments. RO Defence (formerly Royal Ordnance) is a component of BAE Systems (formerly British Aerospace). The firm produces proprietary 76mm, 90mm, 105mm, and 120mm rifled tank gun munitions. In addition, BAE Systems produces Cockerill 90mm tank gun ammunition under license on an as-needed basis.

Eye to Increasing Export Share

Although much of the former RO Defence production served British Army requirements, BAE Systems is constantly striving to increase its export market share. In 1987, RO Defence demonstrated a new 105mm APFSDS round (the H6/62) as a replacement for the L64 round. The round is compatible with the L7 gun and the French F1 gun. While BAE Systems never released any details, RO reportedly enjoyed significant sales through the 1990s.

In August 1998, RO Defence introduced a new line of 105mm ammunition to delegates from 15 countries. BAE Systems continues to keep the details of this 105mm line under tight security. Research indicates the munitions do not include depleted uranium in any form, as such rounds would have virtually no export potential. Another new 105mm APFSDS-T round is the Excalibur, developed in conjunction with Primex Technologies (now General Dynamics) and Giat Industries.

British Army's Rifled 120mm Ammunition

RO Defence was a pioneer, virtually out of necessity, in the development of 120mm rifled tank gun ammunition. The British Army adoption of the 120mm L11 rifled tank gun for the FV4034 Challenger 1 tanks effectively made the British the only major user of rifled 120mm tank guns. This trend continued with the adoption of the 120mm L30 rifled gun for the Challenger 2. The latest indigenous round for the L30 is the formidable L27 APFSDS-T round, also known as the CHARM 3.

In the late 1990s, RO Defence began private development of a new tungsten penetrator-based APFSDS-T round (the L28) to enhance the appeal of the Challenger 2 tank on the export market. By late 2001, the British Army had begun procuring the L28 round.

Going Smoothbore under CLIP

Under the Challenger Lethality Improvement Program (CLIP), the British Army has been sporadically investigating the potential for rearming the Challenger 2 with the 120mm Rheinmetall Rh 120/55 smoothbore tank gun. For a detailed discussion of this ordnance, see Forecast International's "Rh 120/M256 120mm Tank Gun" report.

This ordnance retrofit would enhance interoperability with NATO allies, who have all but universally adopted 120mm smoothbores for their tanks. The retrofit would also alleviate the problem of an increasingly limited supply of depleted-uranium rifled ammunition for the L30. Aside from the procurement of the guns, the Challenger ammunition storage and handling equipment would require modification to accept the fixed 120mm smoothbore ammunition. The latest estimate of the cost to regun the entire inventory of British Army tanks is GBP250 million (\$386 million).

March Toward NATO Standard

In 2005, BAE Systems and Rheinmetall completed initial static test-firings of an Rh 120/55 – known within this program as the "L55 Hybrid" – on a modified Centurion chassis at the Rheinmetall test range in Germany. In early 2006, the contractors integrated the Rh 120/55 with a Challenger 2 in the U.K. for the next round of tests. Evaluations and test-firings under the Smoothbore Option Technical Demonstrator Program (SOTDP) were completed by mid-2006.

Clinging to Hope

In October 2012, the MoD launched a concept phase to determine the scope of a Challenger 2 Life Extension Program. The original intent of the LEP was to upgrade the 227 remaining active Challenger 2 tanks by 2020, at a projected cost of GBP500 million (\$802 million).

The primary focus of the LEP is reportedly to deal with "obsolescence issues" concerning the Challenger 2's fire control system and electronic architecture in order to keep the remaining active Challenger 2s in service through 2035.

Challenger 3 Upgrade

On May 7, 2021, the MoD awarded Rheinmetall BAE Systems Land a \$1 billion contract to upgrade 148 Challenger 2 tanks to the Challenger 3 configuration. A major element of the Challenger 3 upgrade is the long-overdue integration of the 120mm Rheinmetall Rh 120/55 smoothbore tank gun, replacing the 120mm L11A5 rifled tank cannon as its main armament.

New Gun, New Ammo

With the Challenger 3 upgrade, BAE Systems will likely engage in licensed production of Rheinmetall 120mm tank gun munitions.

We believe the export users of the Challenger 2 (notably Jordan and Oman) would eagerly follow suit by integrating 120mm smoothbore main guns on their existing tanks. With this transformation, BAE Systems would likely scale down its production of older, rifled

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munitions in order to concentrate on the 120mm smoothbore munitions market.

International

The following organizations are currently the most active non-U.S. and non-European players in the international tank gun ammunition market:

AFRICA

Republic of South Africa

Denel SOC Ltd. In the 1990s, Denel became the umbrella organization for the manufacturing operations of the government-owned ARMSCOR organization.

105mm Oliphant Ammunition

Denel produces ammunition for the indigenous version of the British 105mm L7 tank gun, which the South African National Defence Force (SANDF) mounts on its Centurion/Oliphant tanks. Denel ordnance is reportedly compatible with U.S. and British munitions for the M68 and L7 tank guns. However, Denel produces its own munitions, primarily for domestic requirements and possibly some limited export sales.

76.2mm Rooikat Ammunition

Denel also produces 76.2mm ammunition for the SANDF Rooikat wheeled tank destroyer. This rather unique munition features a combustible cartridge case with a stub brass base. In 2001, Denel abandoned its depleted uranium penetrator program for 76.2mm and 105mm rounds, adopting tungsten-core penetrators instead. Beginning in the late 1970s, Denel produced as many as 2,100 DU rounds before abandoning the program.

120mm on the Horizon?

The SANDF has been exploring its options for procurement of a new main battle tank mounting a 120mm gun. If the SANDF ultimately fields such a tank, Denel would likely begin producing 120mm munitions (probably under license, at least initially) by the end of the forecast period.

Now that the Republic of South Africa is no longer restricted by U.N. sanctions, Denel is actively promoting its products on the international market.

ASIA

People's Republic of China

China North Industries Corporation (NORINCO). In the early 1980s, the PRC began incorporating Western manufacturing technology into its Soviet-inspired military-industrial complex. By the late 1980s, the PRC had begun serial production of Western-pattern 105mm penetrator ammunition for its indigenous

105mm tank gun. The 105-I is the standard 105mm kinetic energy round; the 105-II features a longer penetrator.

Into the 120mm Market

By the early 1990s, the PRC had reportedly begun production of a Western-pattern 120mm tank gun munition – allegedly an unlicensed copy of the Rheinmetall DM43 APFSDS-T round – for a new Chinese tank destroyer. The original 120-I and the improved 120-II are compatible with various Western-pattern 120mm smoothbore tank guns.

Through NORINCO, the international marketing agency for Chinese-manufactured ammunition, the People's Republic of China now offers a full line of Russian- and Western-pattern tank gun ammunition.

Republic of Korea

Daewoo Ammunition Corporation. Among its other products, Daewoo produces tank ammunition in two calibers.

The 90mm patterns are the indigenous K241 APFSDS and M431A2 HEAT rounds. The 105mm types are the K270 and K273 APFSDS-T rounds and the M456A1 HEAT round.

Licensed 120mm Production?

The Republic of Korea is now fielding a version of the Type 88 main battle tank (the K1A1) with a license-produced version of the U.S. 120mm M256 smoothbore tank gun (itself a license-produced version of the Rheinmetall Rh 120/44). We believe Daewoo will begin producing 120mm ammunition of German, U.S., or indigenous design within the forecast period.

Poongsan Defense. Poongsan produces seven types of tank ammunition, four of which are produced under license from the United States.

Line Similar to Daewoo

For the 90mm M36 and M41 guns, the firm produces M431A2 HEAT and M835 APFSDS ammunition. Poongsan also produces its indigenously developed 90mm K241 APFSDS round.

For 105mm L7 and M68 tank guns, Poongsan produces the M456A1 HEAT round, as well as the indigenously developed K270 and K273 APFSDS-T rounds. The K270 and K273 munitions (also products of Daewoo) are reputedly equal to the best available 105mm tank gun munitions.

Targeting the Export Market

Beyond domestic requirements, Poongsan is targeting the export market. The large remaining inventories of

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U.S.-pattern tanks equipped with 105mm M68 and 90mm M36/41/54 tank guns ensure the firm's ammunition will have a market throughout the forecast period. However, the Republic of Korea is no longer the only nation in the region capable of producing tank gun ammunition for this ordnance at competitive prices.

For the K1A1 main battle tank armed with a 120mm/44 caliber smoothbore gun, Poongsan is producing at least two types of 120mm ammunition with a semi-combustible cartridge case, the K276 and K277.

Singapore

Singapore Technologies Kinetics Ltd. Since securing a license to produce French-pattern ammunition for the AMX-13 tank, Chartered Industries of Singapore (which now operates as Singapore Technologies Kinetics Ltd) has increased its development in this area. ST-K has developed its own canister round and an APFSDS round for the 75mm M50 gun. In addition to meeting domestic requirements, ST-K offers its tank gun ammunition on the open market, albeit without any reported success thus far.

AUSTRALIA/NEW ZEALAND

Australia

Thales Australia. Despite the precipitous decline in Australian munitions production since the mid-1990s, this contractor continues to produce tank guns, components, and ammunition. ADI Ltd has produced the British 105mm L7 tank gun, along with the complete line of 105mm ammunition for the Leopard AS1 tanks of the Royal Australian Armoured Corps. The most recent addition to the 105mm product line is the TC800 canister round, which provides protection from massed infantry attacks out to 300 meters. This indigenously developed round is particularly noteworthy for its reduced barrel wear. Australian production of tank gun ammunition remains for domestic procurement only.

Corporate Evolution

In 1999, the joint venture team of Transfield and Thomson-CSF (now Thales) purchased ADI. In October 2006, the Thales Group (Paris, France) acquired ADI Ltd, the prime Australian contractor for small arms. The contractor now operates as Thales Australia.

Supplying the M1A1 Abrams?

Future market possibilities include production of 120mm munitions to support acquisition by the Australian Ministry of Defence of 59 refurbished M1A1 AIM Abrams main battle tanks from surplus U.S. stocks. Because the M1A1 Abrams mounts the M256 main armament (a license-produced version of the

Rheinmetall Rh 120/44), this is likely. Thales Australia sought a licensing agreement for Rheinmetall's line of 120mm ammunition.

MIDDLE EAST & NORTH AFRICA

Egypt

Heliopolis Company for Chemical Industries. In the early 1990s, Heliopolis achieved the aim of the National Organization for Military Production of attaining some level of self-sufficiency by using technology acquired from the former Soviet Union and the United Kingdom.

Heliopolis secured its first export orders for its Russian-pattern munitions during the 1985 and 1987 Cairo Defense Expositions. Although reverse-engineered copies of Russian designs, Heliopolis munitions are technically comparable to Russian or Chinese products.

Regional Advantage

Heliopolis enjoys an advantageous position in at least the regional export market for Russian- and Chinese-pattern tank gun ammunition. The firm's 115mm BD/36-2 APFSDS-T round, developed with the aid of RO Defence (now a component of BAE Systems), may be especially promising in this market.

Egypt's acquisition of M60 tanks and its ongoing coproduction of M1A1 Abrams main battle tanks create a significant domestic demand for U.S.-pattern 105mm and 120mm tank gun ammunition. The Forecast International Weapons Group expects Heliopolis will expand its licensed production of 105mm and 120mm munitions to meet this requirement.

Israel

Israel Military Industries Ltd (IMI). This government-owned firm currently produces APFSDS ammunition in six calibers. IMI also produces British- and French-pattern 90mm and 105mm munitions under license on an as-needed basis. For an enumeration of IMI tank gun munitions, see the **Technical Data** section of this report.

Export and Licensing

Beyond meeting the domestic requirements of the Israel Defense Forces, IMI serves moderate export commitments. The firm has granted production licenses to Diehl and RUAG, while continuing to explore other markets. Diehl produces the IMI 105mm CL-274 TPFSDS-T round under license as the DM148. The German Bundeswehr type-classified IMI's 105mm M426 APFSDS-T round as the DM63.

The APAM Round

Perhaps the most interesting recent IMI development is the Anti-Personnel/Anti-Materiel round, called APAM.

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Still highly classified, this round dispenses six submunitions. In the late 1990s, General Dynamics and IMI agreed to cooperate in the further development and marketing of the APAM round, to include a 120mm version.

Following its selection of the Leopard 2 as its next tank, Sweden ordered the majority of its 120mm APFSDS ammunition from IMI. More recently, IMI cooperated with Bofors LIAB (now a component of BAE Systems) to develop and produce a new 120mm High Explosive-Tracer (HE-T) round for Sweden's Leopard 2 tanks.

In the late 1980s, IMI entered the market for Russian-pattern 125mm tank gun ammunition. The CL-3254 APFSDS-T round, also known as the M711, is available for export.

NORTH AMERICA

Canada

General Dynamics OTS Canada. SNC Technologies Inc now operates under the General Dynamics corporate umbrella, as a component of General Dynamics Ordnance and Tactical Systems.

Licensed Production

This Canadian contractor is the designated manufacturer of the majority of Canada's 76.2mm and 105mm tank gun ammunition. Though most production occurs under license from BAE Systems (formerly RO Defence), SNC TEC also produces the General Dynamics 105mm FP105 APFSDS-T round under license as the C-76.

Indigenous Development

The contractor has also been pursuing its own munitions development program. The C-71 is an indigenous training round that is equivalent to the C-76. The C-148 is a newer training round, replicating APFSDS-T rounds out to 2,500 meters (2,734 yd). In conjunction with Primex, the contractor has also developed the C-127 as a follow-on to the FP105/C-76.

SOUTH AMERICA

Brazil

Brazil's entire ammunition-production industry has been in turmoil over the past two decades. Brazil's acquisition of more modern Leopard 1 and M60 tanks, both with 105mm main armament, may lead to some stability.

Industria de Material Belico do Brazil (IMBEL). The old IMBEL became a subsidiary of the Engenheiros Especializados organization, under the trading title of Engesa Quimica. The parent Engenheiros Especializados organization experienced economic troubles and ceased operations in 1993. However, the

production facilities and stocks of 90mm tank gun munitions (under the IMBEL name) remain available for both domestic and export sales.

United States

With the adoption of the M1 series Abrams main battle tank by the U.S. Army and U.S. Marine Corps, U.S. tank gun ammunition procurement has been generally limited to munitions compatible with the 120mm M256 smoothbore tank gun.

Further, changing threat scenarios have led to the requirement for a 120mm M256 with a "secondary capability" in terms of both anti-personnel and bunker busting rounds. The development of several new anti-personnel (canister) and High Explosive Dual Purpose (HEDP) rounds began in 1999. In addition, development of several smart 120mm munitions (such as the XM943 STAFF round and the Mid-Range Munition) has been ongoing.

Rise and Fall of the Stryker MGS

On December 2, 2004, the U.S. Army Tank-automotive and Armaments Command (TACOM) awarded General Dynamics Land Systems a contract modification placing the 105mm Stryker Mobile Gun System into low-rate initial production (LRIP). In February 2008, the Defense Acquisition Board approved full-rate production of the M1128 Stryker MGS. The U.S. Army intended to procure 193 Stryker Mobile Gun Systems, at a final cost of approximately \$4.3 million per vehicle.

On December 14, 2005, GDLS delivered the first two of 72 LRIP Stryker MGS to the U.S. Army for test and evaluation. In mid-2007, the Stryker MGS made its combat debut in Iraq, with the 4th Stryker Brigade Combat Team (SBCT), 2nd Infantry Division.

Concurrent with the development of the M1128 Stryker MGS, the U.S. Department of Defense began procuring 105mm tank gun munitions in FY02, after a hiatus of nearly a decade. The Stryker MGS mounts the 105mm M68A1E1 gun.

In May 2021, the U.S. Army announced its intention to divest all Stryker MGS by the end of FY22. This decision came after a comprehensive analysis highlighted obsolescence and systemic issues with the system's dated cannon and automatic loader.

Enter the M10 Booker

On June 28, 2022, the U.S. Army Contracting Command awarded General Dynamics Land System Inc. a \$320,325,338 contract modification (P00050) for low-rate initial production and system technical services for the Mobile Protected Firepower system. According to U.S. Army budget request documentation, Mobile

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Protected Firepower Procurement funding supports production and fielding of the MPF system, which will provide the Army's Infantry Brigade Combat Teams (IBCTs) a protected, long-range, precision direct-fire capability to ensure freedom of movement during offensive operations and defeat an attacking enemy during defensive operations.

On June 10, 2023, the U.S. Army formally introduced the Mobile Protected Firepower system as the M10 Booker Combat Vehicle.

In FY23, the U.S. Army requested \$356.7 million in Base Procurement funding to support the production of 28 Low-Rate Initial Production MPF/M10 Booker systems. This second LRIP lot will enable an orderly production ramp-up and provide two company sets of M10 Bookers for fielding.

The Army expects delivery of the first LRIP systems in 2024 and fielding of the First Unit Equipped (FUE) battalion of 42 M10 Booker Combat Vehicles in the 4th Quarter FY25.

The M10 Booker Army Acquisition Objective (AAO) is 504 systems. The Army reportedly will spend at least \$6.6 billion for these 504 systems. Total program lifecycle costs could reach \$17 billion.

This program element is directly aligned with the Next Generation Combat Vehicle (NGCV) Line of Effort 4 Modernization Priority.

As the M10 Booker mounts the same 105mm M68A1E1 gun as the Stryker MGS, U.S. Army requirements for 105mm tank gun ammunition will now likely increase rather than decrease.

76mm & 90mm Production. Production facilities for both 76mm and 90mm tank gun munitions are still in existence, although production has long been dormant. U.S. production over the past 15 years has solely been for commercial export to countries still fielding older U.S.-designed tanks – namely, the M24 Chaffee, the M41 Walker Bulldog, and the M47 Patton, as well as the M48 through M48A3 Patton tanks.

In this report, we limit our discussion to currently available 105mm and 120mm tank gun munitions.

105mm Tank Gun Ammunition

M456A2. The M456A2 High Explosive Anti-Tank - Multipurpose-Tracer (HEAT-MP-T) round is a fixed, fin-stabilized round with a spike nose design that utilizes a nose and shoulder switch for a full-frontal impact capability.

M724. This Target Practice Discarding Sabot-Tracer (TPDS-T) round, in the A1 model, is the training round

for the M735, M735A1, M774, M833, and M900 rounds. General Dynamics Ordnance and Tactical Systems (formerly Primex Technologies) produced this munition.

M833. The M833 APFSDS-T round consists of a high length-to-diameter-ratio penetrator, supported in-bore by a saddle sabot. The M833 can defeat advanced armor targets at ranges out to 3,000 meters (3,280.8 yd). The U.S. Army type-classified this round for limited production in December 1982. The round became type-classified as standard in April 1983. With award of a production contract in FY83, the munition entered serial production at an annual rate of 7,800 rounds.

The new M833 round achieved Initial Operational Capability (IOC) in September 1983. By mid-1984, the primary and secondary contractors were delivering 10,000 rounds per month.

M900. Concurrent with the development and manufacture of the M833 round, the U.S. Army commenced development of the next generation of 105mm tank gun ammunition, based on the XM900 APFSDS-T round.

In May 1983, Congress authorized funding to begin the 105mm Tank Gun Enhancement program, a minimal-cost effort to extend the useful life of M68 series guns mounted on M60 series and early-model M1 Abrams main battle tanks. In addition to upgrades and retrofits to the tank gun itself, the U.S. Army sought the XM900 APFSDS-T round as the replacement for the M833.

By 1986, the redesigned XM900E1 round featured a DU penetrator and HELOVA propellant to improve performance. Following a series of tests by the U.S. Army Test & Evaluation Command and the Ballistic Research Laboratory, the U.S. Army required further redesign of the XM900E1 to meet armor penetration and accuracy requirements.

The U.S. Army type-classified the munition as the M900 in December 1989. Primex Technologies undertook serial production of the M900A1 round. However, the U.S. Army program to rearm all of its M1 Abrams tanks with the 120mm M256 smoothbore gun severely impacted the M900 production run. Previously manufactured M900 rounds were in storage. These rounds were later the primary anti-armor round for the Stryker MGS.

The M900 is reportedly capable of defeating all existing tanks over the frontal arc.

M901. The M901 Target Practice Cone Stabilized Discarding Sabot-Tracer (TPCSDS-T) round is the U.S. designation for the German DM128 Lochkegelleitwerk

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target practice round. Joint U.S.-German testing of the M901 during 1983-1984 led to revised and revalidated requirements for a target practice round capable of accuracy out to 3,000 meters (3,280.8 yd), essentially replicating the M900 APFSDS-T round.

As part of the October 5, 1983, licensing agreement between Rheinmetall and the U.S. government, Rheinmetall assisted the U.S. in establishing its own data package. This package incorporates standard U.S. components (steel case, M13 tracer, M14 propellant, M120 primer, and T102 liner) for cost-reduction purposes.

The U.S. Department of Defense approved type classification of the M901 in July 1986. The DoD subsequently awarded Rheinmetall a contract in September 1986 for German production of the initial 55,000 training rounds.

120mm Tank Gun Ammunition. Just as the 120mm M256 smoothbore tank gun of the M1A1/A2 Abrams main battle tank is a licensed version of the German Rheinmetall Rh 120/44 design, so too is standard U.S. 120mm tank gun ammunition based on German munitions. Honeywell (later Orbital ATK, now operating as Northrop Grumman Defense Systems) had been prime contractor for licensed production of the German ammunition. By the late 1980s, however, the U.S. Army had begun to expand its production base by bringing in additional firms. These included:

- Armtec Defense Products (combustible cases)
- General Defense, Flinchbaugh Division (metal parts)
- Nuclear Metals (depleted uranium cores)
- Valentec Kisco (metal parts)

General Defense, Flinchbaugh Division (formerly a component of Primex Technologies) now operates as a component of General Dynamics Ordnance and Tactical Systems.

M829. The U.S.-designed M829 APFSDS-T round remains the primary anti-tank round for the M256 tank gun of the M1A1/A2 Abrams main battle tank. The M829 features a DU penetrator, an aerodynamic windshield with tip, six aluminum fins, and an M13 tracer. A four-piece aluminum sabot supports the penetrator body. The cartridge consists of a combustible case sidewall with a steel stub base; it contains granular JA-2 propellant.

The M829 replaced the limited-production M827 (a derivative of the German DM13 round) as the standard 120mm anti-tank round in U.S. service. The M829 cartridge entered full-scale development in FY83. The prime contractor, Honeywell, completed the full-

scale development phase in FY84. In January 1984, the U.S. Department of Defense included the M829 in a first-year 120mm ammunition production contract, supporting the initial fielding of the M1A1 Abrams tank. After M1A1 operational tests, the U.S. Army type-classified the M829 as standard in November 1984. Deliveries of the M829 began in September 1985.

The U.S. Army awarded the M829 production contract to Alliant Techsystems. Subsequently, Alliant Techsystems awarded the component contracts to subcontractors. This was the first time the U.S. Army did not award the individual subcontracts.

The M829A1 and M829A2 were improved versions of the M829. During Operation Desert Storm (1991), the M829A2 earned the nickname "Silver Bullet" for its performance against Iraqi armor. The M829A2 exhibited an enhanced design, with a DU penetrator that weighed only 9 kilograms (19.8 lb). This enhanced design, combined with the use of JA-2 solventless propellant, yielded a round with significantly improved performance. Both ATK and Primex Technologies produced the M829A1 round on a competitive basis; Primex was the sole producer of the M829A2.

In August 1998, in what was a major blow to Primex Technologies, Alliant Techsystems won the \$30 million contract for engineering and manufacturing development (EMD) of the latest version of the M829 tank round, the M829A3. This round is replacing the earlier M829A1 and M829A2 rounds as the primary U.S. anti-armor tank gun munition. In this latest version, the parasitic weight of the M829 sabot is 20 percent lighter; muzzle velocity is 10 percent greater, up to 1,730 meters per second (5,675.8 ft/sec) from a standard M256 barrel.

Alliant Techsystems conducted EMD of the new round. The M829A3 is now in serial production.

M830. The M830 HEAT-MP-T round evolved directly from the German DM12A1 design, in use by the German Bundeswehr in the Leopard 2 main battle tank. The M830 is a fixed, fin-stabilized, chemical energy, multipurpose round with an anti-armor and anti-personnel capability. A steel spike provides standoff capability. The round also employs a nose and shoulder switch for full frontal, area-impact capability. A point-initiating, base-detonating fuze mounts at the rear of the projectile body. The propellant system features a steel stub case with a rubber seal at the mouth, and a combustible wall that encapsulates the propellant.

The M830 differs from its German counterpart primarily in the composition of its explosive charge. The German DM12A1 uses R8151 explosive (94.5 percent cyclonite, 4.5 percent wax, and 1 percent

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graphite). After evaluations, the U.S. Army found the R8151 unsuitable for its requirements. Instead, the Army adopted Composition A3 Type II (consisting of 91 percent cyclonite and 9 percent polyethylene).

The M830 successfully completed the development and Test II phase in early 1984. M1A1 operational testing took place in November 1984. Delivery of the M830 began during the first quarter of FY86. The contractor delivered a total of 1,333 cartridges under the initial contract.

The current production-standard M830A1 is an improved version of the M830. Also known as the Multipurpose Anti-Tank (MPAT) round, the M830A1 offers improved performance against a variety of targets. In fact, the contractor originally designed the M830A1 as an anti-helicopter round, with a secondary capability against ground targets. Type-classified in October 1991, the M830A1 is currently an exclusive product of Alliant Techsystems.

M831. The M831 (German DM18) round is a practice version of the M830 HEAT-MP-T round. The projectile is completely inert. The M831 successfully completed developmental testing in 1983, and the U.S. Army type-classified the M831 as standard in April 1984. Like the M829, the M831 was part of the January 1984 first-year 120mm production contract, supporting the initial fielding of the M1A1 Abrams main battle tank.

The prime contractor, Primex Technologies (now a component of General Dynamics), began deliveries of the M831 in August 1985. Primex delivered 6,840 rounds in FY86. U.S. Department of Defense procurement of the M831 apparently ended in FY06.

M865. The M865 TPCSDS-T round is the U.S. equivalent of the German DM38 120mm target practice round. The M865 has a limited range of up to 7,500 meters (8,202 yd) at 10-degree elevation. It can approximate the ballistic characteristics of the M829 round out to 3,000 meters (3,280.8 yd). The M865 successfully completed the development and test phase in 1983, and the U.S. Army type-classified the M865 as standard in July 1984. The M865 was also part of the January 1984 first-year production contract, supporting the initial fielding of the M1A1 Abrams main battle tank.

Deliveries began in FY86. Deliveries for the U.S. Army and U.S. Marine Corps were reportedly complete by FY13. Extensive live-fire training with the M865 round proved to be a significant contributor to the success of U.S. tank crews during Operation Desert Storm (1991) and Operation Iraqi Freedom/Operation New Dawn (2003-2011).

M1028. For the anti-personnel component of the new asymmetric threat scenario, the U.S. Army initiated development of a canister round. This round provides the M1A1/A2 Abrams a viable anti-personnel capability, something new for the Abrams. Development and low-rate procurement of the M1028 are ongoing.

120mm Shotgun Shell

The M1028 canister round is essentially a 120mm shotgun shell, containing approximately 1,100 tungsten balls. This round provides M1A1/A2 Abrams tank crews with a true anti-personnel weapon system. The U.S. Army's performance requirements for the M1028 included:

- 200- to 500-meter threshold range
- 100- to 700-meter objective range
- Capability of defeating at least 50 percent of a 10-man squad with one shot
- Capability of defeating at least 50 percent of a 30-man platoon with two shots

In addition to being used against dismounted troops, this round can defeat such obstacles as wall barriers and light-skinned vehicles.

On November 10, 2005, the U.S. Army's 16th Cavalry Regiment conducted a live-fire demonstration of the new M1028 round at Fort Knox, Kentucky. The U.S. Army also deployed unspecified amounts of the M1028 canister round to Iraq.

XM908. In the late 1980s, the U.S. Army determined the M1A1 Abrams main battle tank needed a "secondary capability" to deal with enemy personnel and built-up structures. For the built-up structures component of this threat scenario, the Army initiated the development of a new 120mm High Explosive Dual Purpose round, the XM908. The development of this round is ongoing.

Other Tank Ammunition Programs

76mm and 90mm APFSDS-T. General Dynamics has developed APFSDS-T rounds for the 76mm and 90mm guns of the older M41 Walker Bulldog and M47/M48 Patton tanks. These tanks are still in service with some nations. The APFSDS-T rounds significantly enhance the lethality of these obsolete tanks without the expense of installing new guns.

Alternative Penetrators. Both Northrop Grumman Defense Systems (formerly Orbital ATK) and General Dynamics have responded to the market demand for 120mm long-rod penetrating ammunition using tungsten rather than DU penetrators.

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The Orbital ATK round – the Kinetic Energy Tungsten Core (KE-T) – is similar in design and performance to the M829A1 round. General Dynamics offers the 120 KE-W Terminator, a development of its earlier Olin 120 and Olin 120+ tungsten-alloy penetrator munitions.

Our research indicates that an unidentified Middle Eastern nation (most likely Egypt) has purchased a significant number of Terminator rounds. Also, in 1999, Egypt awarded General Dynamics a contract worth \$31.3 million for 10,800 DM43A1 rounds. General Dynamics completed work under this contract in late 2000. In December 2004, Australia procured an unspecified amount of 120mm KE-W A2 ammunition for its incoming lot of surplus U.S. Army M1A1 Abrams tanks.

105mm APFSDS-T. In partnership with RO Defence (now a component of BAE Systems) and Giat Industries (Nexter Munitions), Primex Industries developed the Excalibur, a 105mm APFSDS-T round featuring a long-rod penetrator. The contractors claim a performance equivalent to that of the first generation of 120mm long-rod penetrator rounds. Excalibur muzzle velocity from the L7/Rh 105/M68 series tank gun is reportedly well into the 1,500-meter-per-second range (4,921 ft/sec), and possibly as high as 1,590 meters (5,216.5 ft) per second. Since acquiring Primex, General Dynamics

Ordnance and Tactical Systems has continued this program.

Modular Multipurpose Ammunition. In 1995, Primex Technologies began concept development of a new 120mm tank gun ammunition family, called the Advanced Anti-Materiel/Personnel-Vehicle round (now known as Modular Multipurpose Ammunition).

Still in the concept development stage, MMPA is essentially a modular cartridge design that can accommodate several different warheads. Prior to becoming a component of General Dynamics, Primex may have reached some sort of an agreement with Giat Industries for development of this new ammunition technology.

Multiple-Impact Penetrator. Lockheed Martin has patented a unique technology for tank gun munitions. The multiple-impact penetrator warhead features a series of cone-shaped penetrators, each having a set of drogue fins. As the complete round nears the target, the fins on the rear segment deploy, slowing the segment and allowing the next segment forward to deploy; this process can run to three or more segments. A number of segments attack the target separately, at a very high rate. The timing of the initial separation is adjustable, allowing impact at the same spot or dispersed impact.



M1A2 Abrams Live-Fire Training

Source: U.S. Army

Funding

Individual contractors and various governments fund the development of ammunition programs.

Tank Gun Ammunition

Timetable

European contractors continue to develop enhanced-performance 120mm ammunition, with some research into larger caliber (140mm) designs for the next-generation tank guns. Until the next generation of main battle tank technology emerges, the Forecast International Weapons Group expects the smoothbore 120mm tank gun – especially the Rheinmetall Rh 120 – to reign supreme among European armies throughout the forecast period.

Over the past two decades, production of tank gun ammunition by non-U.S. and non-European players in the international market has risen significantly. Several new players have entered the market. Over the next decade, there may be a consolidation of some of these new players (especially in Southeast Asia and Latin America) as the international market stabilizes.

In the United States, R&D of improved tank gun ammunition is ongoing. In addition to the development of improved 105mm and 120mm munitions (including "smart" rounds), the development of exotic propulsion technologies continues.

Worldwide Distribution/Inventories

The majority of non-U.S. and non-European players in this market fulfill primarily domestic requirements, with relatively little interest in the export market or capability to fulfill export needs. However, a select few international players – such as Denel, IMI, and NORINCO – are emerging to challenge the traditional U.S. and European dominance of this market.

At the end of the day, however, U.S. and European munitions continue to dominate the international market. These designs, or copies thereof, remain ubiquitous worldwide.

Forecast Rationale

Europe

The European tank gun ammunition market continues to reflect the impact of a radically different post-Cold War threat environment. The Forecast International Weapons Group expects the combined production rate will average 265,000 rounds per year among the various European players.

Three major factors have driven the European tank gun ammunition market since 1990. First, a sharp decline in European tank gun ammunition procurement has reduced European production to less than half of its pre-1990 levels. Second, vast remaining stockpiles of munitions from pre-1990s production continue to flood the market. Third, an influx of new players (primarily from the former Soviet Union and Warsaw Pact nations) continues to impact the market share of the European players.

In this environment, new requirements resulting from European support for Ukraine will place a significant strain on European tank gun ammunition production.

Russian ammunition producers are reportedly unable to keep up with Russian Army demand, forcing Russia to seek alternate and supplemental sources of ammunition outside of traditional channels.

International

Overall, the international tank gun ammunition market remains overwhelmingly dependent on U.S. and European munitions designs. The Forecast International Weapons Group expects the combined production rate will average 196,000 rounds per year among the various non-U.S. and non-European manufacturers.

The Rheinmetall Rh 120 series ordnance and its associated ammunition have become the international industry standard for this type of tank main armament. Nevertheless, increasingly tight defense budgets have forced many international consumers to extend the service life of these older designs. This has created a continued and thriving international market for older tank ordnance and ammunition designs. In addition, there is continued development of more lethal kinetic energy rounds of the older 90mm and 105mm tank ordnance.

United States

While the production surge to meet the operational tempo of U.S. combat operations has clearly ended, ongoing material support for Ukraine has necessitated a significant increase in tank gun ammunition production to satisfy donations to Ukraine as well as U.S. Army resupply requirements. The U.S. market for tank gun

Tank Gun Ammunition

ammunition currently reflects this rapid shift in focus from primarily meeting the ongoing requirements to replenish war reserves and training stocks to what is effectively a renewed combat tempo.

We expect that output of 120mm tank gun ammunition by U.S. contractors for U.S. DoD procurement will increase from an average of about 12,120 rounds annually to at least 72,200 round annually, beginning in FY24.