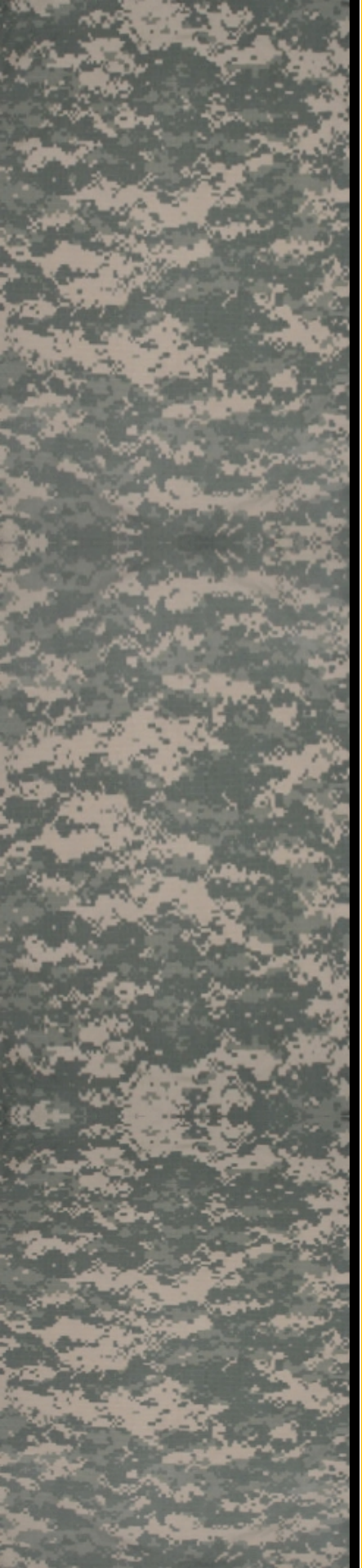

TRISA WEG

Worldwide Equipment Guide

Volume 1: Ground Systems

August 2014

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2. The Army Training Circular 7-100 series describes the doctrine, organizations, TTP, and equipment of such an OPFOR and how to combine it with other operational variables to portray the qualities of a full range of conditions appropriate to Army training environments.

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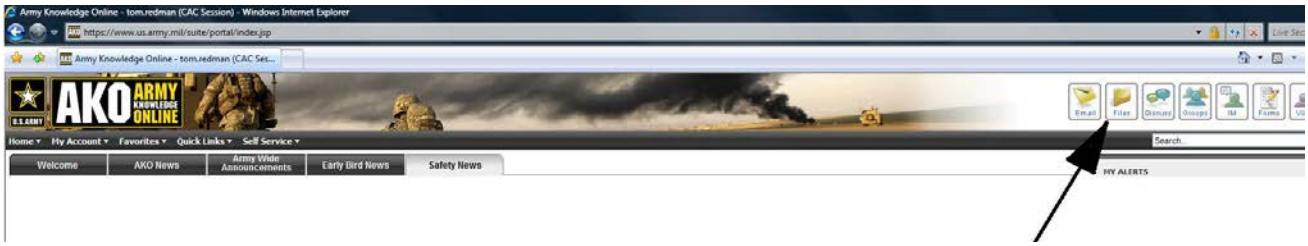

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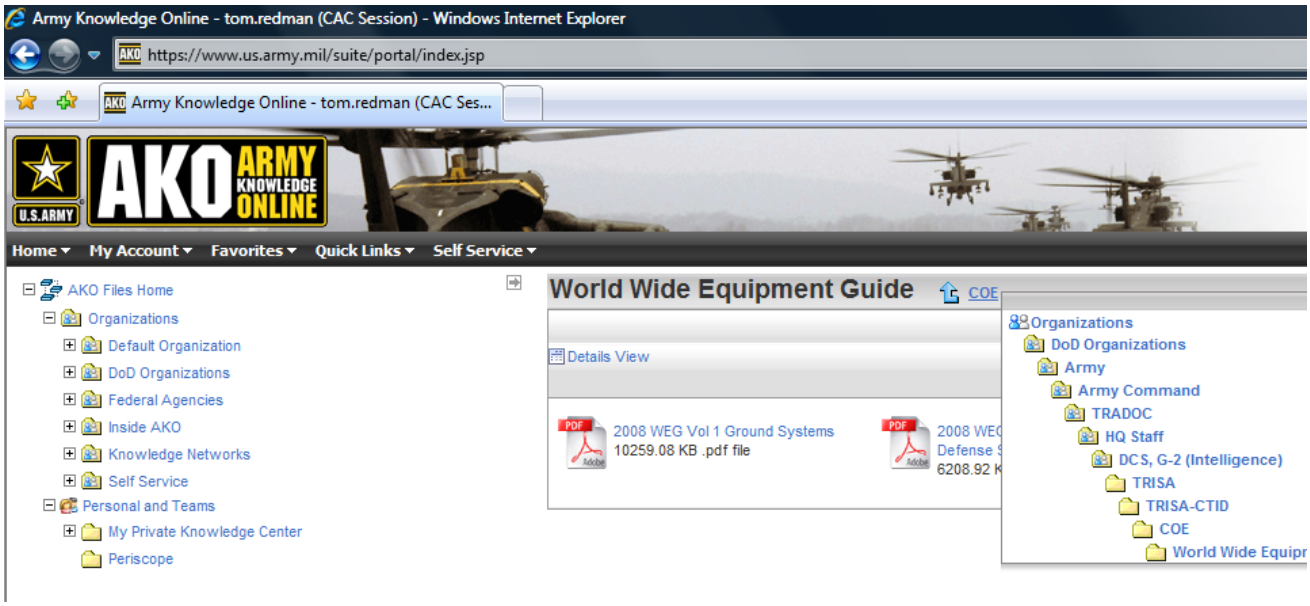

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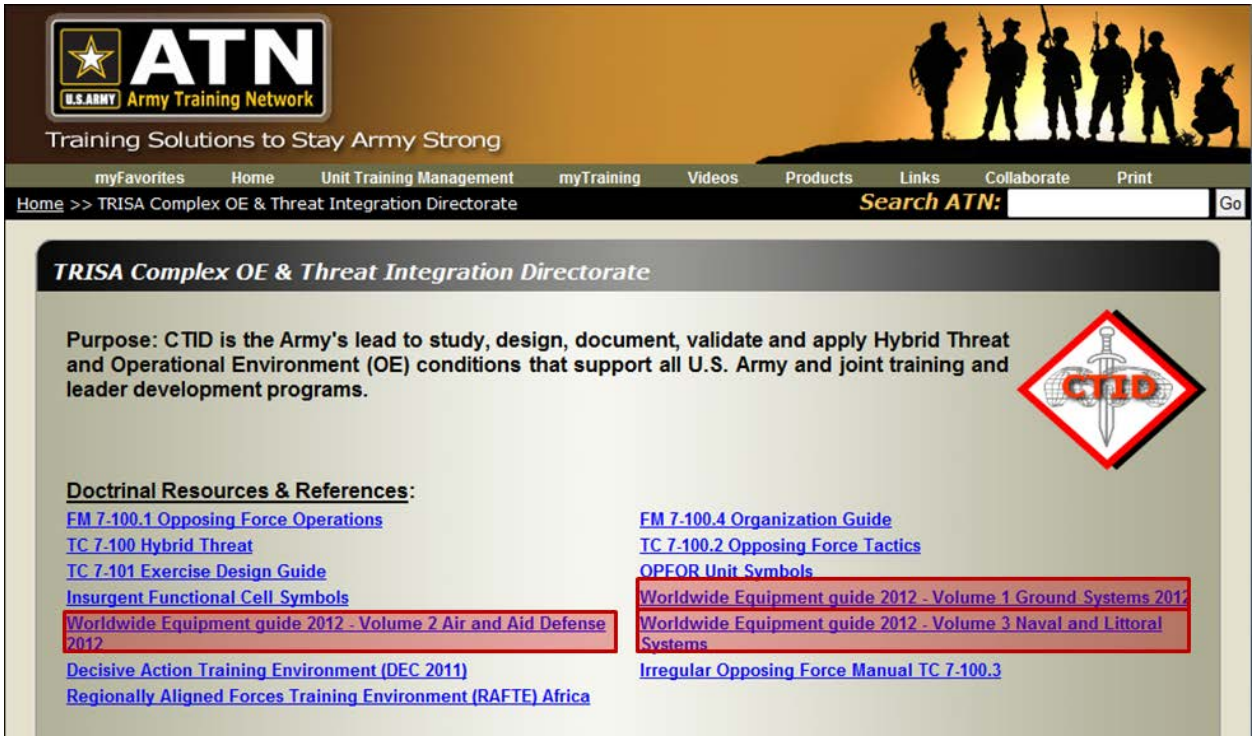

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Enclosure 2

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Opposing Force:
Worldwide Equipment Guide
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GLOSSARY Glossary-1

Errata Changes for 2014 Update

Many chapters have significant changes. Changes include specific changes in text and data, photos, equipment name changes, as well as added or deleted pages. For clarity, functional classifications of aircraft and some designators and names for specific models have been adjusted. Please check page numbers, as many have changed. Some illustrations were replaced or added. The following data sheets and narrative sections are added:

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In these times of reduced economic resources for military force improvements, most forces are focusing more on upgrading existing systems, with reduced numbers of new fielded systems. Thus, many older systems are being upgraded to be more effective against even the most modern forces. Therefore, the number of variants for systems described in the WEG continues to expand. Some system names have been changed to add key upgrade variants which are featured on the data sheets. A red ink edition is available for users who want to know detailed changes to text and data. Major changes can be found on the following pages:

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T-80A	5-37
T-90S	5-38

Preface

The WEG was developed to support the TC 7-100 series and all OPFOR portrayal in training simulations (constructive, virtual, live, and gaming). The equipment portrayed in this WEG represents military systems, variants, and upgrades that U.S. forces may encounter now and in the foreseeable future. The authors continually analyze real-world developments, capabilities, and trends to guarantee that the OPFOR remains relevant.

This series of TC/FM and guides outline an OPFOR capable of portraying the entire spectrum of military and paramilitary capabilities against which the U.S. Military must train to ensure success in any future conflict.

Applications for this series of handbooks include field training, training simulations, and classroom instruction throughout the U.S. Military. All U.S. Military training venues should use an OPFOR based on these handbooks, except when mission rehearsal or contingency training requires maximum fidelity to a specific country-based threat. Even in the latter case, trainers should use appropriate parts of the OPFOR handbooks to fill information gaps in a manner consistent with what they do know about a specific threat.

Unless this publication states otherwise, masculine nouns or pronouns do not refer exclusively to men.

Introduction

This Worldwide Equipment Guide (WEG) describes the spectrum of worldwide equipment and system trends in the Complex Operational Environment (COE). Tier Tables at Chapter 1 provide baseline examples of systems with counterparts in other capability tiers. Other systems are added to offer flexibility for tailoring the force systems mix. Substitution Tables starting at 1-6 offer other system choices versus baseline examples.

The OPFOR in the COE should also include options for portraying "hybrid threat". Hybrid threat is defined as:

…the diverse and dynamic combination of regular forces, irregular forces, terrorist forces, and/or criminal elements, all unified to achieve mutually benefitting effects.

The OPFOR may use conventional weapons; however regular and irregular forces may also employ improvised systems, as described in Volume 1 Chapter 14, and in Volume 2 Chapter 7. Upgrade tables are included to capture WEG systems changes reflecting contemporary upgrade trends. Systems and technologies in Chapter 17, Emerging Technologies, can be used in simulations for Near-Term and Mid-Term scenarios.

The pages in this WEG are designed for use in electronic form or for insertion into loose-leaf notebooks. This guide will be updated as often as necessary, in order to include additional systems, variants, and upgrades that are appropriate for OPFOR use.

WORLDWIDE EQUIPMENT GUIDE

Due to the proliferation of weapons through sales and resale, wartime seizure, and licensed or unlicensed production of major end items, distinctions between equipment as friendly or OPFOR have blurred. Sales of upgrade equipment and kits for weapon systems have further blurred distinctions between old or obsolete systems and modern ones. This WEG describes base models, or fielded upgrades which reflect current capabilities. Many less common variants and upgrades are also addressed. Note the Equipment Upgrades chapter (15) for trends guidance.

HOW TO USE THIS GUIDE

The WEG is organized by categories of equipment, in chapters. The format of the equipment pages is basically a listing of parametric data. This permits updating on a standardized basis as data becomes available. For meanings of acronyms and terms, see the Glossary. Please note that, although most terms are the same as in U.S. terminology, some reflect non-U.S. concepts and are not comparable or measurable against U.S. standards. For example, if an OPFOR armor penetration figure does not say RHA (rolled homogeneous armor) do not assume that is the standard for the figure. If there are questions, consult the Glossary, or contact us.

System names reflect intelligence community changes in naming methods. Alternative designations include the manufacturer's name, as well as U.S./NATO designators. Note also that the WEG focuses on the complete weapon system (e.g., AT-4/5/5B antitank guided missile launcher complex or 9P148 ATGM launcher vehicle), versus a component or munition (9P135 launcher or AT-4/5 ATGM).

Many common technical notes and parameters are used in chapters 2 through 6, since the systems contained in those chapters have similar weapon and automotive technologies. Chapters 2 (Infantry Weapons), 8 (Engineer) and 12 (Logistics), offer systems with many unique parameters and therefore may not be consistent with those in other chapters.

The authors solicit the assistance of WEG users in finding unclassified information that is not copyright-restricted, and that can be certified for use. Questions and comments should be addressed to the POC below. If he is not available, contact the designated chapter POC.

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Units of Measure

The following example symbols and abbreviations are used in this guide.

Unit of Measure	Parameter
(°)	degrees (of slope/gradient, elevation, traverse, etc.)
GHz	gigahertz—frequency (GHz = 1 billion hertz)
hp	horsepower (kWx1.341 = hp)
Hz	hertz—unit of frequency
kg	kilogram(s) (2.2 lb.)
kg/cm^2	kg per square centimeter—pressure
km	kilometer(s)
km/h	km per hour
kt	knot—speed. 1 kt = 1 nautical mile (nm) per hr.
kW	kilowatt(s) (1 kW = 1,000 watts)
liters	liters—liquid measurement (1 gal. = 3.785 liters)
m	meter(s)—if over 1 meter use meters; if under use mm
m^3	cubic meter(s)
m^3/hr	cubic meters per hour—earth moving capacity
m/hr	meters per hour—operating speed (earth moving)
MHz	megahertz—frequency (MHz = 1 million hertz)
mach	mach + *(factor)* —aircraft velocity (average 1062 km/h)
mil	milliradian, radial measure (360° = 6400 mils, 6000 Russian)
min	minute(s)
mm	millimeter(s)
m/s	meters per second—velocity
mt	metric ton(s) (mt = 1,000 kg)
nm	nautical mile = 6076 ft (1.152 miles or 1.86 km)
rd/min	rounds per minute—rate of fire
RHAe	rolled homogeneous armor (equivalent)
shp	shaft horsepower—helicopter engines (kWx1.341 = shp)
μm	micron/micrometer—wavelength for lasers, etc.

Chapter 1
OPFOR Tier Tables – Ground Systems

The OPFOR organization and equipment must support the entire spectrum of Contemporary Operational Environment (see Vol 1 Introduction pg vi) in U.S. forces training. The COE OPFOR includes "hybrid threats" (also pg vi), and represents rational and adaptive adversaries for use in training applications and scenarios. The COE time period reflects current training (2013), as well as training extending through the Near Term. This chapter deals with current time frame systems. Lists of equipment on these tables offer convenient baseline examples arranged in capability tiers for use in composing OPFOR equipment arrays for training scenarios. For guidance on systems technology capabilities and trends after 2013, the user might look to Chapter 17, Emerging Technology Trends. Those tables offer capabilities tiers for Near and Mid-Term.

OPFOR equipment is broken into four "tiers" in order to portray systems for adversaries with differing levels of force capabilities for use as representative examples of a rational force developer's systems mix. Equipment is listed in convenient tier tables for use as a tool for trainers to reflect different levels of modernity. Each tier provides an equivalent level of capability for systems across different functional areas. The tier tables are also another tool to identify systems in simulations to reflect different levels of modernity. The key to using the tables is to know the tier capability of the initial organizations to be provided. Tier 2 (default OPFOR level) reflects modern competitive systems fielded in significant numbers for the last 10 to 20 years.

Systems reflect specific capability mixes, which require specific systems data for portrayal in U.S. training simulations (live, virtual, and constructive). The OPFOR force contains a mix of systems in each tier and functional area which realistically vary in fielded age and generation. The tiers are less about age of the system than realistically reflecting capabilities to be mirrored in training. Systems and functional areas are not modernized equally and simultaneously. Forces have systems and material varying 10 to 30 years in age in a functional area. Often military forces emphasize upgrades in one functional area while neglecting upgrades in other functional areas. Force designers may also draw systems from higher or lower echelons with different tiers to supplement organizational assets. Our functional area analysts have tempered depiction of new and expensive systems to a fraction of the OPFOR force. The more common modernization approach for higher tier systems is to upgrade existing systems.

Some systems are used in both lower and higher tiers. Older 4x4 tactical utility vehicles which are 30 to 40 years old still offer effective support capability, and may extend across three tiers. Common use of some OPFOR systems also reduces database maintenance requirements.

Tier 1 systems are new or upgraded robust state-of-the-art systems marketed for sale, with at least limited fielding, and with capabilities and vulnerabilities representative of trends to be addressed in training. But a major military force with state-of-the-art technology may still have a mix of systems across different functional areas at Tier 1 and lower tiers in 2013.

Tier 2 reflects modern competitive systems fielded in significant numbers for the last 10 to 20 years, with limitations or vulnerabilities being diminished by available upgrades. Although forces are equipped for operations in all terrains and can fight day and night, their capability in range and speed for several key systems may be somewhat inferior to U.S. capability.

Volume I: Ground Forces

	Tier 1	Tier 2	Tier 3	Tier 4
Dismounted Infantry				
Infantry Flame Launcher	(Shmel) RPO-M	RPO-A	RPO	LPO-50
Lt AT Disposable Launcher	Armbrust	Armbrust	Armbrust	RPG-18; M72 LAW
AT Disposable Launcher	RPG-30/32/28	RPG-27	RPG-26	RPG-22
AT Grenade Lcher (ATGL)	Panzerfaust 3-IT600	Panzerfaust 3 T-600; RPG-29	Carl Gustaf M3	RPG-7V
Long-Range ATGL	PF-98 Mounted/Tripod (@ Bn)	RPG-29/Mounted/Tripod	SPG-9M (Imp)	SPG-9
Heavy ATGM Man-Portable	Eryx SR-ATGM	Eryx SR-ATGM	M79/Type 65-1 Recoilless	M67 Recoilless Rifle
Light Auto Grenade Launcher	QLZ-87 (Light Configuration); QLZ-87B	W-87	W-87	W-87
Auto Grenade Launcher	CIS-40 w/Air-Burst Munitions/ AGS-30; QLZ-87 (Heavy Configuration)	AGS-17	AGS-17	AGS-17
Heavy Machine Gun	KORD	NSV	NSV	DShk; M2 Browning
General Purpose MG	PKM Pechneg	PKM	PKM	PKM
Anti-Materiel Rifle	M107A1(.50 Cal); 6S8 and 6S8-1 (12.7mm)	M82A1(.50 Cal); OSV-96 (12.7mm)	M82A1(.50 Cal)	M82A1(.50 Cal)
Sniper Rifle	SVD	SVD	SVD	Mosin-Nagant
Assault Rifle	AK-74M	AK-74M	AKM	AKM
Carbine	AKS-74U	AKS-74U	AK-47 Krinkov	AK-47 Krinkov
Company-Dismount ATGM	Spike-LR ATGM Launcher	Spike-MR ATGM Launcher	AT-13	AT-7
Battalion-Dismount ATGMs	Kornet-E Launcher (1 team) Starstreak-SL AD/AT (1 team)	Kornet-E ATGM Lchr	AT-5B	AT-5
Combat Vehicles				
Infantry Fighting Vehicle	BMP-2M Berezhok	BMP-2M	AMX-10P	BMP-1PG
Infantry IFSV for IFV	BMP-2M Berezhok	BMP-2M w/Kornet/SA-18	AMX-10 w/AT-5B/SA-16	BMP-1PG w/ AT-5/SA-16
Amphibious IFV	BMP-3UAE/AT-10B	BMP-3UAE/AT-10B	BMD-2/AT-5B	BMP-1PG/AT-5
Amphibious IFV IFSV	BMP-3UAE/AT-10B	BMP-3UAE/AT-10B	BMD-2/AT-5B	BMD-1PG w/AT-5/SA-16

Volume I: Ground Forces (continued)

	Tier 1	Tier 2	Tier 3	Tier 4
Armored Personnel Carrier	BTR-3E1/AT-5B	BTR-80A	BTR-80	M113A1
Amphibious APC	BTR-90	BTR-80A	WZ-551	VTT-323
Amphibious APC IFSV	BTR-90/AT-5B/SA-24	BTR-80A w/Kornet-E/SA-18	WZ-551 w/AT-5B/SA-16	VTT-323 w/AT-3C/SA-14
Airborne IFV	BMD-3	BMD-3	BMD-2	BMD-1P
Airborne APC	BTR-D	BTR-D	BTR-D	BTR-D
Airborne APC IFSV	BTR-D w/Kornet-E, SA-24	BTR-D w/Kornet-E/SA-18	BTR-D w/AT-5B/SA-16	BTR-D w/AT-5, SA-14
Heavy IFV/Heavy IFSV	BMP-3M/w Kornet-E, SA-24	BMP-3UAE/Kornet-E, SA-18	Marder 1A1/MILAN 2, SA-16	BMP-1PG/w SA-14
Combat Recon Vehicle	BRM-3K/Kredo M1	BRM-3K	BRM-1K	EE-9
Abn/Amphib Recon CRV	BMD-3/Kredo M1	BMD-3K	BMD-1PK	BMD-1K
Armored Scout Car	BRDM-2M-98/Zbik-A	BRDM-2 M-97/Zbik-B	Fox	BRDM-2
Sensor Recon Vehicle	HJ-62C	HJ-62C	BRM-1K	BRM-1K
AT Recon Vehicle	PRP-4MU (w/Kredo-M1)	PRP-4M (w/PSNR-5M)	PRP-4 (w/PSNR-5K)	PRP-3 (w/SMALL FRED)
Armored Command Vehicle	BMP-1KshM	BMP-1KShM	BMP-1KSh	BMP-1KSh
Abn/Amphib ACV	BMD-1KShM	BMD-1KShM	BMD-1KShM	1KShM
Wheeled ACV	BTR-80/Kushetka-B	BTR-80/Kushetka-B	BTR-60PU/BTR-145BM	BTR-60PU/BTR-145BM
Combat Support Vehicles				
Motorcycle	Gear-Up (2-man)	Gear-Up (2-man)	Motorcycle (2-man)	Motorcycle (2-man)
Tactical Utility Vehicle	VBL MK2	VBL	UAZ-469	UAZ-469
Armored Multi-purpose	MT-LB6MB	MT-LB6MA	MT-LBu	MT-LB
All Terrain-Vehicle	Supacat	Supacat	LUAZ-967M	LUAZ-967M
Tanks and AT Vehicles				
Main Battle Tank	T-90A	T-72BU / T-90S	Chieftain	T-55AM
Amphibious Tank	Type 63A	Type 63	M1985	PT-76B
Tracked Heavy Armored CV	2S25	AMX-10 PAC 90	AMX-13	M41A3
Wheeled Heavy Armored CV	AMX-10RC Desert Storm	AMX-10RC	EE-9	EE-9
Div ATGM Launcher Vehicle	9P157-2/Krizantema-S	9P149 w/AT-9 Ataka	9P149 w/AT-6	9P148/AT-5

Volume I: Ground Forces (continued)

	Tier 1	Tier 2	Tier 3	Tier 4
Bde ATGM Veh Tracked	9P162 w/Kornet	AMX-10 HOT 3	AMX-10 HOT 2	Type 85/Red Arrow-8A
Bde ATGM Veh Wheeled	VBL MK2 w/Kvartet, Kornet	VBL w/Kvartet, Kornet	9P148/AT-5B	Jeep/Red Arrow-8A
Abn ATGM Launcher Veh	VBL MK2 w/Kvartet, Kornet	VBL w/Kvartet, Kornet	BMD-2 with AT-5B	BMD-1P with AT-5
Hvy ATGM Launcher Veh	Mokopa	9P149 w/Ataka	9P149 w/AT-6	9P148/AT-5
NLOS ATGM Launcher Veh	Nimrod-3	Nimrod	--	--
Div Towed AT Gun	2A45MR	2A45M	MT-12	MT-12
Bde Towed AT Gun	2A45MR	MT-12R	MT-12	M40A1
Artillery				
Mortar/Combo Gun Tracked	2S9-1	2S9-1	2S9-1	M106A2
Mortar/Combo Gun Wheeled	2S23	2S23	2S12	M-1943
Towed Mortar or Combo Gun	Type 86 or 2B16	Type 86 or 2B16	M75 or MO-120-RT	M-1943
82-mm Mortar	Type 84	Type 84	Type 69	M-1937
82-mm Auto Mortar	2B9	2B9	2B9	2B14-1
60-mm Mortar	Type 90	Type 90	Type 63-1	Type 63-1
Towed Light Howitzer	D-30	D-30	D-30	D-30
Towed Medium How/Gun	G5	2A65	2A36	D-20
Self-Propelled Howitzer	2S19M1-155, G6, AU-F1T	G6, 2S19M1	2S3M1	2S3M
Multiple Rocket Launcher	9A51/Prima	9A51/Prima	BM-21-1	BM-21
Light MRL/Vehicle Mount	Type 63-1	Type 63-1	Type 63-1	Type 63
Heavy MRL	9A52-2 and 9P140	9A52-2 and 9P140	9P140	Fadjr-3
1-Round Rocket Launcher	9P132	9P132	9P132	9P132
Amphibious SP How	2S1M	2S1M	2S1	2S1
Artillery Cmd Recon Veh	1V13M w/1D15, 1V119	1V13M w/1D15, 1V119	1V13, 1V119	1V18/19, 1V110
ACRV, Wheeled	1V152, 1V110	1V152, 1V119, 1V110	1V119, 1V110	1V18/19, 1V110
Mobile Recon Vehicle	PRP-4MU (w/Kredo-M1)	PRP-4M (w/PSNR-5M)	PRP-4 (w/PSNR-5K)	PRP-3 (w/SMALL FRED)
Arty Locating Radar	1L-259U, 1L-219	1L-220U, 1L-219	ARK-1M	Cymbeline

Volume I: Ground Forces (continued)

	Tier 1	Tier 2	Tier 3	Tier 4
Sound Ranging System	SORAS 6	SORAS 6	AZK-7	AZK-5
Flame Weapon	TOS-1	TOS-1	Type 762 MRL	OT-55 Flame Tank
Reconnaissance				
Ground Surveillance Radar	Kredo-1E	Kredo-M1	PSNR-5M/Kredo-M	PSNR-5/TALL MIKE/Kredo
Man-portable Radar	FARA-1E	FARA-1E	N/A	N/A
Unattended Ground Sensors	BSA Digital Net	BSA Digital Net	N/A	N/A
Remote TV/IR Monitor	Sirene IR	Sosna	N/A	N/A
Thermal Night Viewer	Sophie LR	Sophie/NVG 2 Gen II	NVG 2 Gen II	NVG 1Gen II
Laser Target Designator	DHY-307	DHY-307	1D15	--
Laser Rangefinder/Gonio-meter Fire Control System	Vector/SG12 with Sophie-LR	Vector/SG12 with Sophie	PAB-2M	PAB-2
Communications				
Radio VHF, Hand-Held	Panther-P	TRC5102	ACH42	R31K
Radio, SPF	Scimitar-H	PRC138	PVS5300	PRC104
Radio VHF, Veh Medium Pwr	Panther	Jaguar-V	R163-50U	R173M
Radio HF/VHF, Veh Med Pwr	M3TR	RF5000	XK2000	R123M
Satellite Systems	Syracuse-III	Feng Huo-1	Mayak	Molinya 1
Global Navigation Sattellite	NAVSTAR	GLONASS	Beidou	Galileo
Operational Comms	RL402A	R423-1	KSR8	R161-5
Tac Wide Area Network	EriTac	RITA	N/A	N/A
IBMS Network	Pakistani IBMS	Pakistani IBMS	N/A	N/A
Electronic Warfare				
Ground-Based ESM	Meerkat-S	Weasel 2000	MCS90 Tamara	R-703/709
Ground-Based EA	CICADA-C	TRC 274	Pelena-6	R-330 T/B
TACSAT EA	CICADA-R	GSY 1800	Liman P2	R-934B

Volume I: Ground Forces (continued)

	Tier 1	Tier 2	Tier 3	Tier 4
Radar EA	BOQ-X300	CBJ-40 Bome	Pelena-1	SPN-2/4
GPS EA	Aviaconversia TDS	Optima III	Aviaconversia	--
UAV-Based EA	Fox TX/Barrage	ASN-207/JN-1102	Yastreb-2MB/AJ-045A	Muecke/Hummel
Engineer Systems				
Wheeled Minelaying Systems	PMZ-4	PMR-3	Istrice VS-MTLU-1	--
Tracked Minelaying Systems	GMZ-3	GMZ-2	GMZ	--
Scatterable Mine Systems	PKM Man-Portable Minelayer	UMZ	Istrice VS-MTLU-1	--
Route Recon Systems	IPR	IRM	--	--
Route Clearing Systems	IMR-2M	IMR-2	BAT-2	BAT-M
Bridging Systems	TMM	PMP Pontoon Bridge	MT-55A	--

SYSTEMS SUBSTITUTION MATRIX VOLUME 1

This table provides a list of Vol 1 systems for users to substitute other systems versus OPFOR systems listed in guidance documents. Systems in italics are Tier 2 baseline systems used in the OPFOR Organization Guide. Systems are listed by type in tier order, and can substitute to fit a scenario. Some systems span between the tiers (e.g., 3-4). Also, systems can be used at more than one tier (e.g., 3-4).

	Tier	Page
2. INFANTRY WEAPONS		2-1
Small Arms		
6S8 and 6S8-1 (12.7mm) AM Rifle	1	1-3
M107-A1 Barrett AM Rifle	1	2-13
Pecheneg 7.62-mm GP MG	1	2-17
KORD Heavy MG	1	2-18
OSV-96 (12.7mm) AM Rifle	2	1-3
M82-A1 Barrett AM Rifle	*2-4*	*2-13*
SVD Sniper/Marksman Rifle	*1-3*	*2-10*
AK-74M Assault Rifle	*1-2*	*2-5*
RPK-74 Light Machinegun	*2*	*2-16*
NSV Heavy MG	*1-3*	*2-19*
PKM General Purpose MG	*1-3*	*2-18*
Lee-Enfield Rifle	3-4	2-2
Mosin-Nagant Sniper Rifle	4	2-9
RPK Light Machinegun	3-4	2-15
SKS Rifle	4	2-3
AK-47/AKM Assault Rifle	3-4	2-4
RPD Light Machinegun	4	2-14
DShK 38/46 Heavy MG	4	2-19
M2 BROWNING Heavy MG	4	1-3
Grenade Launchers		
QLZ-87B Auto Grenade Launcher	1	1-3
AGS-30 Auto Grenade Launcher	1	1-3
GM-94 43-mm Magazine Grenade Lchr	1	2-21
QLZ-87 Auto Grenade Launcher	1	2-23
QLB-06 Auto Grenade Launcher	1	2-23
CIS-40 AGL w/Air Burst Munition	1	2-24
CIS-40 Auto Grenade Launcher	1-2	2-24
W-87 Auto Grenade Launcher	*2-4*	*2-23*
GP-30 Under-Barrel Grenade Lchr	*3*	*2-20*
AGS-17 Auto Grenade Launcher	3	2-22
Antitank Weapons		
Panzerfaust 3-IT600 AT Grenade Lchr	1	2-37
PF-98and PF-98BN ATGL	1	2-38
RPG-32/Hashim ATGL	1	2-41
RPG-27 ATDL	*1-3*	*2-45*
RPG-29 ATGL	2	2-41
Panzerfaust-3T600 ATGL	*2*	*2-37*
Carl Gustaf M2 Recoilless Rifle	3	2-35
M67 Recoilless Gun	3-4	2-36
RPG-7V ATGL	4	2-39
RPG-28 AT Disposable Launcher	1	2-33
Armbrust ATDL	*1-3*	*2-42*
AT-4 ATDL	2-3	2-43
RPG-22 ATDL	4	2-44
RPG-30 ATGL	1	1-3
Multi-purpose and Flame Launchers		
Shmel-RPO-M Flame Weapon	1	2-47
RPO-A Flame Weapons	*2*	*2-47*
RPO Flame Weapon	3	2-46
3. INFANTRY VEHICLES		3-1
Armored Personnel Carriers		
BTR-3E1	1-2	3-20
BTR-80A	*2*	*3-20*
BTR-80	3	3-19
Pandur	3	3-24
WZ 551A/Type 92	3	3-26
VTT-323	3-4	3-25
BTR-60PB	4	3-18
M113A1	3-4	3-23
YW 531H/Type 85	3-4	3-28
BOV-M	4	3-16
BTR-60PA	4	3-17
BTR-152 Armored Transporter	4	3-22
YW 531A/531C/Type 63-II	4	3-27
Infantry Fighting Vehicles		
BMP-2M Berezhok	1	3-36
BMP-2M	*2*	*3-37*
Marder 1IFV	2-3	3-38
Warrior IFV	2-3	3-40
AMX-10P IFV	3	3-29
BMP-2 IFV	3	3-34
BMP-1P IFV	4	3-32
BMP-1 IFV	4	3-30
Specialized Carriers/Infantry Fire Spt Vehicles		
BMP-3M Heavy IFV/Amphibious IFV	1	3-48
Kliver IFV Turret on BMP/BTR	1	3-50
BMP-3 UAE Amphibious IFV	*1-2*	*3-46*
BTR-90 Amphibious APC	*1*	*3-21*
BMD-3 Airborne IFV	*1-2*	3-44
BTR-D Airborne APC	*1-4*	3-50
BMD-1/BMD-1P Airborne	4	3-42
BTR-T Heavy APC	1-2	3-60
Combat Support Vehicles		
Spider Light Strike Vehicle	1	3-71
Cobra Light Armored Vehicle	1-2	3-72
Supacat All-Terrain Vehicle	*1-2*	*3-75*

	Tier	Page
VBL and VBR Armored Carrier	*1-3*	*3-69*
UAZ-469 Tactical Utility Vehicle	*2-4*	*3-65*
Gear-up Motorcycle	*2-4*	*3-74*
V-150 Armored Vehicle	3-4	3-70
MT-LB Armored Tracked Carrier series	1-4	3-71
S55 Personnel Carrier	4	3-68

4. RECONNAISSANCE 4-1

Reconnaissance Vehicles		4-4
BRM-3K Kredo-1E Combat Recon Veh	1	4-11
BRDM-2M-98, -97Armored Scout Cars	*1-2*	*4-9*
HJ-62C Sensor Recon Vehicle	*1-2*	*4-13*
VBL and VBL Mk2 Armored Scout Cars	*1-2*	*4-9*
BRM-3K Combat Recon Veh	*2*	*4-11*
BRM-1K Combat Recon Cmd Vehicle	3-4	4-10
Fox Armored Scout Car	3-4	4-12
BRDM-2 Armored Scout Car	4	4-8
Reconnaissance Systems		
Kredo-1E Grd Surveillance Radar	*1-2*	*4-29*
Fara-1E Man-portable GSR	*1-2*	*4318*
PRP-4M Mobile Recon Vehicle	*1-2*	*7-9*
France RASIT GSR	*2*	*4-28*
Kredo-M1 *Grd Surveillance Radar*	2	4-29
Kredo-M *Grd Surveillance Radar*	3	4-29
Kredo/PSNR-5, -5K/TALL MIKE GSR	4	4-29
Sophie MF Forward Observer Sys	1	4-32
Sophie LR Thermal Binoculars/FO Sys	1	4-32
Sophie Thermal Binoculars/FO System	*2*	*4-32*

5. TANKS 5-1

Challenger 2	1	5-9
Leopard 2A5, 2A6	1	5-13
T-90A	1	5-36
Type 99 and Type 99A2	1	5-46
Al Khalid	1-2	5-5
T-80U	1-2	5-34
Leopard 2A4	1-2	5-14
T-90S	*2*	5-38
T-72BM	2-3	5-30
Type 96G	2	5-44
Chieftain Mk 12	2 -3	5-10
T-64B	2-3	5-24
T-80B	2-3	5-32
Chieftain Mk 5	3	5-10
T-72A/T-72M1	3	5-25
T-72B and Other T-72 Upgrade Tanks	3	5-28
AMX-30	3-4	5-7
Leopard 1A1	3-4	5-12
M60A1/M60A3	3-4	5-16
T-55AMV	3-4	5-21
T-62M	3-4	5-22
Type 59-II	4	5-40
T-34	4	5-18

6. ANTITANK AND ANTI-ARMOR 6-1

Dismounted Infantry Crew-served Weapons		
RPG-29 Mounted 105-mm ATGL	*1-2*	*6-21*
Eryx Man-portable ATGM Launcher	*1-2*	*6-22*
Starstreak Air Defense/Anti-armor Missile	*1-2*	*6-23*
Spike-ER ATGM Launcher	*1-2*	*6-25*
Milan/Milan 3/Milan ADT ATGM Lchr	1-3	6-26
AT-13 Man-portable ATGM Launcher	3	6-24
AT-7 Man-portable ATGM Launcher	4	6-24
AT-3/Malyutka-2 ATGM Launcher	4	6-27
Portable Mounted Crew-served Weapons		
Kornet-E ATGM Launcher	*1-2*	*6-31*
9P135 Launcher and AT-4B/5B ATGMs	3-4	6-30
Red Arrow-8 ATGM Launcher	3-4	6-32
SPG-9/-9M 73-mm Recoilless Gun	3-4	6-28
M79 82-mm Recoilless Gun	3-4	6-29
Towed or Vehicle-Mounted Recoilless Guns		
B-10 82-mm Recoilless Gun	4	6-33
M60 82-mm Recoilless Gun	4	6-34
B-11 107-mm Recoilless Gun	4	6-35
Towed Antitank Guns		
2A45MR/2A45M 125-mm Towed AT Gun	*1-2*	*6-39*
MT-12R/MT-12 100-mm Towed AT Gun	*2-3*	*6-38*
D-44/SD-44 85-mm Towed Gun	4	6-37
ZIS-3 76-mm Towed Antitank Gun	4	6-36
Heavy Armored Combat Vehicles		
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Chapter 2
Infantry Weapons

This chapter provides the basic characteristics of selected infantry weapons either in use or readily available to the OPFOR and therefore likely to be encountered by U.S. forces in varying levels of conflict. The selection of weapons is not intended to be all-inclusive, rather a representative sampling of weapons and equipment supporting various military capabilities.

This chapter is divided into two categories—***small arms*** and ***recoilless weapons***. ***Small arms*** covers, in order, assault rifles, under-barrel grenade launchers, light machineguns, general-purpose machineguns, heavy machineguns, and automatic grenade launchers. There are some new updates here in the categories of anti material rifles, heavy machine guns and automatic grenade launchers. The second category, ***recoilless weapons***, contains the US 106-mm Recoilless Rifle M40 and the Russian 73-mm Recoilless Gun SPG-9M. This category also covers a rapidly growing segment of shoulder-fired (unguided), infantry weapons. While originally limited to shoulder-fired unguided antitank weapons such as the Russian 40-mm Antitank Grenade Launcher RPG-7V, the utility of shoulder-fired weapons has expanded to include multi-purpose systems such as the Swedish 84-mm Recoilless Rifle Carl Gustaf M2. This field of weapons is often labeled "antitank" and also includes "bunker-buster" warheads, and weapons which can be fired from within confined spaces such as the German 67-mm Disposable Antitank Grenade Launcher (Armbrust) due to no or minimal back blasts. New, disposable launcher Tier 1 anti armor systems such as the RPG-28, 32 and 30 have also been added. The RPG-30, in particular, is designed to defeat both Explosive Reactive Armor (ERA) and Active Protective Systems (APS) via a sub-caliber device that upon firing reaches the target milli-seconds before the main 105mm HEAT tandem warhead rocket. The RPG 28 is a heavy, 125mm tandem warhead weapon that will penetrate in excess of 1000mm of rolled, homogenous armor (RHG), after defeating ERA. Both are formidable anti-armor systems, which can be easily employed by the individual Soldier or insurgent.

An enduring battle-tested, lethal, shoulder-fired weapon is the Russian Infantry Rocket Flame Weapon RPO-A Series (RPO-A/D/Z) capable of firing either a smoke, incendiary, or a thermobaric warhead to 600 meters. At 200 meters it is accurate to 0.5 m^2. The thermobaric warhead has a blast effect corresponding to a round of 122-mm HE artillery. Due to the relative low cost, availability, versatility, transportability, trainability, and lethality of this category of infantry weapons, trainers should expect to encounter these systems in larger numbers with increasing levels of lethality, penetration, and utility. For information on guided antitank weapon systems see Chapter 6.

Crew-served infantry weapons which require a vehicle, or which limit mobility, have been moved to the Antitank and Anti-Armor chapter (6).

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Tier 3 systems date back generally 30 to 40 years. They have limitations in all three subsystems categories: mobility, survivability and lethality. Systems and force integration are inferior. However, guns, missiles, and munitions can still challenge vulnerabilities of U.S. forces. Niche upgrades can provide synergistic and adaptive increases in force effectiveness.

Tier 4 systems reflect 40 to 50 year-old systems, some of which have been upgraded numerous times. These represent Third World or smaller developed countries' forces and irregular forces. Use of effective strategy, adaptive tactics, niche technologies, and terrain limitations can enable a Tier 4 OPFOR to challenge U.S. force effectiveness in achieving its goals. The tier includes militia, guerrillas, special police, and other forces.

Please note: ***No force in the world has all systems at the most modern tier.*** Even the best force in the world has a mix of state-of-the-art (Tier 1) systems, as well as mature (Tier 2), and somewhat dated (Tier 3) legacy systems. Many of the latter systems have been upgraded to some degree, but may exhibit limitations from their original state of technology. Even modern systems recently purchased may be considerably less than state-of-the-art, due to budget constraints and limited user training and maintenance capabilities. Thus, even new systems may not exhibit Tier 1 or Tier 2 capabilities. As later forces field systems with emerging technologies, legacy systems may be employed to be more suitable, may be upgraded, and continue to be competitive. ***Adversaries with lower tier systems can use adaptive technologies and tactics, or obtain niche technology systems to challenge advantages of a modern force.***

A major emphasis in an OPFOR is flexibility in use of forces and in doctrine. This also means OPFOR having flexibility, given rational and justifiable force development methodology, to adapt the systems mix to support doctrine and plans. The tiers provide the baseline list for determining the force mix, based on scenario criteria. The OPFOR compensates for capability limitations by using innovative and adaptive tactics, techniques, and procedures (TTP). Some of these limitations may be caused by the lack of sophisticated equipment or integration capability, or by insufficient numbers. Forces can be tailored in accordance with OPFOR guidance to form tactical groups.

An OPFOR force developer has the option to make selective adjustments such as use of niche technology upgrades such as in tanks, cruise missiles, or rotary-wing aircraft, to offset U.S. advantages (see WEG Chapter 15, Equipment Upgrades). Forces may include systems from outside of the overall force capability level. A Tier 3 force might have a few systems from Tier 1 or 2. The authors will always be ready to assist a developer in selecting niche systems and upgrades for use in OPFOR portrayal. Scenario developers should be able to justify changes and systems selected. With savvy use of TTP and systems, all tiers may offer challenging OPFOR capabilities for training. The Equipment Substitution Matrices (starting at pg 1-7) can help force designers find weapons to substitute, to reflect those best suited for specific training scenarios.

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British .303 Cal Rifle Lee-Enfield

No. 4 Mk I

Ammunition Types	Typical Combat Load
.303 cal cartridge Ball	**120**

SYSTEM

Alternative Designations: SMLE, Short Magazine Lee-Enfield, Enfield
Date of Introduction: 1895
Proliferation: Widespread
Description:
Weight (kg):
Empty: 4.1
Length (mm):
Overall: 1,130
Barrel: 641
Rate of Fire (rd/min): ≥10 aimed
Operation: Bolt
Magazine: Detachable box magazine
Magazine Capacity: 10 rounds
Fire Mode: Single shot

SIGHTS

Name: INA
Type: Flip up micrometer aperture "peep" sight.
Sighting Range (m): Graduated from 200 to 1,300 yards. Older versions out to 2,000 yards for "volley" fire
Night Sights Available: Yes. A variety of II night sights can fit.

AMMUNITION

Name: Mk VII, Mk VI
Caliber/length: .303 cal British
Type: Ball
Bullet Weight(grain):
Mk VII: 174
Mk VI: 215
Range (m):
Effective: 500
Maximum: 2,730
Armor Penetration: INA
Muzzle Velocity (m/s): 743

VARIANTS (numerous variants and manufacturers)

Mk I: 1895-Original MLE Magazine Lee-Enfield Rifle (infantry and cavalry versions), (Boer War)
SMLE: 1903-Short Magazine Lee-Enfield (standard rifle length). (WWI). Designated the **No. 1 Mk III** in 1926 (WWII).
SMLE Mk I I.P.: Upgrades manufactured in India (WWI-WWII)
No. 3 Mk I: Pattern 1914 Mk I redesignated in 1926 (WWI-WWII)
No. 4 Mk I: 1941-Replaced the SMLE. (WWII and Korean War)
No. 4 (T): Sniper rifle, 4x scope, cheek pad (WWII & Korean War +) Effective range is 1,200 m with telescope.
No. 4 L8A1-A5: 7.62 NATO conversions of No. 4
No. 5: 1944-Jungle carbine, shorter and lighter than No. 4 (WWII)

NOTES
The SMLE, Short Magazine Lee-Enfield standardized the single size of the early rifles. The "Short " refers to the length of the rifle and not the magazine. The No 4 (T) sniper rifles are still in use in a number of countries. Some were converted from .303 British to 7.62 NATO. The Lee-Enfield is still found in large numbers throughout the world. These weapons are easy to acquire and use, simple to repair, reliable, lethal, and cheap. The No. 4 Mk I is the most common rifle of the series.

Russian 7.62-mm Semiautomatic Rifle, SKS

Ammunition Types	Typical Combat Load
7.62-mm cartridge Ball Tracer AP-I	**120**

SYSTEM

Alternative Designations: Simonov Semiautomatic Carbine
Date of Introduction: 1946
Proliferation: Widespread

Description:
Weight (kg):
Empty: 3.85
Length (mm):
Overall: 1,020
Barrel: 520
Rate of Fire (rd/min): 35-40
Operation: Gas
Magazine: Integral box magazine
Magazine capacity: 10 rounds
Fire Mode: Semiautomatic

SIGHTS

Name:
Type: Tangent leaf, graduated from 100 to 1,000 meters
Sighting Range (m): Battle sight 365

Night Sights Available: yes

AMMUNITION

Name: M1943 (57N231S)
Caliber/length: 7.62x39-mm
Type: Ball, steel core
Range (m):
Effective: 350
Maximum: 800
Armor Penetration: 6 mm mild steel plate at 300 m
Steel helmet at 1,000 m
Flak vest at 60 m
Muzzle Velocity (m/s): 718

Name: M1943 (T-45 or 57N231P)
Caliber/length: 7.62x39-mm
Type: Ball-Tracer
Range
Effective: 350
Maximum: 800
Trace (m): 800
Muzzle Velocity (m/s): 718

VARIANTS
Karabiner-S: East German Manufacture
Chinese Type 56: copy
North Korea Type 63: copy
Yugoslavian M59/66: copy, w/permanent grenade launcher

NOTES
The SKS is the predecessor to the Russian AK-47. This reliable rifle is still found in large numbers throughout the world. It is the mainstay of the PRC “Peoples Militia”.

Russian 7.62-mm Assault Rifle AK-47/AKM

Ammunition Types	Typical Combat Load
7.62-mm cartridge	
Ball	**120**
Tracer	
API	
Tracer Incendiary	

SYSTEM

Alternative Designations: AK, Kalashnikov
Date of Introduction: 1949/1961
Proliferation: Widespread (over 50 million)
Description:
Weight (kg):
Loaded (with magazine): 3.8
Empty (w/o magazine): 4.3/3.14
Length (mm): 870/880
Rate of Fire (rd/min):
Cyclic: 600
Practical:
Automatic: 100
Semiautomatic: 40
Operation: Gas
Feed: 30-round curved box magazine
Fire Mode: Selective, automatic or semi-automatic

SIGHTS

Name: INA
Type: Fore, pillar; rear, U-notch
Magnification**:** None
Night Sights Available: Yes

VARIANTS
Numerous. Many countries manufacture clones of the AK-47 or weapons using the basic AK action. Some of these are made in different calibers.

AKS: Folding stock.
AKM: Improved AK-47, sights, magazine, and stock. Easier to manufacture with stamped receiver.
AKMS: Folding stock variant of AKM.

AMMUNITION

Name: M1943 (57N231S)
Caliber/length: 7.62x39-mm
Type: Ball, steel core
Range (m):
Effective: 300
Maximum: 800
Armor Penetration: 6 mm mild steel plate at 300 m
Steel helmet at 1,000 m
Flak vest at 60 m
Muzzle Velocity (m/s): 718

Name: M1943 (T-45 or 57N231P)
Caliber/length: 7.62x39-mm
Type: Ball-Tracer
Range
Effective: 300
Maximum: 800
Trace (m): 800
Muzzle Velocity (m/s): 718

NOTES
Photo is of an AKM. All 7.62-mm Kalashnikov assault rifles are very dependable weapons. They produce a high volume of fire and are simple to maintain and produce. The primary difference between the AK-47 and the improved AKM is the receiver. The receiver of the AK-47 is forged and machined while the receiver of the AKM is stamped metal facilitating easier manufacturing. Both the AK-47 and the AKM can mount a 40-mm under-barrel grenade launcher. The AK-47 and AKM have been replaced in many armies by the newer AK-74. The AK-74 is basically an AKM rechambered to fire a 5.45-mm x 39-mm cartridge. The 7.62-mm RPK light machinegun is based on the AK/AKM design while the RPK-74 is a machinegun version of the AK-74.

Russian 5.45-mm Assault Rifle AK-74M

Ammunition Types	Typical Combat Load
5.45-mm cartridge Ball Ball-tracer Incendiary-T AP	**300**

SYSTEM

Alternative Designations: INA
Date of Introduction: 1974
Proliferation: Widespread

Description:
Weight (kg):
Loaded (with magazine): 3.95
Empty (w/o magazine): 3.4
Length (mm):
Overall: 880 (937 including muzzle brake)
Barrel: 415
Rate of Fire (rd/min):
Cyclic: 600
Practical:
Automatic: 100
Semiautomatic: 40
Operation: Gas
Feed: 30-rd detachable box magazine (40-rd used by RPK-74 LMG is interchangeable)
Fire Mode: Selective, automatic or semi-automatic

SIGHTS

Name: INA
Type: Fore, pillar; rear, U-notch
Magnification**:** None
Night Sights Available: Yes. AK-74M N3 mounts an NSPU-3

VARIANTS

AKS-74: Folding-stock version with a Y-shaped, tubular stock.
AK-74M: Improves the basic AK-74 design by adding a folding plastic stock, an improved mount for night vision or other sights.
AKS-74U: Submachine gun: modified version with a much shorter barrel (207-mm) and a conical flash suppressor instead of a muzzle break. Its overall length is 492 with stock folded.
AK-101: 5.56x45-mm (NATO) variant of the AK-74M.
AK-102: 5.56x45-mm (NATO) short-barrel (314-mm) variant of the AK-74M.
AK-103: 7.62x39-mm variant of the AK-74M.
AK-104: 7.62x39-mm short-barrel (314-mm) variant of the AK-74M.
AK-105: 5.45x39-mm short-barrel (314-mm) variant of the AK-74M.

AMMUNITION

Name: 7N6
Caliber/length: 5.45x39-mm
Type: Ball
Range (m):
Effective: 500
Maximum: 800
Armor Penetration: 6 mm mild steel at 300 m, flak vest at 80 m
Muzzle Velocity (m/s): 880

Name: 7N10 (Enhanced Penetration)
Caliber/length: 5.45x39-mm
Type: Armor piercing
Range (m):
Effective: 500
Maximum: 800
Armor Penetration (mm):
16 mild steel at 300 m
5 armor plate at 150 m
Flak vest 200 m
Muzzle Velocity (m/s): 880

Name: 7T3M
Caliber/length: 5.45x39-mm
Type: Ball-Tracer
Range (m):
Effective: 500
Maximum: 800
Trace: 850
Armor Penetration: INA
Muzzle Velocity (m/s): 880

NOTES
The AK-74 is basically an AKM rechambered and rebored to fire a 5.45-mm cartridge. The AK-74 can mount a 40-mm under-barrel grenade launcher and a passive image intensifier night sight. The AK-74 is also the basis for other 5.45-mm infantry weapons including the RPK-74 light machinegun.

Marksman, Sniper, and Anti-materiel Rifles

The OPFOR recognizes marksmen and snipers as significant combat multipliers at the tactical level, playing an integral part of all OPFOR combined arms operations. They will be used to engage a wide variety of targets, including personnel, vehicles, and materiel. Tasks of marksmen and snipers may overlap on any day's mission; but overall, their roles and impact on the battlefield are different. Snipers often operate autonomously, either individually or as part of a sniper team.

Marksman Rifles. The most proliferated of these threats are marksmen, because they are part of various small units such as squads and teams. They provide accurate, precision fires, thereby extending the lethality of their unit. They are expected to rapidly provide a high volume of aimed shots at high value multiple fleeting targets. Marksmen may use a scoped rifle to engage targets beyond the effective range of most OPFOR soldiers (300 meters+). Although they may reach ranges assocated with snipers (beyond 500 m), they may require multiple shots for a kill. Thus their weapons usually have magazines and semi-automatic capability, for a high volume of aimed fires. In an urban or close environment, many of the marksman's targets may be 100 meters or less, but will use cover and concealment to reduce their silhouette. Thus marksmen must use multiple precise rapid shots to suppress or kill the targets. They are also used in the counter-sniper role and in hunter-killer teams. Marksman accuracy increases with emphasis on training, and with availability of improved rifles, scopes, laser rangefinders and other aids.

Marksmen may use rifles in calibers such as Russian 7.62x39 or 7.62x54R, 7.62x51, Enfield .303-cal, or more modern 5.45 or 5.56-mm. The common 7.62x39 used in many assault rifles is a capable marksman cartridge at ranges 300 meters and less, especially when the marksman is equipped with a scoped rifle. In many forces, existing assault rifles (those tested to have superior accuracy) will be modified for the role. Some rifles and rounds date from the 1890s, but are very effective in the role.
An insurgent marksman may differ from a modern or OPFOR marksman with less equipment or support.

The OPFOR prefers a marksman's rifle with ammunition at least as capable in precision, range, and penetration to the 7.62x54R-mm cartridge. In the marksman role, the 7.62x54R-mm is a much more effective and capable round, with greater effective range than the OPFOR tier-2 standard assault rifle (300-500 m for 5.45-mm AK-74M). The marksmen can fire a mix of sniper, ball, and armor-piercing incendiary (API) ammunition; but (600-m) ball is the most available. The 7.62x54R also has significantly more penetration versus body armor and lightly armored vehicles. With 7.62x54R and API, the marksman weapon can penetrate @ 40 inches of pine at 200 meters and 10 inches of cinder block at 100 meters. The SVD marksman/sniper rifle, from the 1960s (pgs 2-11 to 13), is still very effective in the marksman role.
Upgrades are available for any marksman rifle, including SVD, to improve their capabilities.

The OPFOR marksman carries all equipment typically carried by a rifleman. The scoped marksman rifle is usually the marksman's only weapon; but he may also be assigned an assault rifle. Other mission support equipment is available. They may include, but are not limited to—

* Optical scope (of various types).
* Binoculars.
* Detachable sound suppressor, with matching ammunition.
* Laser rangefinder.
* Night vision goggles.
* Night rifle scope (image intensifier or thermal imager, pgs 2-29 to 2-30).
* Laser pointer.

In recent years, military forces are expanding capabilities of marksmen (aka: designated marksmen or sharpshooters), with new rounds, special-designed marksman rifles, and support equipment. Other unit equipment such as an underbarrel grenade launcher with grenades and a radio can be added.
Sniper Rifles. The accepted U.S. definition of sniper is a "highly skilled military marksman detailed to spot and pick off enemy troops from a concealed position." The skills and abilities of

the snipers set them apart from marksmen. The autonomous capability of snipers permit them to operate beyond unit limits for such missions as overwatch, reconnaissance, anti-material destruction, and targeting of high value personnel targets. OPFOR snipers receive centralized advanced training in precision long-range fires. That precision and the sniper's autonomy/vulnerability generally require a training standard of 1round per kill. Snipers usually carry precision sniper-grade ammunition. They are intensively trained to master field craft, stalking, stealth, concealment, and infiltration and exfiltration. These are not necessarily required for marksmen. OPFOR snipers may or may not be in uniform.

Sniper rifles in 7.62 mm have been used by all armies for many years. Most of these weapons have limited armor penetration ability (lightly armored vehicles). The representative rifle in this caliber is the widely proliferated 7.62x54R SVD (Russian and clones). It can penetrate lightly armored vehicles (10 mm @ 200 m). Most of these weapons have some limited armor penetration ability. Many sniper rifles do not differ greatly from marksman rifles. Other modern sniper rifles are derived from hunting rifles—sophisticated bolt-action rifles firing match or sniper ammunition, with heavier barrels, superior sights, and precision trigger mechanisms. More recently specialized sniper rifles in larger calibers have appeared. Two popular calibers for recent sniper weapons are the .338-cal (8.58 mm) and Winchester .300 Magnum (-cal). Many are tailored to requirements and specifications of the user. Some recent rifles have suppressors attached, and may have special ammunition, e.g. Russian 9mm AS.

At times some or all snipers may carry an assault rifle (for missions in complex terrain) in addition to their sniper weapons. Often a member of larger teams will also be equipped with a light (5.45-mm) or medium (7.62-mm) machinegun to provide security to the team. Each OPFOR sniper has both a 7.62-mm (7.62x54R or 7.62x51 NATO) sniper rifle and an antimateriel rifle available. However, the sniper carries only one of these weapons, depending on the mission. The other rifle remains behind with the vehicle or headquarters element. Each sniper team consists of a team leader/observer (spotter) and a sniper (shooter)/target designator.

Sniper/Antimateriel rifles. A variety of 12.7 mm/ .50 cal (and above) based weapons have proliferated to the point that any U.S. force is likely to encounter them in every combat environment. Some modern sniper rifles offer semi-automatic fire from magazines. These rifles are integral to any modern battlefield. Although generally categorized as sniper rifles (and capable of being used against personnel), they are often employed as antimateriel rifles. The most widely proliferated of these rifles, whether labeled as a sniper or antimateriel rifle, is the U.S. Barrett M82A1/M95 .50 cal semi-automatic rifle, followed by the Croatian MACS M2-1/M3 (12.7-mm bolt action), then the Russian V-94 (12.7-mm semi-auto). The Barrett M82A1 is employed by all U.S. military forces as well as 27 other countries including Belgium, Chile, Denmark, Finland, France, Greece, Italy, Netherlands, Norway, Philippines, Portugal, Saudi Arabia, and UK. The Saboted Light Armor Penetrator (SLAP) round fired from the M82A1 can penetrate 19 mm (.75 in) of armor @ 1,500 m. It can also fire a multi-purpose round (See M82A1 data sheet). Approximately 25 variants of 12.7-mm sniper/antimateriel rifles are available.

Antimateriel Rifles. Often snipers will engage targets in anti-materiel missions. Targets can be mobile or stationary. The term *antimateriel* can refer to a target, a mission, or a specific category of weapons or rifles. They can be used against vehicle and non-vehicle targets, including personnel targets. Generally, there is no difference between how an OPFOR sniper targets materiel or personnel. The same TTP and the same caliber and type of rifle may be used for both missions, depending on the nature of the target, range, and other factors. However, with availability of specialized weapons, the primary difference may be in the weapon selection, determined by mission, availability, and conditions.

Generally, weapons and munitions used in the antimateriel role are more capable with larger calibers for greater penetration, and often greater range. Those rifles may be single-shot, bolt action,or semiautomatic. Some antimateriel rifles can damage or destroy targets at ranges beyond 2,000 meters. Typical calibers used in the antimateriel role are: 7.62-mm (.308 cal.), 8.58-mm (.338 cal.), 12.7-mm (.50 cal.), and 14.5-mm to 20-mm. The most prevalent caliber used is .50 cal/ 12.7-mm.

A trend during the past ten years has been towards larger-caliber anti-materiel rifles, generally in 14.5 to 20 mm. Some of these were designed not to destroy a vehicle but to neutralize a specific capability mounted externally on the vehicle. During the war in former Yugoslavia, M84s were frequently deployed to detect Croatian infantry moving at night; so a tool was developed for infantry to remove their night-vision capability—the RT20 20-mm "hand cannon", for penetrating the armored casing around sight heads and shattering the sights. Although several larger-caliber guns are available, RT20 is the most prevalent (range 1,800 m). It can fire either HE or API rounds.

Other anti-materiel rifles readily available are:

South African NTW 20-mm (range 1,500 m)
NTW 14.5-mm (range 2,300 m)
Hungarian Gepard M3 14.5-mm (range 1,000 m)
Austrian Steyr IWS 2000 15.2-mm (range 1,000 m)

Besides rifles, other sniper mission support equipment is available. OPFOR snipers will carry most support equipment carried by marksmen (pg 2-7), and more. The additional equipment may be mission-specific, and not be carried on all missions. They include, but are not limited to—

* Under-barrel grenade launcher.
* Day/night observation scope (optical and/or or electro-optical, with zoom to 60x).
* Digital camera (possibly digitial w/transmission capability).
* Ballistic computer.
* Handheld GPS receiver.
* Laser target designator for antimateriel sniper missions.
* Handheld thermal viewer.
* Tactical periscope.
* Mission-specific ammunition (sniper-grade, armor-piercing, incendiary, etc.)
* Ghillie suits and/or other special camouflage items.
* Manpack, low-power radio or other tactical radios.
* Satellite radio/telephone, and computer/digital data transmission/receipt system.
* Organic or provided transportation.
* Hide materiel and equipment.

Increasingly, modern snipers are used as forward observors for fire support units (e.g., artillery, anti-armor missiles, air defense, etc.). They may, therefore, be equipped with other equipment, such as man-held/tripod mounted goniometers for precise target acquisition, with radio links for passing fire missions. They can use their superior stalking skills for NAI/TAI missions, when special purpose forces are unavailable. A particularly useful item is the laser target designator (LTD), used to guide semi-active laser-homing precision munitions to target. These munitions can be delivered by mortars, artillery, anti-armor/antitank weapons, aircraft, and naval guns to ground or sea-borne targets. Thus snipers can destroy well-concealed targets in enemy rear area without exposing their presence and location.

Equipment carried by marksmen and snipers will vary based on mission and equipment availability. Despite all of the options available, most marksmen and snipers still carry either a 7.62-mm or 12.7-mm weapon for their primary role. Insurgents, Guerilla, and lower tier units may have less equipment or lighter and less capable equipment, depending on mission, target, and capability tier.

Russian 7.62-mm Sniper Rifle, Mosin-Nagant

Ammunition Types	Typical Combat Load
7.62-mm cartridge Light Ball Heavy Ball Sniper Enhanced Penetration AP-I Tracer	**100**

SYSTEM

Alternative Designations: Mosin/Nagant, Model 1891/30
Date of Introduction: 1891
Proliferation: Widespread

Description:
Weight (kg):
Empty: 4.06
Length (mm):
Overall: 1,230
Barrel: 726
Rate of Fire (rd/min): 10
Operation: Bolt-action
Magazine: box- 5 round
Feed: Stripper clip
Fire Mode: Bolt action

SIGHTS

Name: PE
Type: Optical
Magnification: 4x
Sighting Range (m): 2,000

Night Sights Available:
Sighting Range (m): INA

VARIANTS

M1938 Carbine: No attached bayonet, barrel is 517 mm long.
M1944 Carbine: Permanently attached folding spike bayonet, barrel is 517 mm long.
Sniper Rifle: Shown

AMMUNITION

Name: INA
Caliber/length: 7.62x54R-mm rimmed
Type: Ball
Range (m):
Practical: 400
Muzzle Velocity (m/s): 862

Name: Sniper (7N14)
Caliber/length: 7.62x54R-mm rimmed
Type: Steel core
Range (m):
Maximum: 3,800
With Scope: 1,300
Without Scope: 800
Armor Penetration: INA
Muzzle Velocity (m/s): 823

Name: 7N13
Caliber/length: 7.62x54R-mm rimmed
Type: Enhanced penetration
Range (m):
Area Target: 2,000
Armor Penetration (mm): INA.
(Effective against lightly armored vehicles and crews.)
Muzzle Velocity (m/s): INA

Name: B-32
Caliber/length: 7.62x54R-mm rimmed
Type: AP-I
Range (m):
Area Target: 2,000
Armor Penetration: 10-mm @ 200 m
Muzzle Velocity (m/s): 808

Name: T-46
Caliber/length: 7.62x54R-mm rimmed
Type: Tracer
Range of Trace (m): 1,200
Muzzle Velocity (m/s): 798

NOTES
The 7.62x54-mm rimmed cartridge of the M1891/30 rifles or M1938 and M1944 carbines is not interchangeable with the 7.62x39-mm rimless round of the AK-47/AKM or SKS. Performs best with sniper grade ammo (or any other ammo used in SVD) but standard (PKM/PKT) 7.62x54-mm rimmed rounds may also be fired.

Russian 7.62-mm Sniper/Marksman Rifle SVD

Ammunition Types	Typical Combat Load
7.62-mm cartridge Standard Ball Heavy Ball Sniper Enhanced Penetration AP-I Tracer	**40**

SYSTEM
Alternative Designations: Dragunov. See pg 2-12.
Date of Introduction: 1967
Proliferation: Widespread

Description:
Weight (kg):
Loaded (with magazine): 4.5
Empty (w/o magazine): 4.3
Length (mm):
Overall: 1,230
With Bayonet: 1,370
Barrel: 620
Rate of Fire (rd/min): 30
Operation: Gas
Feed: 10-rd detachable box magazine (15-rd available for the SVD-S)
Fire Mode: Semi-automatic only

SIGHTS
Name: PSO-1
Type: Infrared detection capability for night firing
Magnification: 4x
Field of View (°): 6
Sighting Range (m): 1,300

Night Sights Available: Yes. NSPU-3. The NSPU-3 increases accuracy to 1,000 m at night or during poor visibility.

VARIANTS
Discussion of origin, history, capabilities, and uses of the system can be found at pg 2-12.
SVD-S: Folding stock, 15-rd magazine
SVU: Bullpup (trigger forward of magazine)
OTs-03AS: SVU w/PSO-1 sight.
6V1: SVD with PSO-1 sight.
6V1-N3: SVD with NSPU-3 night sight.

AMMUNITION
Name: 57-N-323S
Caliber and Length: 7.62x54-mm rimmed
Type: Ball, standard steel-core
Range (m):
Effective: 600
Effective Night: 300 sight INA
Armor Penetration (mm):
Steel plate: 6 @ 520 m
Flak vest: Yes @ 110 m
Muzzle Velocity (m/s): 828

Name: Sniper (7N1)
Caliber/length: 7.62x54R-mm rimmed
Type: Steel core
Range (m):
Effective With Scope: 1,000
Effective Without Scope: 800
Armor Penetration: INA
Muzzle Velocity (m/s): 823

Name: 7N13
Caliber/length: 7.62x54R-mm rimmed
Type: Enhanced penetration (steel core)
Range (m):
Effective With Scope: 1,000
Effective Without Scope: 800
Armor Penetration (mm):
Steel Plate: 6 @ 660 m
Flak Vest: 800 m
Muzzle Velocity (m/s): 828

Name: 7B2-3
Bullet: B-32
Caliber/length: 7.62x54R-mm rimmed
Type: AP-I
Range (m):
Effective With Scope: 1,000
Effective Without Scope: 800
Armor Penetration: 10-mm armor plate @ 200 m
Muzzle Velocity (m/s): 808

Name: 7T2m
Bullet: T-46
Caliber/length: 7.62x54R-mm rimmed
Type: Tracer
Range
Range (m):
Effective With Scope: 1,000
Effective Without Scope: 800
Trace (m): 1,200
Time of Trace (sec): 3
Muzzle Velocity (m/s): 798

NOTES
The bolt mechanism and gas recovery system of the SVD are similar to those of the AK and AKM. The 7.62x54-mm rimmed cartridge of the SVD is not interchangeable with the 7.62x39-mm rimless round of the AK-47/AKM. The SVD performs best when using target grade ammunition, however standard (PKM/PKT) 7.62x54-mm rimmed rounds may also be fired. Every OPFOR infantry squad has an SVD.

Russian Sniper/Marksman Rifle SVD (*SNAYPERSKAYA VINTOVKA DRAGUNOVA*)

The SVD rifle design was developed by Evginiy Fedorovich Dragunov in the late 1950s. The weapon is a gas operated, 7.62x54Rmm, semi-automatic rifle that has a 10 round magazine (see pg 2-11). The rifle was fielded to the Soviet military in 1963. The main purpose of the SVD rifle was to replace the aging Mosin Nagant M91/30 and SVT Tokarev "sniper rifles." The unique operating system of the SVD changed the average marksman's rifle from a bolt action rifle to a semi-automatic rifle.

The SVD has a number of variants, and the operating system is similar to that of the Kalashnikov, such as the Avtomat Kalashnikova 'AK' family of weapons. The major difference between the SVD and the AK operating systems is that the SVD uses a short-stroke piston design as opposed to the long stroke operating rod common with most AK systems. The SVD is used to leverage any standoff distance between the average soldier and targets at ranges typically greater than can be successfully engaged with an iron sighted AK/AKM and the relatively inaccurate 7.62x39mm or 5.45x39mm cartridges they are chambered for. It will enable a rifle squad to engage targets at extended ranges with a much greater level of accuracy (dependent upon the marksman and prevailing conditions) and with a much more powerful rifle cartridge.

The Soviets developed the SVD as a true precision "sniper rifle" (perhaps the first attempt at designing and building a sniper rifle from the ground up). But as defined by U.S. Army sniper doctrine and current technology, it falls significantly short by today's standards, primarily due to its relative inability to produce consistent, precision shot placement at longer ranges. The SVD, in capable hands, can produce 2 MOA groups at 100 yards (a two inch group) whereas modern U.S. sniper systems can consistently shoot sub MOA (less than one inch groups) at that range. In other words, the SVD does not possess the intrinsic accuracy of even the venerable U.S. M21 and other more modern systems.

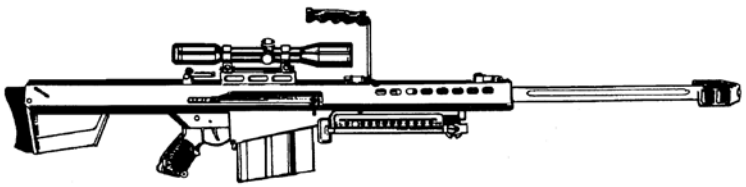
Bottom line, it is a 600 meter system; past that range, the shooter is hard pressed to obtain consistent accuracy with issue ammunition, particularly so during conditions of high cross winds, limited visibility, etc. Nonetheless, the SVD can be quite effective in urban settings as a sniper rifle, due to typically shorter standoff distances between shooter and the target, as has been demonstrated repeatedly in urban areas of Iraq when used by trained or semi-trained snipers/marksmen by AQ and/or other insurgent groups. During WW2, the Red Army fielded both male and female Soldiers who were highly trained as true snipers and who were employed with great effect against the German Army and Waffen SS on the Eastern Front. After the war, the Soviets modified their sniper doctrine and today, the Russian Federation fields what would be more analogous to our Designated Marksman at small unit level. Those marksmen are typically equipped with the SVD. This is mostly due to the difference in Soviet/Russian doctrine—the use of "marksmen" versus" snipers" (see pg 2-7).

Iraqi soldiers with SVD rifle

Of particular note is the capability of the optical scope that is standard equipment for the most common variant of the SVD. The PSO-1 telescopic sight is a 4X power optic with the capability to detect infrared illumination systems when used by the enemy. Note that during the Vietnam War, when setting ambushes for Viet Cong, there was no concern regarding infrared (IR) detection, and IR floodlights and goggles were often used at night to detect the enemy. However, if intelligence reports indicated that regular North Vietnamese Army units were operating in the area (and some were reported to have the SVD), then IR illumination systems were not used during night ambushes. Other, newer variants of the SVD also have night vision scopes available and rail interface systems (RIS) installed as well.

The SVD is a versatile and tough rifle that can be used in all types of hostile environments. The rifle has multiple variants that are proliferated world-wide, and the SVD is still also currently in the Russian inventory.

United States M82A1A .50-cal Anti-Materiel Rifle



Ammunition Types	Typical Combat Load
.50-cal cartridge Raufoss Grade A Ball (M2/M33) AP (M2) AP-I (M8) API-T (M20) Tracer (M10/21) SLAP (M903) MP (MK211 Mod 0)	30

SYSTEM
Alternative Designations: None
Date of Introduction: Early 1980s
Proliferation: Widespread (27+)

Description:
Weight (kg):
Empty (w/o magazine): 14.75
Length (mm):
Overall: 1,448
Barrel: 736
Rate of Fire (rd/min): 20
Operation: Recoil
Feed: 10-rd detachable box magazine
Fire Mode: Semi-automatic only

SIGHTS
Name: Unertl
Type: Optical (matches trajectory of .50-cal Raufoss Grade A)
Magnification: 10x

Name: Swarovski
Type: Optical (with ranging reticle)
Magnification: 10x42
Night Sights Available: yes
Magnification: 10x42

Name: Barrett Optical Ranging System (BORS)
Type: Ballistic Computer. This add-on device couples to the telescope, in place of the rear scope ring. It can then adjust for range, air temperature, round used, and other factors. A commonly associated scope is the Leupold Mark 4; but it can also work with other scopes.

Night Sights Available: yes

AMMUNITION
Name:Raufoss Grade A (match)(DODIC A606) (USMC)
Caliber/length: .50-cal BMG/12.7-mm x 99-m (NATO)
Type: Standard operating round
Range (m) (equipment-size targets):
Maximum (w/scope): 1,800
Muzzle Velocity (m/s): 854

Name: MP NM140 (Nammo) MK211 Mod 0
Caliber/length: .50-cal BMG/12.7-mm x 99-m (NATO)
Range (m) (equipment-size targets):
Maximum (w/scope): 1,800
Armor Penetration: 11 mm @45° @1,000 m
Fragmentation: 20 fragments after hitting 2 mm steel
Incendiary Effect: Ignition of JP4 and JP8
Accuracy: <15 cm @ 550 m
Muzzle Velocity (m/s): 915

Name: AP-S NM173 (Nammo)
Caliber/length: .50-cal BMG/12.7-mm x 99-m (NATO)
Type: Armor piercing
Range (m) (equipment-size targets):
Maximum (w/scope): 1,800
Armor Penetration: 11 mm @30° @1,500 m
Accuracy: <15 cm @ 550 m
Muzzle Velocity (m/s): 915

Name: M903 (Olin)
Caliber/length: .50 cal BMG/12.7-mm x 99-m (NATO)
Type: Saboted Light Armor Penetrator (SLAP) (actual bullet is tungsten .30 inch penetrator wrapped in a .50-cal plastic sabot)
Range (m) (equipment-size targets):
Maximum (w/scope): 1,500
Armor Penetration: 19 mm (.75 in) @1,500 m
Accuracy: INA
Muzzle Velocity (m/s): 1,014

Name: M8
Caliber/length: .50-cal BMG/12.7-mm x 99-m (NATO)
Type: Armor piercing incendiary
Range (m) (equipment-size targets):
Maximum (w/scope): 1,800
Armor Penetration: 20 mm @ 100 m
Accuracy: <25 cm @ 550 m
Muzzle Velocity (m/s): 881

Name: M20
Caliber/length: .50-cal BMG/12.7-mm x 99-m (NATO)
Type: Armor piercing incendiary-Tracer
Trace (m): 91 to 1,463
Armor Penetration: 20 mm @ 100 m
Accuracy: <25 cm @ 550 m
Muzzle Velocity (m/s): 887

VARIANTS: M107-A1 is a product improvement

	of the M82A1A. Improvements include: reduction in weight by 5 pounds; cylindrical titanium muzzle brake; titanium barrel key/recoil buffer system in order to operate with a Barrett suppressor; functional modifications to increase durability and ease of operation. Barrett introduced this variant in 2013.

NOTES
The M82A1A provides maneuver commanders with the tactical option of employing snipers with an anti-materiel weapon to augment present 7.62-mm anti-personnel sniper rifles. Recoil equals 7.62x51-mm levels. The USMC uses Raufoss Grade A ammunition, but the rifle is capable of firing any standard 12.7x99-mm Browning machinegun ammunition.

Russian 6S8-1, 12.7mm, Anti-Materiel Rifle

Ammunition Types	Typical Combat Load
7N34 Sniper BZ (API) BZT (API-T)	Approx 30

SYSTEM
Alternative Designations: KSVK
Date of Introduction: 2013
Proliferation: Russia (Army)

Description:
Weight (kg):
Empty (w/o magazine or optical sight): 12.5
Length (mm):
Overall: 1,420
Barrel: 1,000
Rate of Fire (rd/min): 10
Operation: Bolt action, bull pup design
Feed: 5-rd detachable box magazine
Max Eff Range (m): 1,500 w/optical sight; 1,000 w/iron sights.
Muzzle velocity (m/s): 770-860

SIGHTS
Name:
Type: Optical: Orsis T-5000 or night vision scope mounted on integral Picatinny rail.
Magnification: specifics unknown, but a variable power scope

Night Sights Available: yes

Russian OSV-96, 12.7mm, Anti-Materiel Rifle

Ammunition Types	Typical Combat Load
7N34 Sniper BZ (API) BZT (API-T)	Approx 30

SYSTEM
Alternative Designations: KSVK
Date of Introduction: 2013
Proliferation: Russia, Belarus, India, Syria (SA and various FSA factions, and it would be reasonable to assume, ISIL as well). Note that in Russia, this system is primarily used by Federal Security Service (FSB) and Ministry of Internal Affairs SPETSNAZ units.

Description:
Weight (kg):
Empty (w/o magazine or optical sight): 12.9
Length (mm):
Overall: 1,746
Barrel: 1,000
Rate of Fire (rd/min): limited to shooter's ability to acquire and engage targets and reload. 20 SPM would be a practical maximum.
Operation: Semi automatic, gas operated, rotating bolt.
Feed: 5-rd detachable box magazine
Muzzle velocity (m/s): 770-860
Max Eff Range (m): 2,000

SIGHTS
Name:
Type: Optical: POS 13x60 or night vision scope mounted on integral Picatinny rail.
Magnification: 13x

Night Sights Available: yes

NOTES
The OSV-96 is somewhat unique in that it can be broken down and folded in half at the point where the barrel joins the receiver. This facilitates transport of an otherwise very unwieldy weapons system

Russian 7.62-mm Light Machinegun RPD

Ammunition Types	Typical Combat Load
7.62-mm cartridge	
Ball	
Tracer	
API	
Tracer Incendiary	**1,000**
Total	

SYSTEM

Alternative Designations: Degtyarev
Date of Introduction: 1944
Proliferation: Widespread
Description:
Weight (kg):
Empty (w/o magazine) (kg): 7
Loaded (with magazine): 13
Mount: Bipod
Length (mm):
Overall: 1,037
Barrel: 520
Quick Change Barrel: No
Rate of Fire (rd/min):
Cyclic: 600
Practical: 150
Fire Mode: Automatic
Operation: Gas
Feed: Metallic-link belt, 100-rd drum (containing belt). The Chinese copies may use 200-rd drums.

SIGHTS
Name:
Type: Leaf sights
Sighting range (m): 900 in 100 m steps
Magnification: None
Night Sights Available: yes

AMMUNITION

Name: M1943 (57N231S)
Caliber/length: 7.62x39-mm
Type: Ball, steel core
Range (m):
Effective: 800
Maximum: 800
Armor Penetration: 6 mm mild steel plate at 300 m
Steel helmet at 1,000 m
Flak vest at 60 m
Muzzle Velocity (m/s): 718

Name: M1943 (T-45 or 57N231P)
Caliber/length: 7.62x39-mm
Type: Ball-Tracer
Range
Effective: 800
Maximum: 800
Trace (m): 800
Muzzle Velocity (m/s): 718

Name: M1943
Caliber/length: 7.62x39-mm
Type: API
Armor Penetration (mm @ 0° obliquity @ 500m): 8
Muzzle Velocity (m/s): N/A

VARIANTS
Type 56 & 56-1: Chinese
Type 62 Light MG: North Korean
M52: Czech

NOTES*:*
The RPD can be used as an assault rifle. The use of the drums for ammo can make carrying the ammunition earlier than carrying large ammunition boxes. It was replaced by the RPK (which was in-turn replaced by the RPK-74) by several armies. This reliable light machinegun is still found in large numbers throughout the world. It is the mainstay of many militias. These weapons are numerous, easy to acquire, reliable, lethal, and cheap.

Russian 7.62-mm Light Machinegun RPK

Ammunition Types	Typical Combat Load
7.62-mm cartridge	
Ball	
Tracer	
API	
Tracer Incendiary	**1,000**
Total	

SYSTEM

Alternative Designations: none
Date of Introduction: 1964
Proliferation: Widespread
Description:
Weight (kg):
Empty (w/o magazine) (kg): 4.9
Loaded (with magazine): 5.67 w/40-rd mag
Mount: Bipod
Length (mm):
Overall: 1,035
Barrel: 591
Quick Change Barrel: No
Rate of Fire (rd/min):
Cyclic: 650
Practical (auto): 150 (80 sustained, see note)
Practical (semi): 50
Fire Mode: Selective
Operation: Gas
Feed: 40 round-curved box or 75-rd drum magazine. Can also use the 30-round curved box magazine used by the AKM.

SIGHTS
Name: N/A
Type: Leaf sights
Magnification: None
Night Sights Available: yes, (luminous front/rear)

AMMUNITION

Name: M1943 (57N231S)
Caliber/length: 7.62x39-mm
Type: Ball, steel core
Range (m):
Effective: 800
Maximum: 800
Armor Penetration: 6 mm mild steel plate at 300 m
Steel helmet at 1,000 m
Flak vest at 60 m
Muzzle Velocity (m/s): 718

Name: M1943 (T-45 or 57N231P)
Caliber/length: 7.62x39-mm
Type: Ball-Tracer
Range
Effective: 800
Maximum: 800
Trace (m): 800
Muzzle Velocity (m/s): 718

Name: M1943
Caliber/length: 7.62x39-mm
Type: API
Armor Penetration (mm @ 0° obliquity @ 500m): 8
Muzzle Velocity (m/s): N/A

VARIANTS
RPKS: Folded stock version (820 mm in length)

NOTES*:*
The RPK is the machinegun variant of the AKM and as such is an extended version of the AKM. It has a longer, heaver barrel than the AKM (591 mm vs 414 mm). Most moving parts are interchangeable with the AK-47 or AKM assault rifles. The sustained rate of fire cannot exceed 80 rds per minute due to "cook off". It has been replaced by the 5.45-mm RPK-74 in many armies.

Russian 5.45-mm Light Machinegun RPK-74

Ammunition Types	Typical Combat Load
5.45-mm cartridge Ball Ball-tracer Incendiary-T AP	**320**

SYSTEM

Alternative Designations: INA
Date of Introduction: Late 1970s
Proliferation: Widespread

Description:
Weight (kg):
Loaded (with magazine): 5.0
Empty (w/o magazine): 4.6
Length (mm):
Overall: 1.07 m
Barrel: 590 mm (including flash suppresser)
Rate of Fire (rd/min):
Cyclic: 600
Practical:
Automatic: 150
Semiautomatic: 50
Operation: Gas
Feed: 40-rd detachable box magazine (30-rd used by AK-74 is interchangeable)
Fire Mode: Selective, automatic or semi-automatic

SIGHTS

Name: INA
Type**:** Fore, cylindrical post; rear, tangent leaf with U-notch; adjustable to 1,000 m
Magnification**:** None
Night Sights Available: Yes. 1LH51 night sight

VARIANTS

RPKS-74: Folding stock

AMMUNITION

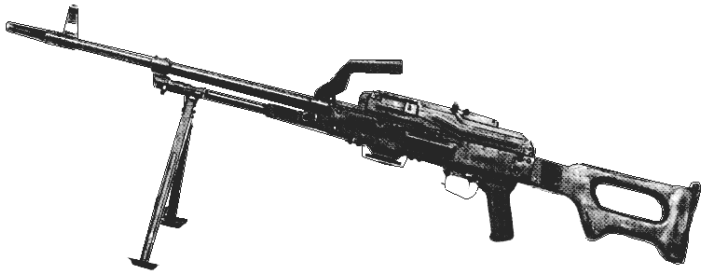
Name: 7N6
Caliber/length: 5.45x39-mm
Type: Ball
Range (m):
Effective: 800
Maximum: 1,000
Armor Penetration: 6 mild steel at 300 m, flak vest at 80 m
Muzzle Velocity (m/s): 960

Name: 7N10 (Enhanced Penetration)
Caliber/length: 5.45x39-mm
Type: AP
Range (m):
Effective: 1,000
Maximum: 1,000
Armor Penetration (mm):
16 mild steel at 300 m
5 armor plate at 150 m
Flak vest 200 m
Muzzle Velocity (m/s): 960

Name: 7T3M
Caliber/length: 5.45x39-mm
Type: Ball-Tracer
Range (m):
Effective: 800
Maximum: 1,000
Trace: 850
Armor Penetration: INA
Muzzle Velocity (m/s): 960

NOTES
The RPK-74 is the machinegun version of the AK-74, firing the same ammunition. Instead of the prominent muzzle brake used on the AK-74, the machinegun is longer than that normally used with the AK-74, but the magazines are interchangeable. The RPK-74 has a bipod and is compatible with the front firing ports of BMPs.

Russian 7.62-mm General Purpose Machinegun PKM and Pecheneg



Ammunition Types	Typical Combat Load
7.62-mm cartridge Ball Ball-tracer Incendiary-ranging API API-T	**INA**

SYSTEM
Alternative Designations: (see VARIANTS)
Date of Introduction (PKM/PKT): 1971/1968
Proliferation: Widespread

Description:
Crew: 2
Weight (kg):
Empty (w/o magazine) (PKM/PKT) (kg): 8.4/10.66
Loaded (with magazine): Varies with magazine
Ammo box (only) with 100/200-rd belt (kg): 3.9/8.0
Tripod (lightweight) (kg): 4.75
Length (mm):
Overall (PKM/PKT): 1,160/1,080
On tripod (PKS): 1,267
Barrel: 658
Barrel Change: Yes
Mount Type: Pintle, coaxial, bipod or tripod (Stepanov)
Mounted On: (see VARIANTS)
Rate of Fire (rd/min):
Cyclic: 650
Practical: 250 for PKM. Bursts to 600 for Pecheneg/PKP
Fire Mode: Automatic
Operation: Gas
Feed: Belt, 100-rd belt carried in a box fastened to the right side of the receiver. 25-rd belts can be joined in several combination lengths (100/200/250)

SIGHTS
Name: INA
Type: Open iron sights
Sighting range (PKM/PKT) (m): 1,500/2,000
Magnification: None
Night Sights Available: Yes

VARIANTS
PKM: Squad machinegun
PKT: Vehicle mounted MG with solenoid electric trigger, remote sight, and a longer heavier barrel. It lacks a stock and, bipod. Some are coaxial to a main gun and use its sights. Others operate separately. They generally do not dismount for ground use.
PKS: Lightweight tripod-mounted infantry weapon
PKMS: Lightweight tripod-mounted variant of the PKS
PKB (PKBM): Pintle-mounted on APCs, SP guns, BRDM, BTRs, has butterfly trigger rather than solenoid, double space grips, and front and rear sights

Pecheneg/PKP/6P41: Modernized PKM with longer service life and lower recoil. Improved accuracy to 1,500 m reduces firing error 80% versus PKM. The barrel rear is steel-jacketed and ribbed with muzzle break air vents, for full-length barrel cooling and longer bursts (to 600 rounds) with no barrel change needed. The carry handle with built in rear sight (and telescopic sight mount) eliminates blurred sight image due to heat shimmer. The bipod is fitted to the barrel for better balance.

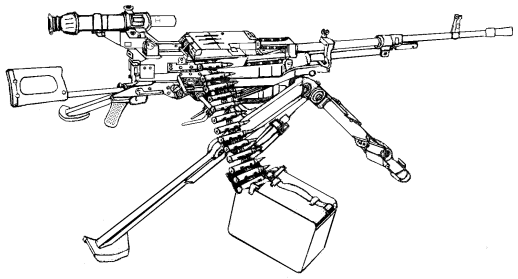
AMMUNITION

Name: 57-N-323S
Caliber and Length: 7.62x54-mm rimmed
Type: Ball
Max Range (PKM/PKT) (m): 3,800/4,000
Practical Range (PKM/PKT) (m):
Day: 1,000/2,000
Night: 300/INA
Armor Penetration @ 0° obliquity
@ 500 range (mm): 8
steel plate @ 520 m (mm): 6
Flak vest: 110 m
Muzzle Velocity (PKM/PKT) (m/s): 825/855

Name: 7BZ-3
Caliber and Length: 7.62x54-mm rimmed
Type: Armor piercing incendiary
Max Range (PKM/PKT) (m): 3,800/4,000
Practical Range (PKM/PKT) (m):
Day: 1,000/2,000
Night: 300/INA
Armor Penetration
@ 200 range (mm): 10
Muzzle Velocity (PKM/PKT) (m/s): 808

NOTES
The 7.62-mm general-purpose machinegun (PKM) is a gas-operated, belt-fed, sustained-fire weapon. The basic PKM is bipod-mounted but can also fit in vehicle firing ports. It is constructed partly of stamped metal and partly of forged steel. Compared to the US M-60, the PK-series machineguns are easier to handle during firing, easier to care for, and lighter. The 7.62x54R is a more powerful cartridge than the US with a slightly shorter effective range.

Russian/Kazhakstani 12.7-mm Heavy Machinegun NSV/NSVT and Russian Kord _



Ammunition Types	Typical Combat Load
12.7-mm cartridge	**300**
API (B-32)	
API-T (BZT-44)	
HEI	

SYSTEM

Alternative Designations: NSVS (tripod-stand mounted), Utyos
Date of Introduction: Early 1970s
Proliferation: Widespread. The original plant is in Kazakhstan. After dissolution of the USSR, a Russian plant now produces the MG.

Description:
Weight (kg):
Total System (w/6T7): 43
Empty: 25
Loaded: INA
Tripod (6T7 tripod): 16
Length (mm):
Overall: 1,560
On 6T7 Tripod: 1,900
Width (on 6T7 tripod) (mm): 860
Height (on 6T7 tripod) (mm): 380
Barrel Life (rds): 5,000
Barrel Change Time (sec): 5
Barrel Weight (kg): 9.2
Mount Type: 6T7 (infantry) tripod or 6U6 (w/seat) universal tripod
Mounted On: (see VARIANTS)
Traverse (°): 360
Elevation (°): -5 to +75
Rate of Fire (rd/min):
Cyclic: 680-800
Practical: 100
Fire Mode: Automatic; short bursts (four to six), long bursts (10 to 15), or continuously
Operation: Gas
Feed: Left or right from metal link belt from 50-rd boxes

SIGHTS

Name: INA
Type: Metallic sights, (tangent leaf rear and folding front post)
Sight Range (m): 2,000
Name: 10P50 Optical
Type: Day optical sight
Magnification: 3-6x
Name: 1PN52-1
Type: Night sight
Magnification: 5.3x
Name: 10P80 (used w/ 6U6 mount)
Type: AA collimating sight (aircraft speed to 300 km/h)
Name: 10P81 (used w/ 6U6 mount)
Type: Ground target sight
Name: K10-T (on NSVT for T-72/T-80)
Type: Reflex AA sight

VARIANTS

NSVT: Tank-mounted version (See NOTES)
A tripod-mount (6T7) version is available for infantry use in a ground role. However, the NSVT appears more commonly mounted on the turrets of tanks as an antiaircraft machinegun.

Russian NSV/NSVT: The Russian version can produce the guns for either Russian 12.7x108 or NATO 12.7 x 99 (.50-cal) ammunition.

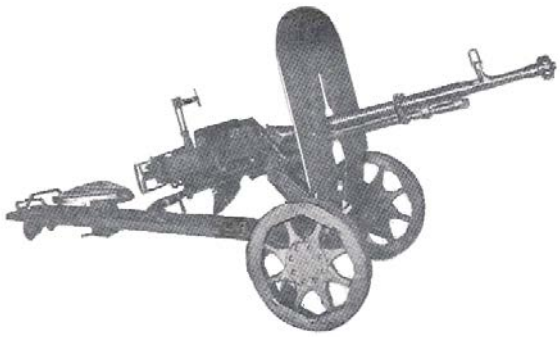
Kord: A Russian modernized version of the NSV/NSVT. Improvements include reduced weight (50% for hand-carry 6P57), reduced recoil, increased barrel life, improved reliability, improved accuracy, increased burst rate capacity, and improved reliability and maintenance. Reduced weight and recoil permits use with the 6T19 light machinegun bipod. Like the above Russian MGs, the Kord can be produced in either ammunition version. Vehicle version is 6P49. Swivel mount hand-operated versions are 6P58 and 6P59.

AMMUNITION

Name: B-32
Caliber and Length: 12.7x108-mm
Type: Armor Piercing Incendiary
Max Range (ground) (m): 7,850
Effective Range (m):
AA: 1,000
Ground: 2,000
Armor: 800
Night (w/1PN52-1): 1,000
Armor Penetration @ 0º obliquity @ 500/1,000m range (mm): 20/13.2
Muzzle Velocity (m/s): 860

NOTES
On the T-72 and the T-80, it has a rotating mount and can be fired from within the tank. The tank commander employs the K10-T reflex sight to engage aircraft. On the T-72/T-80 mount he engages ground targets with metallic sights on the gun itself. The T-64 tank mounts a modified version with a fixed mount on the commander's cupola. It fires by means of an electrical solenoid when the tank is buttoned up. An optic serves this purpose. Instead of the normal 50-round ammunition belt container, the NSVT on the T-64 may use a larger belt container holding 200 rounds.

Russian 12.7-mm Heavy Machinegun DShK 38/46



Ammunition Types	Typical Combat Load
Ball	
API (B-32)	
API-T (BZT-44)	
HEI	
Total	750

SYSTEM

Alternative Designations: DShKM, Degtyarev, DShK 38
Date of Introduction: 1946
Proliferation: Widespread
Description:
Weight (kg):
Empty (gun only): 36.6
w/Mount: 158
Length (mm):
Overall: 1,588
Quick-change Barrel: Yes
Barrel Length (mm): 1,070
Mount Type: Vehicle, wheels, or tripod (M1938)
Traverse (°): 90, free on tripod
Elevation (°): -10 to +80, free on tripod
Rate of Fire (rd/min):
Cyclic: 540-600
Practical: 80-100
Fire Mode: Automatic only
Operation: Gas, fires from open bolt
Feed: 50 round non-disintegrating metallic belt (feed from both sides)

SIGHTS

Name: NFI
Type: metallic leaf sights
Sight Range (m): 2,000
Name: Model 1943 Antiaircraft Sights
Type: Computing AA sight
Night Sights Available: Yes

VARIANTS

DShKT: Tank mounted
Chinese Type 54 Heavy Machinegun: Copy
Czech M54 Quad Mount

AMMUNITION
Name: B-32
Caliber and Length: 12.7x108-mm
Type: Armor Piercing Incendiary
Max Range (ground) (m): 7,850
Effective Range (m):
AA: 1,000
Ground: 2,000
Armor: 800
Night (w/1PN52-1): 1,000
Armor Penetration @ 0º obliquity @ 500/1,000m range (mm): 20/13.2
Muzzle Velocity (m/s): 860

NOTES
The DShK 38/46 is a widely proliferated heavy machinegun generally used as an antiaircraft or anti-vehicle weapon. Many countries use the DShK 38/46 on vehicular mounts while others use it mostly on its ground mount. Many Asian counties use a 2-wheel mount in the ground role. The M1938 tripod is used for ground fire but can be readily converted for AA fire. M38 and M46 ammo belts are not interchangeable. A large flat armored shield is occasionally used to protect the crew when the gun is used in its ground role. In many countries this weapon was replaced by the 12.7-mm NSV in the ground role or by the heavier 14.5-mm ZPU series in the antiaircraft role.

United States Browning Machine Gun, Caliber .50, M2 HB _____

Ammunition Types

Ball M33
Tracer M17
API M8
API-T M20
SLAP M903
SLAP-T M962

SYSTEM

Alternative Designations: M2A1, AN/M2, M296, M213, etc.
Date of Introduction: 1933
Proliferation: Widespread
Description:
Weight (kg):
Empty (gun only): 38
w/tripod and T&E: 58
Length (mm):
Overall: 1,654
Quick-change Barrel: Yes
Barrel Length (mm): 1,143
Mount Type: Vehicle or tripod .
Rate of Fire (rd/min):
Cyclic: 450-550
Sustained: ~40
Fire Mode: Automatic or single shot
Operation: Short recoil, closed bolt
Feed: Belt fed (M2 or M9 links), 110 round belts.

SIGHTS

Name:
Type: metallic leaf sight (rear) and blade front w/cover.
Sight Range (yds): 2,600

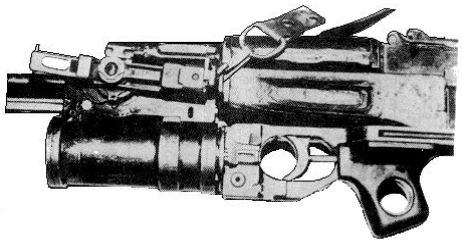
VARIANTS

M2A1: Latest version (2010); does not require head space and timing adjustments by crew. Max eff range of approx 2,000m.

PERFORMANCE DATA
Name:
Caliber and Length: .50 Caliber/12.7x99-mm
Max Range (ground) (m): 6,800
Effective Range (m): 1,800
Muzzle Velocity (m/s): 890 (M33 Ball)

NOTES
The Browning M2 is a widely proliferated heavy machinegun generally used as an antiaircraft or anti-vehicle weapon. Many countries use the M2 on vehicular mounts or on the tripod with issued T&E for a very effective ground weapon for use against vehicles or troops in the open or in buildings. The M2 can be equipped with night or day scopes, and can be used as a very effective sniper weapon when equipped with a telescopic sight and used in its single shot mode with special ammunition.

Russian 40-mm Under-Barrel Grenade Launcher GP-30 and RG-6 Grenade Lchr__



Ammunition Types	Typical Combat Load
40-mm grenade	**10**
Frag-HE (impact)	
Frag-HE (bounding)	
Smoke	
Tear gas	

SYSTEM
Alternative Designations: BG-15 Mukha; GP-25 Koster, GP-30 Obuvka
Date of Introduction: 1980
Proliferation: Widespread
Description:
Weight (kg):
Loaded: 1.79
Empty: 1.5
Length (mm):
Overall: 323
Barrel: 205
Rate of Fire (rd/min): 4-5
Operation: N/A
Feed: Muzzle-loaded
Fire Mode: Single-shot
Accuracy @ 400 m:
Distance: 6.7 m
Deflection: 3 m
Components: Barrel (w/ mounting bracket and sight), trigger assembly

SIGHTS
Name: N/A
Type: Front post and rear open U-notched
Location: Left side of mounting bracket
Sighting Range (m): Graduated out to 400

VARIANTS
BG-15, GP-25: (see NOTES)

RG-6/6G30: Hand-held 40-mm grenade launcher with 6-shot revolver cylinder. The launcher is 690 mm long (520 with buttstock retracted) and weighs 6.2 kg unloaded. With swing-out cylinder for fast loading and double action trigger, it can deliver a high volume of precision fire (16 rd/min) to 350 m. It fires all grenades listed to the right.

Penal: Hand-held disposable grenade launcher with the VOG-25 grenade. Max range is 30-40 m. This would be treated as additional squad ammunition, and be used by other squad members to supplement grenadier fires.

AMMUNITION
Name: VOG-25
Caliber/length: 40x102-mm
Type: Frag-HE with impact fuze
Weight (kg):
Round: .250
Exposive: .048
Range (m):
Maximum: 400
Minimum: 10–40 (arms itself)
Casualty Radius (m): 6; (90% @ 10)
Self-destruct Time (sec): 14–19
Muzzle Velocity (m/s): 76

Name: VOG-25P
Caliber/length: 40x122-mm
Type: Bounding Frag-HE, explodes .5 to 1.5 m from impact
Weight (kg):
Round: .278
Exposive: .037
Range (m):
Maximum: 400
Minimum: 10 – 40 (arms itself)
Casualty Radius (m): 6; 90% @ 10
Self-destruct Time (sec): 14 –19
Muzzle Velocity (m/s): 75

Name: GRD-40
Caliber/length: 40x150-mm
Type: Smoke
Effective Against: Visual and infrared
Weight (g): 260
Smoke Screening Range (m): 50, 100, 200
Smoke Screen Dispersion (m):
1 sec.....10x10x10
2 sec.....20x20x20
3 sec.....25x25x25
Smoke Screen Duration @ wind speed of 3-5 m/s: At least 60 sec
Muzzle Velocity (m/s): 70-75

Other Grenades: Gvozd ("Nail") tear gas grenade

NOTES
The GP-30 Obuvka is a widely proliferated, muzzle-loaded, single-shot, detachable, under-barrel grenade launcher. The BG-15, GP-25 and the GP-30 are all basically the same weapon. Variants can be mounted on all models of Kalashnikov assault rifles. The rifleman can fire the launcher only when the complete weapon is attached to the assault rifle.

Russian 43-mm Magazine Grenade Launcher GM-94

GM-94 with fixed stock

GM-94 with folding stock

Ammunition Types	Typical Combat Load
40-mm grenade	**For dismounts 16**
HE Thermobaric	**From vehicles <48**
Non Lethal:	**Single load 4**
Shock effect	
Smoke	
Tear gas	

SYSTEM
Alternative Designations: Some sources state that the GM-94 is the same weapon as Infantry Flamethrower **LPO-97**; but KBP, the manufacturer, lists them separately.
Date of Introduction: 2007
Proliferation: Russian Ministry of Internal Affairs, and other paramilitary units.

Description:
Weight (kg):
Empty: 4.8
Length (mm):
With stock folded: 540
With stock extended: 810
Width (mm): 80
Height (mm): 320 with folded stock
Rate of Fire (rd/min): 12 (salvo of 4 in 8seconds, 4 reloads, est)
Operation: Pump action
Feed: Over-barrel magazine
Fire Mode: Semi-automatic

SIGHTS
Name: N/A

Type: Front post and rear open U-notched, 2 blades
Location: Top of magazine
Sighting Range (m): Graduated out to 300

VARIANTS
GM-93: Nomenclature for a prototype version. A two-barreled prototype version was seen briefly as shown below.

AMMUNITION
Name: VGM-93
Caliber/length: 43-mm
Type: HE thermobaric, with impact fuze. The round has a plastic nose with the explosive fill. It deforms and detonates against hard and soft targets.
Weight (kg): INA
Range (m):
Maximum: 600
Maximum Sighted: 300
Casualty Radius (m): 3 With no metal fragments, the round can be used for room-to-room clearance of buildings (3-m lethal radius), with minimum damage to nearby personnel (5-m safe distance). Concussive effect from the blast will debilitate or shock personnel over a wider area than with the Shock Effects grenade noted below.
Armor Penetration (mm): 8. The deforming round permits armor penetration against light armor, such as that found on tactical utility vehicles, trucks, etc. The round can destroy materiel targets.
Muzzle Velocity (m/s): 85+

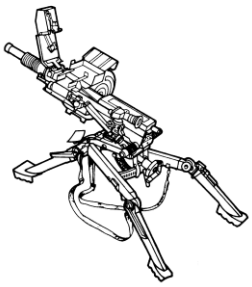
Other Ammunition Types: Non-lethal grenades: Smoke, shock effect, and tear gas.

The Shock Effect grenade is a "flash-bang" non-lethal grenade for temporarily pacifying persons in a target area, aiding discrimination of targets from neutral personnel in the area.

Tear gas grenade effectiveness area is $100m^2$ against personnel in the open or 300 m^2 against personnel in enclosed areas.

NOTES
There are some unconfirmed reports of Frag-HE grenades for this weapon. Military forces applications will likely require Frag-HE grenades.

Russian 30-mm Automatic Grenade Launcher AGS-17 and AGS-30



AGS-17

AGS-30

Arbalet

Ammunition Types	Typical Combat Load
30-mm grenade Frag-HE	**Dismounted 87**

SYSTEM
Alternative Designations: Plamya (Flame)
Date of Introduction: 1974
Proliferation: At least 12 countries
Description:
Crew: 3 (gunner and two riflemen-assistant gunners). For ground transport the AGS-17 breaks down into four parts: launcher, sight, tripod, and magazine. When dismounted the gunner carries the sight and launcher, the first assistant carries the tripod and a magazine, and the second assistant carries two additional magazines. An additional ammunition bearer may be used.
Weight (kg):
Empty (without magazine): 30.71
Loaded (with magazine): 45.05
Launcher: 17.86
Sight: .99
Tripod: 11.86
Magazine (loaded): 14.34
Length (m): 1.28
Height (m): INA
Width (m): INA
Tripod Name: SAG-17
Mounts: Tripod, vehicle, or helicopter
Traverse (°): 30 total
Elevation (°): +7 to +87
Service Life of Barrel (rds): 6,000
Barrel Change Time: Quick disconnect
Rate of Fire (rd/min):
Practical: 60-100
Cyclic: 100-400 Adjustable with a thumb safety. May be fired single shot or in short (≤ 5 rds) or long (6-10 rds) bursts.
Operation: Blowback
Feed: Drum magazine containing 29 round belt.
Fire Mode: Selective, automatic and semi-automatic
Loader Type: Manual

SIGHTS
Name: PAG-17
Type: Illuminated day optical sight
Sighting Range (m): 1,700
Magnification: 2.7x
Location: Left rear of launcher
Night Sights Available: Yes. The AGS-17 is capable of mounting night vision sights, with a range of 1,500+ m.

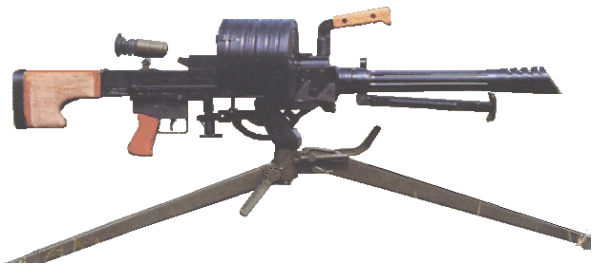
VARIANTS
AG-17: Helicopter and vehicle mount AGL with electric trigger and remote sight. The **AG-17A** has a water cooled quick-change barrel and rate of fire to 420-480 rd/min, with a 300 rd belt.
AGS-17M: Recent version for light vehicles with pintle or ring mounts. It has a ballistic LRF sight for a range of l,730 m. The **Adunok** remote operated weapon station is a light mount for use on tactical utility vehicles, trucks, etc., with the AGS-17M. It could also be secondary RWS for IFVs/APCs.
AGS-30/TKB-722K AGL: Lighter version and follow-on to the AGS-17, fires the same ammunition as the AGS-17, with a max range of 2,100 m. The AGL can use the 1PN102-1 day/night sight with 3rd gen II night range of 1,500+ m (est). The **AG-30** version can be heli/vehicle mounted for remote operation to 2,100 m.
Arbalet: Shoulder-fired semi-auto grenade launcher. It has a 5 or 10-rd magazine, 1,000-m aimed range, and a weight of 10 kg.

AMMUNITION
Name: VOG-17A, VOG-17M (self-destruct)
Caliber/length: 30x132.8-mm
Type: Frag-HE, with a steel wire coil and aluminum nose fuze
Range (m)
Direct Fire Range (m): 700
Effective (m): 1,200
Min Range (m): 50
Max Indirect Range (m): 1,730
Armor Penetration: Lightly armored vehicles.
Accuracy @ 400 m (m): 4.3 distance, 0.2 deflection
It is very accurate in the semiautomatic mode and is quite effective in area coverage in the automatic mode. The 50-meter increments in the range table atop the receiver indicate accuracy against point targets.
Casualty Radius (m): 15 (90% at 7 m)
Complete Round Weight (grams): 350
Grenade Weight (grams): 280
Warhead Explosive Weight (grams): 36
Muzzle Velocity (m/s): 185
Fuze Type: Impact, activates after 25 spins.
Self-destruct time (sec): 27

Other Ammunition:
Name: VOG-30 Frag-HE with grooved body for controlled fragmentation, and increased HE fill (40 g). Lethal radius is 6 m at (90%) against personnel, with increased personnel injury effects at 10m and increased anti-material effects.
Name: VUS-17 smoke grenade with a red phosphorus fill.
Name: GPD-30 Frag-HE grenade. It features an effects radius of 20 m. When used with the AGS-30, range is 2,100 m.

NOTES
AGS-17 provides infantry an area suppressive capability. Although primarily for use against personnel, it has a limited capability against light armored vehicles. AGS-17 is normally organized in a platoon consisting of 6 launchers, carried in pairs in three armored vehicles (they can also be carried in trucks or by individuals). One AGL can create a damage zone 15 meters wide. A platoon can cover a sector 90 m across.

Chinese 35-mm Automatic Grenade Launcher W-87, QLZ-87, and QLB-06 _____



Ammunition Types	Typical Combat Load
35-mm grenades Frag-HE HEAT-MP	**Crew load 36** Drums of 6, 9, 12, 15

SYSTEM
Alternative Designations: INA
Date of Introduction: WLZ-87 prior to 1988 (limited production)
QLZ-87 fielded by 2007
Proliferation: At least one
Description:
Weight (kg):
Empty (without magazine): 12
Tripod: 8
Mounts: Bipod (attached) or Tripod
Operation: Blowback
Feed: 6, 9-rd box, 12-rd drum, 15-rd drum
Fire Mode: Semi or Automatic
Loader Type: Manual
Recoil: Similar to .50 cal rifle

PERFORMANCE
Range (m)
Direct Fire Range: INA
Effective: 600
Max Range: 1,500
Rate of Fire (rd/min): 400
Muzzle Velocity (m/s): 170

AMMUNITION
Name: INA
Caliber/length: 35-mm
Type: Frag-HE
Grenade Fill: HE and 400 3-mm steel balls
Armor Penetration: Penetrates body armor
Lethal Radius (m): 11
Complete Round Weight (grams): 270
Muzzle Velocity (m/s): 170

Name: "HEAT"
Caliber/length: 35-mm
Type: HEAT-multipurpose (with anti-armor HEAT warhead and anti-personnel/anti-materiel HE blast effects)
Armor Penetration: 80 mm @ 600 m
Lethal Radius (m): 5 for HE effects
Complete Projectile Weight (grams): 270
Muzzle Velocity (m/s): 170

SIGHTS
Type: Optical

VARIANT
WLZ-87: Early prototype, found in few units.

QLZ-87: Updated lighter variant, adopted for PLA forces. It comes in standard and heavy configurations. The standard version, with a bipod and telescope, weighs 12 kg, and has an anti-armor range of 600m. Range with the Frag-HE grenade is 1,000-1,750 m. The heavy version is more suitable for vehicle pintle mount or dismounted tripod. It is scoped, weighs 20 kg, and ranges to 1,750 m.

QLB-06/87B: Recent lightweight shoulder version (9.1 kg), which also
fires HEAT-MP grenades to 600 m, Frag-HE to 1,000 m, and has a rate of fires of 500 rd/min. The launcher has a 3x day telescope, EO night sight, bipod, and uses 6- or 15-grenade drums.

NOTES
The W-87 is significant in that it weighs a little more than a medium 7.62-mm GP MG (PKM 18.5 lbs/U.S. M60 MG 32 lbs). It is smaller and lighter than the AGS-17 but still provides the infantryman with the ability to destroy lightly armored vehicles at 2 to 3 times the range of the majority of infantry light AT systems. Ten 35-mm W-87 rounds weigh less than 100 linked 7.62 rounds. The 35-mm rounds are probably more effective against point targets at medium to long ranges than ball 7.62-mm.

Other unit members can carry additional ammunition as needed, and can break down load into smaller increments for easier carry.

Singaporean 40-mm Automatic Grenade Launcher CIS 40 AGL / Air Bursting Munition (ABM) System

CIS-40 pre-ABM System

Ammunition Types	Typical Combat Load
HE Dual Purpose, Self -Destruct **HE-M384/CIS S412 HE**	32 Dismounted (1 CIS can) 48 Dismounted (1 US M548 can) 400 vehicle mount
Optional: **Buckshot (US)**	
Air Bursting Munitions (See next page)	

SYSTEM
Alternative Designations: INA
Date of Introduction: 1990
Proliferation: Over 18, CIS-40
Description:
Crew: 3- gunner, assistant gunner, ammo bearer
Weight (kg):
- Empty (without magazine): 33
- On softmount: 52

Magazine: Metal box
- Capacity (rds): CIS-32 rds, US M548-48 rds
- Weight (M548) (loaded) (kg): 28
- Weight (CIS-32 rds) (kg): 18

Barrel Length (m): .350
Length (m): .966
Length (on softmount) (m): 1.025
Height (on softmount) (m): .389
Width (m): .375
Width (on softmount) (m): .47
Tripod Name: M3
Tripod Weight M3 (kg): 20
Lightweight Tripod Avail: Yes
Mounts: Tripod, vehicle, pedestal, or turret
Rate of Fire (rd/min):
- Rapid: 60
- Sustained: 40
- Cyclic: 375

Operation: Air cooled, Direct blowback with advanced primer ignition
Feed: Disintegrating metal link belt (M16A2), left to right
Fire Mode: Selective, automatic and semi-automatic, turret mounts (CIS 40/50) can be fired remotely
Loader Type: Manual

SIGHTS
Reflex sight is standard.
Day optical sights and computerized laser rangefinder optical sights available.
Night Sights Available: AN/PAS-13-type Thermal sight (higher tier units), or US AN/TVS-5-type II Night Vision Sight (6.5x, lower tier units)

AMMUNITION
Name: S411, CIS HEDP self-destruct (data based on M430)
Caliber/Length (mm): 40x53 high-velocity, standard for most Western AGLs
Type: HE Dual Purpose (standard round for US MK 19)
Range (m)
- Effective: 1,500
- Minimum: Arms (M430) 18 to 30 meters
- Maximum: 2,200
- Sighting Range: 1,500

Armor Penetration (mm): 60
Kill Radius (m): 5 (M430)
Casualty (wound) Radius (m): 15
Complete Round Weight (grams): 340
Muzzle Velocity (m/s): 240
Fuze Type: Point Initiating Base Detonating
Self-Destruct: Yes

Other Ammunition Types: HEDP-M430/CIS S411 Dual Purpose, US HE M384/CIS S412, M385/CIS S416A Practice**,** US Buckshot, other compatible 40mm AGL cartridges

EBIX: A new class of Singaporean ammunition has been developed for both 40x53 high-velocity AGLs and low-velocity shoulder/rifle grenade launchers. The grenades use enhanced-blast explosive, with a 5-m lethal radius, and wide fireball and blast overpressure effects. These effects can disable personnel and equipment, and can be used in enclosures and around corners where other explosives cannot reach. HEDP versions also produce armor penetration of 63 mm against steel (50 RHAE).

NOTE:
Originally developed by Singapore CIS for infantry support mounted on a tripod the CIS 40AGL is now available for mounting on vehicles and in turrets. The CIS 40/50 is a 40-mm AGL and .50 cal HMG together in a one-man cupola available on M113 series of vehicles. The CIS 40AGL is designed to fire all US 40-mm MK 19 Mod 3 ammunition. All CIS 40-mm ammunition is designed to US military specification. Weapons systems similar to the CIS 40AGL (less the ABMS) are manufactured all over the world. CIS licensed Indonesian production as well.

Singaporean Air Bursting Munition (ABM) System

AIR BURSTING MUNTION SYSTEM (ABMS)
The ABMS consists of the Air Bursting Munition, Fire Control System (FCS), and ammunition. The system is a kit (see photo below) which fit a variety of launchers which use NATO standard 40-mm AGL ammunition. Specific systems noted include: CIS40AGL, MK19 MOD 3, ST Kinetics Super Light Weight AGL (LWAGL) and other 40-mm AGLs to fire ABM.

A similar ABMS is used in the US version of the CG-40 40-mm AGL, called M47/STRIKER. This technology is comparable to that in US OICW and OCSW programs.

Fire Control System
Name: ABMS
The ballistic FCS consists of an electronic induction ammunition programmer, laser rangefinder, optical targeting module and ballistic computer. The gunner selects a target, and the FCS programs proper detonation data into the 40-mm ABM. This detonates the ABM at the intended point. ABM is extremely effective against concealed and defilade targets. The higher probability of hits requires fewer rounds.

Day Sight: 6x
Night Sight: Integrated Gen II & Gen II+
Laser Rangefinder: Yes, integrated into the computerized FCS
Weight (kg): <5 w/bat

Air-Bursting Ammunition
Name: ABM
Caliber/Length (mm): 40x112
Type: Frag-HE
Range (m)
- Effective: 1,500
- Maximum: 2,200
- Sighting Range: 1,500

Casualty Radius (m): INA

Complete Round Weight (grams): 340
Muzzle Velocity (m/s): 240
Fuze Type: Programmable
Arming Time: Electronic & Mechanical

Other Ammunition Types: The automatic grenade launcher with ABMS can also fire conventional 40mm AGL grenades as noted on the previous page.

OTHER USING SYSTEMS:
LWAGL (lightweight Automatic Grenade Launcher): Singaporean 40-mm AGL with capability for firing all types of NATO-compatible grenades, as well as programming ABM grenades. The AGL, without mount and ammo, weighs 19.5 kg. With all attachments as shown below, it weighs about 64 kg.

An improved lighter design employs its own ABM system with a simpler sight system, lighter tripod, and the programmer stalk next to the muzzle, rather than on the muzzle. A smaller magazine can be used for lightweight carry.

Initial version of the LWAGL, with ABMS

Infantry Weapon Day Sights

The OPFOR, as with most military forces in the world, will have a mix of older and newer infantry weapons with varying upgrades of sight systems. Most have the original day sights which came from the factory. Tier 1 and Tier 2 units may upgrade to more modern sights. Units with priority missions in lower tier forces (e.g., snipers and well equipped insurgents) may upgrade their weapon sights. For night sights, see pages 2-29 and 2-30.

Even older specialized weapons with some older sights can be sufficiently accurate in the hands of a skilled shooter to challenge the most modern weapons and sight systems. Improved sights post-World War II made the rifleman better able to deliver a high volume of fire. Nevertheless, changes in rifle, bullet, and sight design continued to be a compromise among the priorities of high volume of fire, precision, range, and affordability. . Recent wars have demonstrated that even a weapon designed for precision fire to a range of 500-800 meters, in the hands of the average marksman, will be relatively ineffective beyond a few hundred meters during combat. Modern military forces can be expected to upgrade higher lethality weapons with modern day and night sight systems.

Most infantry rifles today have iron sights. Some still have open sights with front sight blades and V- or notch rear sights. Since World War II the more popular rear sights are peep sights, which offer a marginal improvement for the average shooter. Sniper weapons are likely to have optical telescopes (or "scopes"). Selected rifles dating back to 1900 can be effective sniper weapons in the hands of trained snipers, when fitted with a good quality telescope (see WEG pgs 2-6, 2-7, 2-11, and 2-28).

Most forces around the world are looking at new sight technologies to improve weapon range and precision. In the last two decades we have seen a myriad of these technologies for use in day and night observation systems. Many improvements were first applied to hand-held viewers. These are being combined within sight systems to yield more effective infantry weapons.

- Plastics, composites and graphite materials for lightweight weather-resistant housings.
- Improved optics and graticules for wider fields of view, magnification where needed, and a variety of sight pictures.
- Electro-optics (EO) to assist optics in manipulating sight picture, e.g., zooming in and out for specific weapon needs.
- Better mount systems, such as the Picatinny rail, which permit users to switch sights for different needs.
- Addition of lasers for laser aiming sights and laser pointers. Laser aiming sights enable the user to place the laser spot on a target with assurance of a hit. Laser pointers enable a leader to designate a particular target for concentrated fires.
- Compact ballistic computers which can be incorporated into sight systems.

A variety of subtle features can improve weapon sights. A recent trend for rifles is to mount rail interface systems (RIS) that allow mounting of optical sights, lights, laser sights and vertical fore end grips that provide greater capability for the Soldier to engage the enemy effectively and accurately at all ranges. For normal day use a day sight is mounted. For longer range a telescopic sight is used. A night sight can be quickly and easily mounted. Scopes and EO sights can also be used for observation and surveillance. Conversely some handheld viewers can mount on weapons as sights.

Close-in urban and jungle environments present different challenges for weapon designers. Streets, alleys, and multi-story buildings in urbanized areas offer sufficient ranges to require the use of snipers and shots of up to 2,000 m. But most soldiers will operate in areas with sight lines of 10-300 meters. When entering buildings soldiers need weapons which can quickly slew to snap shoot with minimum reaction time while providing a high volume of fire. Yet precision is paramount to minimize harm to civilians and avoid fratricide. A collimator sight such as "red dot" sight facilitates rapid sighting for a shot. A laser aimer illuminates a target accurately for quick-reaction use, such as hip-firing. It can be part of or separate from the day sight, and used as a laser pointer to point out targets for concentrated unit fires. Combination day/night sights are available for military rifles. Russian Golodayev and other makers offer remote viewers and cable links for rifle sights which allow soldiers to see and fire their weapons around corners. With all of these contradictory requirements, the force must have a mix of weapons for this mix of priorities, along with compatible sights.

Priority weapons such as sniper and anti-materiel rifles, MGs, and auto-grenade and anti-tank grenade launchers require more range and accuracy than standard infantry rifles. Thus RPG-7V has an optical sight. But more advanced and costly sights are needed. The most advanced sights currently available are called by various terms, such as "laser rangefinder fire control systems". Integrating EO sights with LRF and small ballistic computer devices, they permit a user to shift the aim point in the sight window for factors such as target speed and direction, and wind. Most are still too cumbersome for infantry rifles but fit easily on larger weapons which may need more precision and range than rifles. Examples are the Swedish CLASS computerized laser sight, the Norwegian Simrad IS2000 laser sight, and Russian 2Ts35 Fire Control System. Many of these sight systems can be fitted with night sights.

Generally, the datasheet for each weapon will note the sights commonly used with that weapon. But there are dozens of day and night sight options available for any weapon listed. Today many forces and insurgents still use 100-year-old weapons with good day sights (e.g., Mosin-Nagant Model 1891, Lee-Enfield SMLE Mk 4T, Springfield Model 1903, Mauser Model 1896) that can outrange modern Tier 1 assault rifles. We can assist the trainer in selecting reasonable upgrade options appropriate for a given weapon, and which fit user mission priorities.

Day Sights for Selected Infantry Weapons

Type	Notch Sight (Iron or Open)	Peep Sight (Iron)	Telescope (Scope)	Collimator Sight (Red-Dot)	Optical Sight	Electro-Optical (EO) Sight	Laser Sight (Laser Aim Sight)	LRF Fire Control System
Example	SW125	Mini-14 sight	Nikon	PK-A 3298	PGO-7	Eotech 551	ITAL	IS2000
Common Use	pistols, rifles	rifles	sniper rifle, MG	rifle, pistol, etc	RPG-7V ATGL	all weapons	pistol, rifle, separate	ATGL, MG
Remarks	widespread	standard use	3.3 - 10 X	1 X	2.7 X	day/night sight	supplemental sight	3.5 X
Illustration								

Infantry Weapon Night Sights

The OPFOR like most forces in the world exploits cover of darkness to execute combat missions. After the 1960s more modern military forces acquired technologies to pierce the veil of darkness and see enemy clandestine activities. That advantage played a vital role in successful military campaigns of the last 20 - 30 years. With night vision instruments, goggles, and weapon sights, higher tier countries have been able to "own the night", and execute operations with a clear advantage which often led to decisive battlefield success.

Infantry without night sights are not totally blind. With ambient lighting such as starlight, moonlight, or streetlights, night range varies (50m close terrain - 200m open). Day sights can be improved with white dot or tritium markings for sight alignment and illuminated reticles on scopes. Pointing devices (flashlights, spotlights, tracers, and laser pointers) can direct unit fires. Early infrared (IR) band night sights used spotlights, such as the Russian NSP-2. A critical vulnerability is that they are "active", emitting energy which can be detected and engaged. As a rule at night, unless your force has overwhelming superiority, the need for stealth outweighs advantages of active emitters. In crucial times such as in attacks against critical targets, an OPFOR with superior firepower can use illumination to "turn night into day". Generally, with limited night acquisition, an inferior force must concede the cover of darkness, or employ covert movements and accept losses.

In recent years military forces around the world have prioritized acquisition of passive night fighting technologies to eliminate that vulnerability. For several decades, cost and budget considerations excluded many military forces from effective access to those technologies. Most forces worldwide accepted the limitations and incrementally upgraded with night systems which may be technically inferior to most sights in the US and other western countries. However, that separation has narrowed. The increased military priority and hunter-based markets have generated a technology explosion in commercial and military sectors with a variety of night sights for infantry weapons, starting at or below $500 (Falcon, Newcon, Yukon, and ATN). Sales are booming. ***In most areas of the world today, no one force owns the night***.

Most night sensors are passive electro-optic (EO), using the IR band. The most numerous night sensors are sights which combine EO processing and sight optics. Most EO sights employ image intensifier (II) systems which use ambient light in a portion of the near IR band (0.7-0.9 μm), intensify the image, and display it in a device. The current trend is to reduce reliance on bright ambient light sources (e.g., moonlight), with improved II, laser aimers, and thermal sights. Technologies in II can be grouped in generations, with 1st gen using a photocathode display tube. The 2 gen II improves clarity, brightness control and range with display in a micro-channel plate. The 3 and 4 gen sights approach TIS in capability. Gallium arsenide photocathodes and other technologies contribute to the 3 gen II upgrade. Improvements from early II include range, resolution, resistance to blooming in bright light, lower weight, and lower cost, which continue to make II a competitive option for night sights. A less expensive EO technology is a charged-coupled device (CCD), offering superior day images and low light level use in partial light.

New sight technologies, military and civilian demand, and wide availability have driven down costs and expanded features and applications for night sights. Many hand-held night viewers, such as the Cyclop-NS2, double as weapons-mount night sights. Most weapons must remove the day sight to mount a night sight, losing its zeroed-in setting. However, some new sights with standardized sight rails are zeroed at the factory and retain the setting. Day/night sights such as Eotech M551 retain both settings (including zeroing and magnification). Clip-on night sights (e.g., Simrad KN250F) mount onto day sights, simply adding a night channel. One maker offers the tiny ZF-Light Intensifier, an II

clip-on eyepiece to convert telescopes into night scopes. The Russian Falcon sight has a ranging feature and a laser pointer. Signal UA1137 powers its EO circuits with hand-generated action. Tier 1 and 2 crew weapons have the better night sights for greater range and precision.

Thermal imaging uses a camera which sees light in the 3-5μm or 8-12μm band from heat (temperature differential) as a digital image, then converts it to a microchannel plate in the viewer. Thermal imaging systems (TIS) have seen many improvements in processing and display technologies. The three greatest limitations of TI for weapon sights have been weight, size, and cost. A recent development, uncooled thermals, takes away the bulky coolant bottle. Reductions in size for microcircuits and imagers have permitted development of thermal sights that can mount on rifles or onto rifle scopes. More than a dozen designs are available, such as Elop ARTIM-LR, French Elite, and Aselsan Portable Weapon Sight. Cost still limits fielding in most countries, e.g., to larger Tier 1 or 2 infantry weapons for the OPFOR.

An OPFOR force can mitigate vulnerability to superior night systems by using cover and concealment, exploiting civilian illumination, and using other reconnaissance systems such as hand-held night viewers, radars, unattended ground sensors (for detection and location), IR illumination rounds and IR markers, NVGs, and laser aimers or pointers to direct fires. The most numerous military sensors will continue to be II sights. With II ability to include the background in the image, it provides superior discrimination over thermal. Although II sights offer less range than thermal, the limited range of most infantry weapons mean that II is sufficient to support their night range needs and is still less costly.

The following are examples of night sight capabilities for portrayal of the listed OPFOR equipment. Several military forces possess infantry night weapon sight capabilities comparable to U.S. forces (Tier 1). Most can be characterized as somewhat inferior to U.S. forces, with fewer systems and older generation systems. Tier 1 OPFOR forces have 2-3 gen II, with laser aimers built in. Other devices can support night fires by OPFOR Tier 1 and 2 infantry, such as hand-held thermal viewers. A Tier 2 OPFOR force has night sights with laser aimers for the more lethal weapons: grenade launchers, machineguns, anti-tank grenade launchers, and sniper rifles. Tier 2 II sights are mostly 2nd gen. Some use image intensifier (II) night vision goggles (NVGs) for sighting, such as for rifle under barrel grenade launchers. Remaining sensors are II weapon sights. Lower Tier forces have fewer NVGs and early generation II sights. Tier 3 would have some 1 gen II sights. Tier 4 units have few II sights, except in niches. Most insurgent forces have few or no night sights; but the contrary is also true—selected insurgent forces or units may be well-equipped with night sights. The below table provides data for OPFOR systems, reflecting a mix of older and newer night sights.

Night Weapon Sights and Capabilities for Primary OPFOR Infantry TOE Weapons

Weapon	Example	Lowest Unit Level	Description	Range Vehicle (m)	Range Person (m)	Remarks
Under-barrel Grenade Launcher	GP-30	Squad	NVG	400	300	Also follow laser pointer directions
Antitank Grenade Launcher	Panzerfaust-3T	Squad	2 or 3 gen II LRF sight	990	500+	Ballistic computer sight
General Purpose Machinegun	PKM	Squad	2 or 3 gen II	1,500	600	Wide variety available
Squad/dismount team leader	AK-74 mount or hand pointer	Squad	NVG and laser pointer	400	300	Observe/direct fires
Sniper Rifle	SVD	Platoon	1 or 2 gen II	700/1,500	400/600	Standard/Upgrade night scope
Antitank Grenade Launcher	RPG-29	Platoon Wpn Sqd	2 or 3 gen II LRF sight	990	500+	Ballistic computer sight
Automatic Grenade Launcher	W-87	Platoon Wpn Sqd	2 gen II on W-87, also hand-held thermal viewer	1,500	600	Thermal viewer adjusts fires and observes to 4 km for the platoon

* Data is provided to support night weapon sight portrayal for systems when not listed on data sheets for particular systems. They reflect Tier 1 or Tier 2 systems and sight capabilities. These are capabilities of representive marketed foreign sensors fielded on systems or available for OPFOR systems upgrades. Ranges reflect standard range criteria for: detection, classification, recognition or identification.

Selected Infantry Weapons

Automatic Grenade Launchers (AGLs)

Name	Producing Country / Number of Users	Crew/ Combat Load Total Weight (kg)	Munition Nomenclature (Diameter and Type)	Munition Capabilities: Range (m)/ Effectiveness (mm) (HEAT CE armor penetration)	Sights Day/night	Comments
AGS-17 30-mm	Russia +12	3 90 45.05 (includes tripod)	VOG-30 (Frag-HE) VOG-17M (Frag-HE self-destruct)	1,200m/AP and light armored Vehicles. 1,700m indirect fire casualty radius 15 m = 90% @ 7 m)	D: PAG-17 (2.7x) N: yes	For ground transport, breaks down into four parts. Tripod= 11.86 kg, Mag (30 rd)=13.7 kg Tripod or pintle mount
AGS-30 30-mm (aka TKB-22K)	Russia	2 90 16.55 less ammo & sight (includes tripod)	VOG-30 (Frag-HE) VOG-17M (Frag-HE self-destruct)	1,200m/AP and light armored vehicles casualty radius 15 m =90% @ 7 m)	D: PAG-17 (2.7x) N: yes	The AGS-30 is a lightweight variant of the AGS-17. Tripod= 6 kg, Mag (30 rd)=13.7 kg Tripod or pintle mount
RAG-30 30-mm	Slovak Rep (development)	1 15 or more 11 empty, 13.2 full	VOG-30 (Frag-HE) VOG-17M (Frag-HE self-destruct)	1,200m/AP and soft targets casualty radius 15 m =90% @ 7 m)	D: iron N: INA	Shoulder-fired with bipod
QLB-06 35-mm	China	1 15 or more	HEAT Frag-HE	600m/80mm Anti-armor 1,750m HE	D: optical N: see comment	Shoulder-fired with bipod mount Telescope and EO II sight are used to adjust fire.
QLZ-87 35-mm	China	1 15 or more	HEAT Frag-HE	600m/80mm Anti-armor 1,750m HE	D: optical N: see comment	Shoulder-fired with bipod, pintle or tripod mount Thermal hand-held or II sights are used to adjust fire.
W-87 35-mm	China	1 12 or more 12.0 (empty)	HEAT Frag-HE	600m/80mm 1,750m HE	D: optical N: see comment	Shoulder-fired with bipod, pintle or tripod mount Thermal hand-held or II sights are used to adjust fire.
CIS-40 AGL 40-mm	Singapore	2 lighter than Mk 19	Same as MK19 ABM	1,500m	D: optical N: yes	Integrated fire control with LRF, day/night sight, ballistic computer. The ABMS available. (ABM System made by Singapore Technologies Kinetics -STK) can be retrofitted to any new and current 40mm systems including US MK 19.
LG-3 40-mm	China	2 30 or 40 39 total	HE made by China HEAT made by China All other 40X53 SR series	2,380 max	D: iron/optical N: INA	Recent system
MK19 40-mm	US widespread	2 vehicle 48 rd ammo can gun (35kg) Tripod (22kg)	HE HE DP Buckshot (HEAT made by Pakistan)	1,500m/55mm max 2,400m	D: open N: yes (AN/TVS-5)	The fire control systems for the Striker and the CIS-40 AGL
Striker 40-mm (aka CG40)	Sweden widespread	2 gun (17.5kg)	Same as MK19 ABM (airburst)	1,500m	D: optical (8x) N: yes (Gen III II)	Integrated fire control with LRF, day/night sight, with video imaging, ballistic computer. Computer-controlled fire control system manufactured by Saco and Bofors/Carl Gustav/CDC. ABM = Air bursting munitions

Antitank Grenade Launchers (ATGLs)

Name	Producing Country / Number of Users	Crew/ Combat Load Total Weight (kg)	Munition Nomenclature (Diameter and Type)	Munition Capabilities: Range (m)/ Effectiveness (mm) (CE armor penetration)	Sights Day/night	Comments
RPG-7V 40-mm	Russia +40 Variants +7	2/7.9 Empty/2.6 /4.5 /1.7 /4.5	PG-7VL (93mm HEAT) PG-7VR (105mm TandemHEAT) OG-7VM (Frag-HE) TBG-7V (105mm Thermobaric)	300m/600mm 200-550m/950+, 750+ w/ERA 200-700m based on sight 1000m/rein concrete:+1,500	D: PGO-7 N: NSP-3, NSP-2 (IR), NSPU, PGN-1 (II), 1PN58 (II), others.	In addition to AT role, can be used against personnel and for bunkerbusting and as a side-attack mine system (See Note 2). Other countries have developed rounds for RPG-7V. For TBG-7V see Thermobaric/Bunkerbusters.
Type 69-1 40-mm tube (similar to RPG-7V) It can also fire all RPG-7 ammunition.	Chinese widespread	2/ 5 5.6	Type 84 (85mm HEAT) HE/HEAT (92mm with Frag-HE)) Type 69 (75 mm APERS) AP, HE-Incendiary (76mm) Illumination (75mm)	350m/380mm 1,800m AP/20m lethal radius 600m AT/400mm 1,500m/18m lethal radius 1,500m/15m lethal radius 600m or 1,500m/35 seconds	D: optical N: yes, II and IR.	See Note 2. The AP is an airburst grenade. It strikes the ground and bounds up to explode. *OPFOR could mix Chinese, Russian, and Bulgarian rounds, as well as well as commercial ammunition for these systems marketed by western firms. The G-Law SAL-H guided grenade can be fired from this system.
RPG-2 40-mm	Russia widespread	1, 2 with bearer 5/2.8 (empty)	PG-2 (80-mm HEAT)	100m/180mm	D: folding leaf N: yes, NSP-2 IR	Obsolete system from 1950s.
Panzerfaust-3T600 **(**aka Pzf-3T600) 60-mm tube Original launcher Panzerfaust-3 **Fire Salamander**	German +1	2/12 INA/3.8	3-T (110mm Tandem HEAT) Other munitions include: HEAT-125, HEAT-90, HESH, MZ-110 (Multipurpose-Frag), Illumination, IR Smoke, Smoke. 3LW-HESH 3LWD Multipurpose PZF-3 (110mm HEAT-original rd) BASTEG see Bunker Busters	600m/800+ mm 300-400m/700+mm	D: Simrad IS2000 LRF. N: Simrad KN250 series II Note: Pzf-3 or 3-T can add Simrad IS2000 sight and 3-T/3-IT tandem HEAT grenade to make it same as 3-T600/3-IT600. D: Optical N: yes. IR goggles.	Tube is disposable—the firing post & sight are reusable. System can fire from enclosures. Pzf 3-T=launcher,3-T grenade, + optical sight. **Pzf-3-T** added new grenade. **Pzf-3T600** adds new sight. System can be used as side-attack mine system (See Note 2). Advanced tripod mount with a **SIRA** sensor package uses acoustic detection and IR sensor triggering. **Fire Salamander** has 4 x Pzf-3 series launchers on tripod with remote controlled TV camera and other sensors, also auto-launch.
Panzerfaust 3-IT600 60-mm (aka Pzf 3-IT600) **Pzf-3-LR / RS PZF 3**	German +1	2/INA 12+sight (+ laser unit for Pzf-3-LR)	3-IT (110mmTandem HEAT) Other munitions oted above. Pzf-N (Tandem HEAT) Pzf-3-LR (Tandem SAL-H)	600m/900+mm, Dual-mode (also sets to bunker buster) 600m/900+mm 800m/700+mm	D: Simrad IS2000 laser rangefinder sight N: Simrad KN250 series II night sight	Pzf-N was designed to compete for UK NLAW. Pzf 3-LR is a developmental semi-active laser homing (SAL-H) system. It requires a CO^2 laser guidance unit and SAL-H grenade. Fire Salamander and SIRA can be used with IT600.
SMAW 83-mm	US (USMC)	1 INA/7.6	HEDP HEAA (antitank)	500, 250 for1x2m target 500, 250 for1x2m target	D: optical N: yes, AN/PVS-4	SMAW (Shoulder-launched Multipurpose Assault Weapon).
Carl Gustaf M2/M3 Recoilless Gun 84-mm in-bore round	Sweden +20	1,2 with ammo bearer INA M2:14.2 M3: 8.5	FFV 551 (HEAT) FFV 751 (Tandem HEAT) FFV 502 (DP-HEAT/HE) FFV 441B (HE) Smoke and illumination	700m/400mm 500m/500+mm 1000m AP-500m AT/150+mm 1100m/INA	D: optical 3x Option is CLASS LRF computerized sight. N: Option gen 3 II sight/ CLASS night channel.	Weapon uses a round with a rocket-propelled grenade, for shorter flight time & better hit probability. In addition to AT, it can be used against personnel, for smoke/illum support, and for bunker busting. M3- lightweight variant
RPG-29 105-mm in-bore grenade	Russia +5, and insurgent/ terrorist groups	2 INA 11.5	PG-29V (Tandem HEAT) HE Thermobaric available	500 or 800m/750+mm + ERA 950+mm Conventional Also brick/concrete/Log/dirt	D: optical for shoulder, ballistic LRF for tripod N: avail, II for tripod	Tripod or mounted range is 800m, stationary target. Disposable grenade canister extends launcher. Note 2.
RPG-32/Hashim 105-mm	Russia and Jordan	2 3, 10 loaded	PG-32V (105mm Tandem HEAT) TBG-32V (105mm Thermobaric) MRO-A (72.5 mm Thermobaric)	700m/650+mm with ERA 850+mm Conventional Multi-role/bunker buster	D: Collimator (binocular Rangefinder) sight N: Built-in II night sight	Grenade canister extends launcher. Other 72.5-mm grenades. Vehicle-mount option. In 2010, 80% P-hit and range increase are due.
PF-98 120-mm	Chinese	2/	HEAT (Tandem HEAT) Multipurpose (w/incendiary)	800m/800+mm 2,000/25m lethal radius	D: Optical co/EO bn N: 300m co/ 500m bn	Bn tripod version has LRF computer sight. Grenade canister extends the launcher tube.

NOTES: 1. All weapons can be shoulder fired, as well as other mounts as noted in comments.
2. Generally, the systems can be employed as a side-attack (off-route) mine, with a break wire. Selected systems can be fitted with a multi-sensor unit for conversion into a sensor-fuzed mine.

Antitank Disposable Launchers (ATDLs)*

Name	Producing Country /Number of Users	Crew Combat Load Total Weight (kg)	Munition Nomenclature (Diameter and Type)	Munition Capabilities: Range (m)/ Effectiveness (mm) (HEAT CE armor penetration)	Sights Day/night	Comments
RPG-18 64-mm	Russia +15	For all crew of 1 for single launcher 2.7	HEAT	200m/375	D: Iron N: No	RPG-18, 22, & 26 are copies of the US M72 LAW. Also penetrates reinforced concrete: 500, brick: 1,000
RBR M80 64-mm	Former Yugo +3	3	HEAT	200/300+	D: Iron N: INA	Very similar to US M72 LAW
M-72 LAW 66-mm	US widespread		HEAT	300/300	D: Peep N: Yes, AN/PVS-4	
Armbrust 67-mm	German +7	6.3	HEAT	400/300	D: reflex N: no	Low signature and IR detectability. Does not emit smoke or flash, (even seen from rear). It is quieter than a pistol shot. Only to fire. Can be fired from confined space (only .8 m clearance is required).
RPG-75 68-mm	former Czech +13		HEAT HEDP	300/ 300 300/300	D: Iron N: No	Similar to US M-72 LAW
RPG-22 72.5-mm	Russia +15	2.8	HEAT	250/ 390	D: Iron N: No	Improved (range) version of the RPG-18 (LAW). Also rein concrete: 1,000, brick: 1,200
RPG-26 72.5-mm	Russia + 15	2.9	HEAT	250/ 400	D: Iron N: No	Improved RPG-22 Also rein concrete: 1,000 brick: 1,500 log & earth: 2,400
PF-89 80-mm **PF-89 Type I**	Chinese	3.7	HEAT Tandem HEAT (PF-89 Type I)	200/630 (180 at 65°) INA (PF-89 Type I)	D: Optical	Disposable waterproof launch tube. The PF-89 Type I entered service in 2004.
AT4 (US M136) 84-mm	Sweden +7	6	AT4 HEAT (HEAT) LMAW (HEDP) AT4CS (Confined Space) AT4E2 HP-T (High Penetration)	330/420 330/150 330/INA 330/600+	D: popup N: yes, INA	LMAW = Light Multipurpose Assault Weapon Grenade is similar to Carl Gustaf FFV 502. AT4 CS can be fired from confined space.
C-90-C (M3) 90-mm	Spain +3	3.9	HEAT Smoke Incendiary HE Frag	400/400	D: optical N: yes	Four variants: C-90-CR-RB (M3) = AT C-90-CR-AM (M3) = (DP+ AT & AP) C-90-CR-FIM (M3) = Smoke, incendiary C-90-CR-BK (M3) = Anti-bunker
RPG-27 105-mm	Russia +15	8	Tandem HEAT	200/ 750 + with ERA 950 + conventional	D: Iron N: No	Disposable version of RPG-29. Also rein concrete 1,500, brick: 2,000, log & earth: 3,700
APILAS 112-mm	France +15	9	HEAT	330/720 rein concrete: 2,000	D: optical 3x N: yes, (nonexpendable) INA	APILAS-APA mounts on a tripod with breakwire sensor. Can also be used on a tripod with the AJAX sensor package. (see Notes)
AT-12-T / 120-mm	Sweden 1	14	Tandem HEAT	300/900	D: popup N: no	
RBR M90 120-mm	Former Yugo +2	10	HEAT	250/800+	D: optical N: INA	A reusable Hornet-S launcher which launches this grenade is in development.
RPG-28 125-mm	Russia		Tandem HEAT	300/ 900+ with ERA 1,100+ conventional	D: optical N: INA	

NOTES: Single disposable ATDLs are aka Antitank Rocket Launchers (ATRLs) – Disposable. They are issued as rounds of ammunition (crew of one). Users are assigned mission in addition to other duties, to supplement fires. All disposable ATRLs can be shoulder fired, as well as other mounts as noted in comments. Generally launcher can be employed as a side-attack (off-route) mine, with a break wire. Selected systems can be fitted with a multi-sensor unit for conversion into a sensor-fuzed mine. The AJAX advanced side-attack mine sensor uses acoustic sensors to identify targets and to turn on the IR sensor. When in view of the IR sensor the rocket is fired, destroying the target.

Thermobaric, Flame, and Smoke Weapons

Name	Producing Country / Number of Users	Crew/ Combat Load Total Weight (kg)	Munition Nomenclature (Diameter and Type)	Munition Capabilities: Range (m)/ Effectiveness (mm) (HEAT CE armor penetration)	Sights Day/night	Comments
TBG-7V Grenade on RPG-7V	See RPG-7V	See RPG-7V 4.5 kg	TBG-7V (105-mm HE) See Thermobaric above	200m/2 m radius 200m/AT against light armor	See RPG-7V	The demolitions effect of the TBG-7V equates to a 122-mm HE artillery round.
TBG-29V Grenade on RPG-29V	See RPG-29V	See RPG-29V	TBG-29V (105-mm HE) See Thermobaric above	50-2,000m	See RPG-29V	The demolitions effect of the TBG-29V surpasses a 122-mm HE artillery round
RPO Flame Launcher (Reusable)	Russia +15	1 2 / 22 for a pack	RPO (122-mm Napalm-type Pyrogel)	190m/10-40m path 3-4m wide	Post sight	Being replaced by RPO-A/Z/D Pack=launcher & 2 rds
RPO-A Thermobaric Launcher (Disposable)	Russia +15	1/2 per package 11	RPO-A (93-mm Thermobaric) (encapsulated)	600m/50m lethal radius 600m/AT against light armor	Post sight OPO-1	LMAW (Light Multipurpose Assault Weapon) Can be fired from enclosures.
RPO-Z Flame Launcher (Disposable)	Russia +15	1/2 per package 11	RPO-Z (93-mm Incendiary/ napalm)		Post sight OPO-1	Can be fired from enclosures.
RPO-D Smoke Launcher **(Disposable)**	Russia +15	1 2 per package/11	RPO-D (93-mm Red Phosphorus) (encapsulated)	200m/2 m radius/Smoke screen 55-90 m long,3-5 min.	Post sight OPO-1	Can be fired from enclosures. Effective against visual & IR.
RShG-2 (Disposable) **72.5-mm**	Russia	4.0	Thermobaric. Effects are similar to Frag-HE, over wider area	Lethal area 200m^2 personnel Also affects vehicles, materiel	Post sight	**RShG-1** has same design and role, but is 105-mm, weighs 8.3 kg, and is more lethal.
Shmel-M Thermobaric Launcher (Reusable)	Russia and others	1/2 per package 8.8	PDM-A (90-mm Thermobaric) (encapsulated)	800m/75 m lethal radius 600m+/AT against light armor	Optical 4x day sight. Night sight expected.	Replacement for RPO-A. Smoke and flame munitions are due for fielding.
WPF-89-1 and 2 Flame Launchers	China	WPF-89-2 issued as a round	WPF-89-1 80-mm Thermobaric WPF-89-2 80-mm Thermobaric	INA	INA	WPF-89-1 is reusable. WPF-89-2 is disposable.

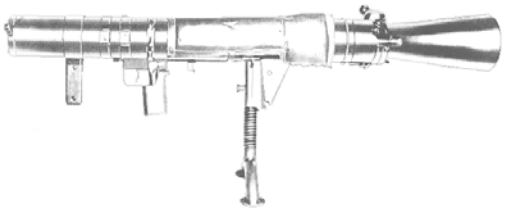
NOTES: ATDLs are issued as rounds of ammunition. Thermobaric grenades are sometimes classed as Multi-purpose or as Bunker Busters, with flame and HE demolition effects (including AT) as noted below.

Multi-Purpose and Bunker Buster Weapons

Name	Producing Country / Number of Users	Crew/ Combat Load Total Weight (kg)	Munition Nomenclature (Diameter and Type)	Munition Capabilities: Range (m)/ Effectiveness (mm) (HEAT CE armor penetration)	Sights Day/night	Comments
PF-89A (80-mm ATDLs)	China	1/ Issued as round/ 4.2	HE, 80 mm Tandem HE, 80 mm	180 effective/15 m kill radius 20 mm HEAT/20 m kill radius	D: optical N: INA	1000 m max range.
SMAW HEPD 83-mm Grenade	US		HEDP	500, 250 for1x2m target	D: optical N: AN-PVS-4	See ATRLs
AT8 Bunker Buster 84-mm **ATDL**	Sweden/US	1/ issued as round 7.2	AT8 (HEDP Multi-purpose)	250m/1-m hole in LAV /260+mm in concrete	D: Pop-up sight	Designed to fit in AT-4 launcher. Grenade is same as for SMAW.
C90-CR-BK (M3) 90-mm ATDL	Spain	1 INA Fire: 5.1 Trans: 5.4	Tandem HE	350m/70mm /600mm brick wall /300+mm concrete reinforced	D: optical N: yes	Precursor shaped charge for punching a hole and follow-though HE grenade explodes (400 fragments) inside the bunker.
TBG-7V Grenade on 40mm RPG-7V	See RPG-7V	4.5 kg	TBG-7V (105-mm HE) See Thermobaric above	200m/2 m radius 200m/AT against light armor		The demolitions effect of the TBG-7V equates to that of a 122-mm HE artillery round.
BASTEG Barricade & Street Encounter Grenade 60-mm	See Pzf-3 T600		BASTEG (HEMP—High Explosive Multipurpose), Tandem 110-mm HEAT/47-mm HE	/30+ (15mm at 45°) /AP fragmentation		on Pzf-3, 3-T, 3-T600, 3-IT600 Other penetrations: 920 mm sandbag, 256 mm concrete

NOTES: Disposable weapons are issued as rounds of ammunition. Users are assigned the mission in addition to other duties to supplement fires or to create a breach. All shaped charge and high-explosive (HE) grenades have some penetration effect for bunker-busting and against structures. Thermobaric grenades (e.g., RPO-A, Shmel-M) have superior demolition effects against bunkers, structures, vehicles, as well as personnel inside.

Swedish 84-mm Recoilless Rifle Carl Gustaf M2



Ammunition Types	Typical Combat Load
84-mm round	**INA**
HEAT (tandem)	
HEDP	
HEAT	
HE	
Smoke	
Illumination	

SYSTEM

Alternative Designations: INA
Date of Introduction: INA
Proliferation: At least 20 countries
Description:
Crew: 1 or 2 (see NOTES)
Caliber (mm): 84
Weight (kg):
Mount: .8
M2: 14.2
M3: 8.5
Length (mm): 1,065
Rifling: 24 lands/progressive twist
Breech Mechanism Type: Hinged
Rate of Fire (rd/min): 6
Fire From Inside Building: INA

SIGHTS

Name: INA
Type: Iron and telescoped
Magnification: 3x
Location: Left side
Weight (kg): 1
Used With Range Finders: Yes, laser
Other sights: Simrad IS2000 or CLASS laser computing sight
Night Sights Available: Gen 2 or 3 Image Intensifier night sight.

VARIANTS
M3: Lightweight version of the M2

AMMUNITION

Name: FFV 751
Type: HEAT (tandem)
Range (m):
Effective: 600+
Arming range: 20-40
Moving: INA
Penetration:
Armor (mm CE): 500+ behind ERA
Weight (kg): 4

Name: FFV 502
Type: HEDP with dual mode fuze (impact and delay)
Range (m):
Effective (personnel in open): 1,000
Effective (stationary): 500
Moving: 300
Arming Range: 15-40
Penetration:
Armor (mm CE): 150+ with brush safety fuze and delay fuze
Weight (kg): 3.3 complete round
Muzzle Velocity (m/s): 230

Name: FFV 551
Type: HEAT
Range (m):
Effective: 700
Arming Range: 5-15
Penetration:
Armor (mm CE): 400
Weight (kg): 3.2
Muzzle Velocity (m/s): 255

Name: FFV 441B
Type: HE
Range (m):
Effective (unprotected troops, soft-skinned vehicles): 1,100
Arming Range: 20-70
Casualty Radius (m): INA
Weight (kg): 3.1
Muzzle Velocity(m/s): 240

Name: ADM 401
Type: Flechette (1,100 per round)
Range (m):
Effective: 100
Arming Range: 0
Casualty Pattern: 5-10 flechettes per m^2 upright target at 100 m

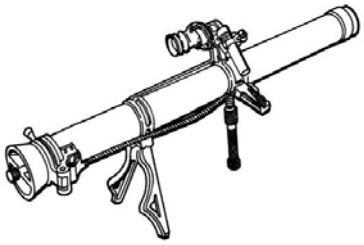
Name: FFV 469B/C
Type: Smoke
Range (m):
Effective: Up to 1,300
Weight (kg): 3.1
Muzzle Velocity (m/s): 240

Name: FFV 545C
Type: Illumination
Range (m):
Practical: 300-2,100
Burning Time (sec): 30
Illuminated Area, dia: 400-500
Candle Power: 650,000 cd
Weight (kg): 3.1 complete, 0.8 of smoke composition
Muzzle Velocity (m/s): 260

Other Ammunition:
FFV 441D HE Impact/Airburst, with 800 stell pellets and time delay. Range is 1250 m.

NOTES
The 84-mm Carl Gustaf recoilless rifle is a one-man portable, direct-fire, single-shot, breech-loading weapon. Several versions of the Carl Gustaf are produced outside Sweden; however, the ammunition is interchangeable among the variants. While the weapon can be operated by one person it is better to have two—one to fire the gun, and the other to carry and load the ammunition. In addition to its antitank role, the weapon can be used as part of an illumination plan, to provide smoke, or for bunker busting.

United States 90-mm Recoilless Rifle M67



Ammunition Types	Typical Combat Load
90-mm recoilless gun HE HEAT APERS Target Practice	**7**

SYSTEM

Alternative Designations: INA
Date of Introduction: Late 1940s
Proliferation: At least 11 countries
Description:
Crew: 3 (see Note)
Caliber (mm): 90
Weight (empty) (kg): 16.4
Length (mm): 1.35
Height (ground-mounted) (mm): 432
Mount: Rear bipod and forward monopod
Feed: Manual
Rate of Fire (rd/min):
Maximum: 1 each 6 seconds, not to exceed 5 rounds
Sustained: 1
Fire From Inside Building: No

SIGHTS

Name: M103
Type: Optical, (graduated in 50 m intervals up to 400 m, every 100 m up to 800 m)
Magnification: x3
Field of View (°): 10
Location: Left center

VARIANTS (INA)

AMMUNITION

Name: INA
Type: HE
Range (m):
Effective: 400
Weight (kg): INA

Name: M371E1
Type: HEAT
Range (m):
Aimed: 800
Effective: 420
Penetration:
Armor (mm CE): 350
Weight (kg): 4.2
Fuze: Point Detonating
Muzzle Velocity (m/s): 213

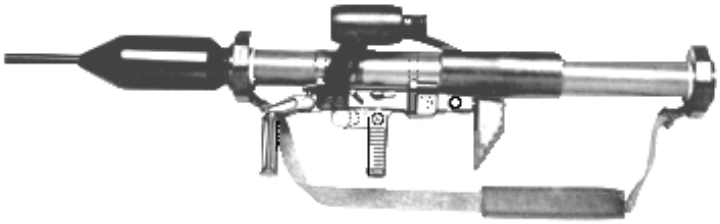
Name: XM590E1
Type: APERS Canister (antipersonnel)
Fill: 2,400 eight-grain flechettes
Range (m):
Effective: 200
Weight (kg): 3.08
Muzzle Velocity (m/s): 381

Name: XM590E1
Type: Target Practice
Range (m): Ballistically identical to the HEAT M371E1
Weight (kg): 3.08
Muzzle Velocity (m/s): 381

NOTES
The M67 90-mm recoilless rifle is a lightweight, portable, direct-fire only, crew-served antitank weapon. It is designed to be fired primarily from the ground using the bipod and monopod, but it may be fired from the shoulder. It is an air-cooled, breech-loaded, single-shot rifle that fires fixed ammunition. Although intended primarily for use as an antitank weapon, the M67 can be used against secondary targets such as gun emplacements and bunkers. It is also very effective in an anti-personnel role. Although no longer produced in the US, the M67 is still in production by South Korea.

The crew consists of a gunner, assistant gunner, and ammo bearer. The M67 can be operated with a crew of only two; however, the third crew member (ammo bearer) is considered necessary for efficient operations. In the absence of an individual to perform the duties assigned to the ammo bearer, the gunner (crew member 1) lays and fires the 90-mm rifle and is the crew leader. He carries the M67 and a pistol. The loader (crew member 2) is responsible for loading the rifle and acts as the gunner when required. He secures ammunition and checks the clearance of the backblast area prior to firing. He carries a pistol, spare parts, cleaning materiel, and 3 rounds of 90-mm. The ammunition bearer (crew member 3) is responsible for securing ammunition and providing security for the recoilless rifle position. He carries an assault rifle and 4 rounds of 90-mm.

German 60-mm Antitank Grenade Launcher Panzerfaust 3-T600 and 3-IT600



Original Panzerfaust-3 launcher system with Pzf-3 grenade

Ammunition Types	Typical Combat Load
60-mm grenade	**5**
Tandem HEAT	
Multipur-FRAG (MZ-110)	
BASTEG	
Illumination	
Smoke/IR Smoke	
Tandem HEAT	
Multipurpose HESH	
Tandem HEAT SAL-H (Pzf-3LR)	

SYSTEM
Alternative Designations: Balliste, Pzf 3-T600
Date of Introduction: 1990, 1996 for 3-T600
Proliferation: At least 8 countries all Pzf series
At least 1 country for 3-IT600
Description:
Crew: 2
Caliber (mm):
Launch Tube: 60
Warhead: 110
Weight (kg): 12
Length (mm):
Firing Position: 1,200
Travel Position: 1,200
Rifling: None
Breech Mechanism Type: N/A
Rate of Fire (rd/min): 5
Fire From Inside Building: Yes

SIGHTS
Name: DynaRange (Simrad IS2000) for Pzf 3-T600 and Pzf 3-IT600
Type: Computer laser range-finder (LRF) sight
Magnification: 1x/3.5
Location: Left side
Night Sights Available: Yes, KN-250 series II Day sight can be used with Simrad GN1 NVG.

AMMUNITION
Name: 3-T (Tandem)
Caliber (mm): 110
Type: Tandem HEAT (Pzf 3-T and 3-T600)
Effective Range (m): 600 moving and stationary)
Armor Penetration (mm CE): 800 behind ERA
Weight (kg): 4.3
Muzzle Velocity (m/s): 152
Flight Velocity (m/s): 220
Time of Flight to 300 m (sec): INA

Name: BASTEG (Barricade and Street Encounter Grenade)
Caliber (mm): 110
Type: Shaped-charge w/stand-off fuze
Range (m): 11 to 600
Penetration (mm): 15 armor at 45°, 920 sandbag, 256 concrete
Weight (kg): 4.3
Time of Flight to 300 m (sec): INA

Name: 3-IT (Improved Tandem)
Caliber (mm): 110
Type: Tandem HEAT/HESH (Dual-mode) on Pzf 3-IT600
With nose retracted, HESH mode has greater effects against APCs, material targets, etc.
Effective Range (m): 600 moving and stationary
Armor Penetration (mm CE): 900+ behind ERA, with nose extended
1,150 conventional, with nose extended
Weight (kg): 5.4
Muzzle Velocity (m/s): 152
Flight Velocity (m/s): 220
Time of Flight to 300 m (sec): INA

Other Grenades: See above.
The new **3LWD** multipurpose grenade has a shaped charge and HE/anti-armor effects of a high-explosive squash-head (HESH) round.

VARIANTS
Panzerfaust 3 (Pzf 3): Original system with 110-mm HEAT grenade (nose probe for 700 mm penetration). Optical day sight limits range to 300 m moving, 400 stationary.
Panzerfaust 3-T: Upgrade with 3-T tandem HEAT grenade and original day sight. It is effective against targets to 300m stationary, 400m moving. Night sight is optional.
Panzerfaust 3-T600: Tier 2 upgrade adds the IS2000 computer laser day sight with range of out to 600 m for moving targets. It uses the Simrad KN250 series II night sight. Acquisition-to-firing time is 3-4 seconds.
Panzerfaust 3-IT600: Tier 1 capability upgrade adds more recent 3-IT grenade which penetrates 900+ mm armor behind ERA (equals 1,150 mm vs armor without ERA).
Panzerfaust 3LTW: Light-weight launcher weighing less than 10 kg.
Panzerfaust 3LR: Long-range semi-active laser homing (SAL-H) system requires CO^2 laser guidance unit and SAL-H grenade. Range-800 m, armor penetration-700 mm.

OFF-ROUTE MINE SYSTEM AND REMOTE LAUNCHER
The original launcher and variants can be tripod mounted, and can be used autonomously with sensor package.
Name: SIRA
Target Speed range (km/h): 30-60
Effective Range (m): 150
Operational Time (days): 40
Acquisition: Targets detected by acoustic sensor which activates the infrared sensors.
Sensors:
Acoustic: Capacitative microphone to detect and arm
IR Sensor: Passive, two-color
IR Optics: Double parabolic, off-axis

Name: Fire Salamander Remote launcher and off-route mine system
Description: 4x Pzf-3 launcher mount on a tripod with remote controlled TV camera for controlled launch, and sensors for automatic launch.

NOTES
The Panzerfaust 3 series of launchers is a compact, lightweight, shoulder-fired, unguided antitank weapon series. It consists of a disposable canister with a 110-mm warhead and reusable firing and sighting device. The Panzerfaust 3 is light enough to be carried and fired by one person. It can fire from enclosures. The gunner carries at least two rounds while the assistant grenadier carries an additional three rounds.

Chinese 120-mm Antitank Grenade Launcher PF-98

PF-98 launcher company version

PF-98 launcher battalion version

Ammunition Types	Typical Combat Load
120-mm grenade Tandem HEAT Multipurpose	**5**

SYSTEM
Alternative Designations: Queen Bee
Date of Introduction: 2000
Proliferation: At least one country

Description:
Crew: 2, 3 if more rounds are needed
Caliber (mm):
Launch Tube: 120
Warhead: 120
Weight (kg): INA
Length (mm):
Firing Position: INA
Travel Position: INA
Rifling: None
Breech Mechanism Type: Rocket canister is attached to end of launcher, extending the launch tube.
Launcher mount: Shoulder for company launcher, Tripod, shoulder, or pintle for battalion launcher.
Rate of Fire (rd/min): 4-6
Fire From Inside Building: No

SIGHTS
Name: Y/MK/PF98(Y)-120
Type: Ballistic computer laser range-finder (LRF) sight for battalion version, and optical telescope for company sight
Magnification: 4 telescope for company sight.
Location: Left side
Used With Range Finder: Yes
Night Sight: Thermal, range 500 m on battalion sight
II night sight 300 m for company sight

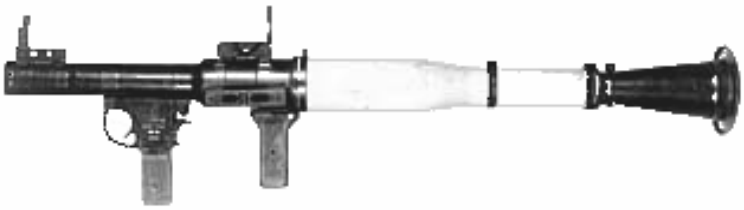
AMMUNITION
Name: HEAT, with time fuze
Caliber (mm): 120
Type: Tandem HEAT (shaped charge)
Range (m): 800 battalion, 400-500 with company level launcher
Penetration (mm CE): 800+
Weight (kg): 6.4
Time of Flight (sec): 10

Name: Multipurpose
Caliber (mm): 120
Type: Frag-HE-Incendiary (120 steel balls)
Range (m): 2,000
Penetration: 400 mm KE for steel balls, 25 m lethal radius
Weight (kg): 7.6

VARIANTS
Company and battalion versions fire the same rounds. In subsequent years, these systems will proliferate throughout battalions in weapons units and into infantry platoons and lower. Over time the battalion version will replace squad ATGLs. Battalion system could be a representative COE Tier 1 ATGL for infantry units.

NOTES
The PF-98 appears to have employed propulsion principles from the Swedish Bofors Carl Gustaf 84-mm M2/M3 recoilless gun. The Carl Gustaf has a compact round with an expulsion charge to launch its grenade, a method which offers greater precision than more common rocket-propelled systems. But like the more recent and larger Gustaf rounds, the PF-98 added rocket assist to extend projectile ranges. Thus the producer refers to PF-98 as an "anti-tank rocket launcher". By using sealed canisters to serve as launcher extensions, Queen Bee offers a trend-setting and effective way to increase lethality by growing ammunition to 120-mm, while retaining portability and extending range capability. BN designation is for launcher mounted on tripod.

Russian 40-mm Antitank Grenade Launcher RPG-7V and Chinese Type 69_____



Original RPG-7

RPG-7V with PG-7VR and PG-7VL grenades

Ammunition Types	Typical Combat Load
40-mm grenade	**5**
PG-7V	
PG-7VM	
PG-7VS	
PG-7VL	
PG-7VR	
TBG-7V	
OG-7V	
OG-7VM	
See **AMMUNITION**	

SYSTEM
Alternative Designations: INA
Date of Introduction: 1962
Proliferation: At least 40 countries
Description:
Crew: 2 RPG-7V is light enough to be carried and fired by one person if needed. With a crew of 2, an assistant grenadier normally deploys left of the gunner to protect him from small arms fire. The full set has two bags: one has two grenades, spare parts, tools and accessories. The other has three more grenades.
Caliber Launcher (mm): 40. The grenade warhead is forward of tube. Thus grenade diameter can be 105 mm or more.
Weight (kg): 7.9 empty, loaded varies with grenade
Length (mm): 950
Rate of Fire (rd/min): 4-6
Fire From Inside Building: No

SIGHTS
Name: PGO-7V
Type: Optical illuminated
Magnification: 2.7x, 13° field of view
Location: Top of launcher/sight-left side
Sighting Range (m): 500
Name: PGO-7V3 (RPG-7V1 sight with longer range)
Name: UP-7V For RPG-7V1, a telescopic collimating attachment fits on PGO-7V3 sight and extends sight range for larger munitions
Night Sights Available: NSP-3, NSP-2 (IR), NSPU, PGN-1 (II), 1PN58 (II), 1PN51, 7V1N3

VARIANTS
This is the most widely proliferated infantry AT system in the world. There are dozens of copies and variants of this launcher.
RPG-250: Prototype and test base for the RPG-7V.
RPG-7B1N3, -7N, and -7N1: Night site variant
RPG-7V1: Upgrade w/bipod and improved PGO-7V3 sight. This is the standard production ATGL version since the late 1990s.
RPG-7D, RPG-7DV1, and **RPG-7D2N3 (night):** Folding variants used by airborne troops. **RPG-7D3** is the airborne counterpart to RPG-7V1.
Type 69-1, II, III: Chinese upgrades variants with lighter weight, a wide range of munitions, and 3.0 x longer range sights.

AMMUNITION
Grenade Components: Warhead, rocket motor, tail assembly

Name: PG-7V Chinese variant is the Type 69 HEAT
Caliber (mm): 85
Type: HEAT (shaped-charge)
Range (m): 500 effective, 300 vs moving targets
Penetration:
Armor (mm CE): 300
Concrete (m): .6 +
Brick (m): 10 +
Earth (m): 1.5 +
Length (mm): INA
Weight (kg): 2.2

The original (1962) PG-7 warhead had inconsistent lethality (260-330 mm) and an unreliable fuze. Many early foreign copies had the same problems. In 1965 they were corrected on the Russian standard PG-7V.

NOTES
RPG-7V is the standard (tier 4) squad antitank weapon in use by the OPFOR. It requires a well-trained gunner to estimate ranges and lead distances for moving targets. The RPG-7V has been used to shoot down helicopters in several conflicts.

Russian Antitank Grenade Launcher RPG-7V and Chinese Type 69 continued _____

AMMUNITION (continued)
The RPG-7V grenade launcher fires a variety of rocket-assisted grenades from its 40-mm smoothbore launcher tube. With grenade warheads outside of the tube, grenades can vary for different uses. AT grenade sizes have increased to match increased tank armors.

Name: PG-7VM replaced PG-7V in Russian forces in 1969.
Caliber (mm): 70.5
Type: HEAT (shaped-charge)
Range (m): 500 effective
Penetration:
- Armor (mm CE): 330 +
- Concrete (m): .7 +
- Brick (m): 1 +
- Earth (m): 1.8 +

Muzzle Velocity (m/s): 140
Length (mm): 950
Weight (kg): 2

Name: PG-7VS
Caliber (mm): 72
Type: HEAT (shaped-charge)
Range (m): 500 effective
Penetration:
- Armor (mm CE): 400 +
- Reinforced Concrete (m): 1 +
- Brick (m): 1.5 +
- Earth (m): 2.4 +

Muzzle Velocity (m/s): INA
Length (mm): INA
Weight (kg): 2

Name: PG-7VL adopted in 1977
Caliber (mm): 93
Type: HEAT (shaped-charge)
Range (m): 300 effective
Penetration:
- Armor (mm CE): 600
- Reinforced concrete (m): 1.2 +
- Brick (m): 1.7 +
- Earth (m): 2.4 +

Muzzle Velocity (m/s): 112
Length (mm): 980
Weight (kg): 2.6

Name: PG-7VR (uses RPG-7V1 launcher sights)
Caliber (mm): 105
Type: Tandem (same basic warhead as RPG-29)
Range (m): 200 effective
Penetration:
- Armor (mm CE): 750 + behind ERA
  950 + conventional
- Reinforced Concrete (m): 1.5 +
- Brick (m): 2 +
- Earth (m): 3.7 +

Muzzle Velocity (m/s): INA
Length (mm): 1,306
Weight (kg): 4.5

Name: Type 69 or DZGI-40 (Airburst, Chinese)
Caliber (mm): 75
Type: APERS (Anti-personnel), bounds 2 m prior to detonating
Range (m): 1,500 effective
Lethal Radius (m): 18 with 800 steel balls

Name: HE/HEAT-MP (Chinese)
Caliber (mm): 92
Type: HE and HEAT effects, and 1,500 steel fragments
Range (m): 600 HEAT, 1,800 vs soft targets in Type 69 launcher
Casualty Radius (m): 20 against soft targets

Name: OG-7VM
Caliber (mm): 40
Type: Frag-HE
Range (m): 1,000 effective
Casualty Radius (m): INA
Muzzle Velocity (m/s): 145
Length (mm): 595
Weight (kg): 1.7

Name: OG-7V
Caliber (mm): 40
Type: Frag-HE
Range (m):
- Effective: 280 (RPG-7V)
- Effective: 350 (RPG-7V1)
- Effective: 700 (RPG-7V1 w/UP-7V)
- Max: 950

Casualty Radius (m): 7 m w/flak vests on.
Muzzle Velocity (m/s): 152
Length (mm): 569
Weight (kg): 1.7

Name: TBG-7V (uses RPG-7V1 launcher sights)
Caliber (mm): 105
Type: Thermobaric (similar to RPO-A warhead)
Range (m):
- Effective: 200 (RPG-7V)
- Effective: 550 (RPG-7V1 w/UP-7V)
- Max Range: 700

Penetration:
- Armor (mm): INA
- Brick (m): +1.5
- Reinforced concrete (m): + 1.5

Casualty Radius (m): Neutralizes personnel in trenches and bunkers at 2 m from a trench or bunker opening. Neutralizes a 300 m^2 area.
Muzzle Velocity (m/s): INA
Length (mm): INA
Weight (kg): 4.5

Other Ammunition:
More than 2 dozen countries produced improved grenades. European grenade options include HEAT grenades with penetration of 600 mm or more (including the Czech PG-7M 110, with 700 mm penetration).

Anti-personnel (APERS) grenades are generally Frag-HE (see above). Other APERS include Czech Type 69. Several countries offer rockets to fit 60/82-mm mortar rounds for RPG-7V launch. This feature can extend ammunition availability and lethal area for this weapon.

Other grenades include tear gas, illumination, incendiary, and multi-purpose. Multi-purpose grenades include dual-purpose (e.g., Chinese HE/HEAT-MP above), thermobaric multi-purpose (Romanian GTB-7G), and Incendiary-HE (Chinese 76mm). A private venture is the PG-7VYA HEAT grenade, with an optional spacer insert. Adding the insert changes it to a multi-purpose Frag-HE grenade.

A modern trend is to give shoulder-launch weapons precision close to that of ATGMs. The RPG-7V achieves that with the Israeli G-LAW, a semi-active laser-homing HEAT grenade with precision to 800 m.

Russian 105-mm Antitank Grenade Launcher RPG-29 and RPG-32/Hashim _____

Ammunition Types	Typical Combat Load
105-mm grenade HEAT (tandem)	**3**
HE thermobaric	As needed

SYSTEM
Alternative Designations: Vampir. Both variants can be used.
Date of Introduction: Late 1980s
Proliferation: At least 5 countries and several terrorist/insurgent groups. RPG-32/Hashim is currently produced for 2 countries. RPG-32 export negotiations are underway.
Description:
Crew: 2
Caliber (tube) (mm): 105
Weight (w/o sight) (kg): 11.5 (launch tube and canister/extension)
Length (transport) (mm): 1,000 without rear section/canister
Length (firing) (mm): 1,850, with grenade canister attached
Life of Tube/barrel: 300
Rate of Fire (rd/min): INA
Fire From Inside Building: INA
Maximum Target Speed (km/h): INA
Emplacement/displacement time (min): <0.25
Deployment: The pintle permits the launcher to attach to a tripod ground mount or a vehicle mount. The RPG-29 can be broken down into two parts for one soldier carry (launcher unit front section, and grenade/canister rear section). It can be made ready to fire within a few seconds with quick connect couplings. A folding bipod is provided to assist aiming during prone firing.

SIGHTS
Day sight:
Name: 1P-38
Type: Optical and iron, for RPG-29 shoulder-launch
Magnification: INA
Location: Left side
Sighting Range (m): 500 for optical sight. Effective range for the iron (post) sight would probably be less
Weight (kg): .6

Night Sight:
Name: 1PN51, 1PN52 standard RPG-29 or RPG-29N
Type: II sight
Weight (kg): 2.1

AMMUNITION
Name: PG-29V (in canister/launch tube extension)
Caliber (warhead): 105
Type: Tandem HEAT (shaped charge)

RPG-29 is a multi-purpose fire support system with both AT and HE grenades. Thus it serves as all-purpose small unit artillery against the gamut of targets, including vehicles, personnel, buildings, and any other direct-fire targets within range - including helicopters.

Effective range (m): 500 in the AT role
800 for Multi-purpose with HE
Penetration (mm CE):
Armor: 750 + behind ERA, 950 + conventional
Other: 1,500+ concrete and brick, 2,000 brick, 3,000 earth
Length (mm): INA, but it fits in the 850-mm long canister
Complete Round Weight (kg): 6.7
Muzzle Velocity (m/s): 280

Other: **TBG-29V** multipurpose HE thermobaric grenade.
Blast effects are the same as the TBG-7V (previous pg).
Effective range (m): 50-2,000
RPG-27, PG-7R grenade for RPG-7V, and RPG-32/Hashim use the same tandem warhead design.

VARIANTS
RPG-29 comes in three versions. The shoulder launch version is the base version described here (see photo above). The shoulder launch RPG-29 could become a standard squad ATGL for maneuver forces; However, the launcher, even stripped down for shoulder launch, is considered to be fairly burdensome and ungainly for use with squads attempting to move quickly in close quarters and dense cover. Thus the RPG-32/Hashim (below) was developed.

RPG-29 Mounted is an improved crew-served launcher upgrade for a more limited use ground and vehicle mount (see page 6-21). For Tier 1 and Tier 2 COE OPFOR, **RPG-29 Mounted** is the crew weapon in Weapons Squads and other supporting tactical units.

RPG-29N: Night sight only shoulder-launch variant

RPG-32/Hashim: Russian/Jordanian 105-mm ATGL with RPG-29V variant tandem HEAT and HE thermobaric grenades (pg 2-32). The launcher base is a short tube with optics and trigger assembly. Sight is a collimating (binocular rangefinder) day/II night sight. The canister sleeve fits inside the short launcher stub to serve as a launch tube extension, resulting in a very lightweight 1.2-m length shoulder launcher ranging 700 m. Penetration is 850+mm vs conventional armor (650+ vs ERA), with 2 per carry case. It can launch 72.5-mm MRO-A thermobaric multi-role grenade, and perhaps other 72.5-mm grenades. Jordanian KADDB offers a vehicle remote weapons station with 7.62-mm MG, Hashim launcher, and thermal sight. An upgrade is due in 2010, to add "precision" for increased range and 80% P-hit. 1200mm in length (105mm); 900mm in length (72.5mm). Weight: 10kg/105mm. 6kg/72.5mm. Range:700m (max); 300m(effective).

German 67-mm Antitank Disposable Launcher Armbrust _____

Ammunition Type	Typical Combat Load
67-mm grenade HEAT	**INA**

SYSTEM

Alternative Designations: Crossbow
Date of Introduction: INA
Proliferation: At least seven countries

Description:
Crew: 1
Caliber (mm): 67
Weight (kg): 6.3
Length (mm): 850
Rifling: None
Breech Mechanism Type: N/A
Rate of Fire (rd/min): N/A (disposable)
Fire From Inside Building: Yes (see NOTES)

SIGHTS

Name: N/A
Type: Reflex
Magnification: None
Location: Left side
Sighting Range (m): INA
Night Sights Available: INA

VARIANTS

NA

AMMUNITION

Name: INA
Type: HEAT
Range (m):
Maximum: 1,500
Effective AT: 400
Flight Time (sec) @ 300 m: 1.5
Penetration:
Armor (mm CE): 300
Reinforced Concrete (m): INA
Muzzle Velocity (m/s): 210

NOTES
The Armbrust is a preloaded, disposable, shoulder-fired antitank weapon. It has a low signature and low IR detectability and can be safely fired from small enclosures or rooms. The muzzle does not emit smoke or blast and no flash can be seen from the rear. Only .8 m clearance is required between the rear of the weapon and the wall. It is quieter than a pistol shot. The entire weapon is considered a round of ammunition and the launcher is thrown away once the weapon is fired. The system is also manufactured by Singapore Industries.

Swedish 84-mm Disposable Light Antitank Weapon AT4

Ammunition Types	Typical Combat Load
84-mm round	**INA**
HEDP	
HEAT	

SYSTEM

Alternative Designations: US M136, Bofors AT 4, FFV AT4
Date of Introduction: INA
Proliferation: At least seven countries

Description:
Crew: 1
Caliber (mm): 84
Weight (kg): 6
Length (mm):
Firing Position: 1,000
Travel Position: 1,000
Rate of Fire (rd/min): N/A (disposable)
Fire From Inside Building: See AT4 CS

SIGHTS

Name: INA
Type: Popup, preset to 200 m
Location: Top left
Night Sights Available: Yes, INA

VARIANTS (see NOTES)

LMAW: Light Multipurpose Assault Weapon, uses HEDP
AT4 CS: Confined space
AT4 HP: High penetration

AMMUNITION

Name: AT4 HEAT
Caliber (mm): 84
Type: HEAT
Range (m):
Effective: 300
Arming Range: INA
Penetration:
Armor (mm CE): 420
Weight (kg): 6.7
Muzzle Velocity (m/s): 285

Name: LMAW (see VARIANTS)
Caliber (mm): 84
Type: HEDP, modified Carl Gustaf HEPD FFV 502 (with dual mode fuze)
Range (m):
Effective: 300
Arming Range: INA
Penetration:
Armor (mm CE): 150
Concrete (m): INA
Casualty Radius (m): INA
Muzzle Velocity (m/s): 235

Name: AT4 CS (confined space) can fire from confined spaces as small as 22.5 m^3
Caliber (mm): 84
Type: HEAT or HEDP (LMAW) warheads
Range (m):
Effective: INA
Arming Range: INA
Penetration:
Armor (mm CE): 500
Weight (kg): INA
Muzzle Velocity (m/s): INA

Name: AT4 HP (high penetration)
Caliber (mm): 84
Type: HEAT
Range (m):
Effective: INA
Arming Range: INA
Penetration:
Armor (mm CE): 600
Weight (kg): Less than 7
Muzzle Velocity (m/s): 290

NOTES
The AT4 is a lightweight, preloaded, disposable anti-armor weapon intended for firing one round, after which the tube is discarded. All AT4 systems share the same launcher but may contain different preloaded munitions. The variant selected depends on the intended use. The AT4's average recoil is comparable to the M16 rifle.

Russian 72.5-mm Antitank Disposable Launcher RPG-22

Ammunition Types	Typical Combat Load
72-mm grenade HEAT	**INA**

SYSTEM

Alternative Designations: INA
Date of Introduction: 1985
Proliferation: At least three countries

Description:
Crew: 1
Caliber (mm): 72.5
Weight (kg): 2.8
Length (mm):
  Firing Position: 850
  Travel Position: 750
Rifling: None
Breech Mechanism Type: N/A
Rate of Fire (rd/min): N/A (disposable)
Fire From Inside Building: No, backblast out to 30 m behind the weapon.

SIGHTS

Name: INA
Type: Iron, calibrated for 50, 150, 200 m
Magnification: None
Location: Top of launcher
Sighting Range (m): 250
Night Sights Available: No

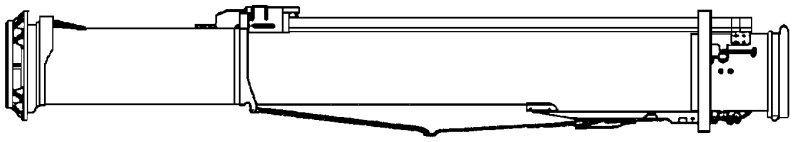
VARIANTS (None)

AMMUNITION (see NOTES)

Name: INA
Caliber (mm): 72
Type: HEAT
Range (m):
  Effective: 250
  Arming Range: INA
Penetration:
  Armor (mm CE): 390
  Brick (m): 1.2
  Reinforced Concrete (m): 1
Muzzle Velocity (m/s):
  Initial: 133
  Maximum: 300
Length (mm): 618
Weight (kg): 1.48

NOTES
The RPG-22 is a lightweight, shoulder-fired, preloaded, disposable anti-armor weapon intended for firing one round, after which the tube is discarded. It is basically a scaled-up version of the RPG-18 (similar to the US LAW) and has no dedicated grenadier; however, all soldiers train to use the squad-level disposable weapon.

Russian 105-mm Disposable Antitank Grenade Launcher RPG-27



Ammunition Type	Typical Combat Load (NA)
Tandem-HEAT	Varies

SYSTEM
Alternative Designations: Tavolga (Meadow Grass)
Date of Introduction: 1989
Proliferation: At least 15 countries.
Description:
Crew: 1
Caliber (mm): 105
Weight (kg): 8
Length (mm):
Firing Position: 1,155
Travel Position: 1,155
Rate of Fire (rd/min): Single-shot disposable

SIGHTS
Type: Raised iron peep site
Sighting Range (m): 50, 100, 150, 200
Night Sights Available: No (can be used with NVG found in OPFOR units). Other sights can be adapted, such as the strap-on British Ring Sight, with NVG.

AMMUNITION
Name:
Caliber (mm): 105
Type: Tandem-HEAT
Range (m):
Effective: 200
Penetration:
Armor: 750 + behind ERA, 950 + conventional
Brick: 2,000
Reinforced Concrete: 1,500+
Log and Dirt (m): 3,700
Muzzle Velocity (m/s): 120

NOTES:
This is a disposable launcher version of the RPG-29. The RPG-27 has a 105-mm tandem warhead similar to that of the PG-7VR (RPG-7V) and that of the PG-29V (RPG-29).

Russian 125-mm Disposable Antitank Grenade Launcher RPG-28

Ammunition Type	Typical Combat Load (NA)
Tandem-HEAT	Varies

SYSTEM
Alternative Designations: Klyukva ("Cranberry")
Date of Introduction: 2011
Proliferation: Unknown
Description:
Crew: 1
Caliber (mm): 125
Weight (kg): 12 (projectile) 13.5kg (loaded launcher).
Length (mm):
Firing Position: 1200
Travel Position: 1200
Rate of Fire (rd/min): Single-shot disposable

SIGHTS
Type: Raised iron peep sight; optical sight (PGO-7) is optional.
Sighting Range (m): 50, 100, 150, 200 , 300

AMMUNITION
Name:
Caliber (mm): 125
Type: Tandem-HEAT
Range (m):
Effective: 300
Penetration:
Armor: 1000mm + behind ERA, 950mm + conventional
Brick: 3,000
Reinforced Concrete: 1,500+
Log and Dirt (m): 3,700
Muzzle Velocity (m/s): UNK

Russian 105-mm Disposable Antitank Grenade Launcher RPG-30

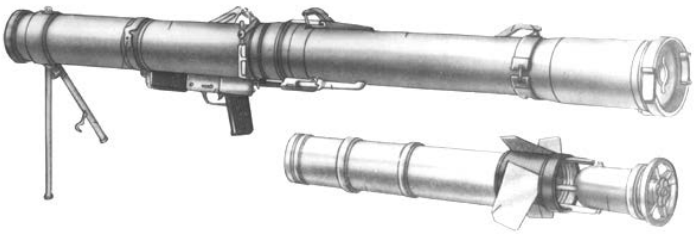
Ammunition Type	Typical Combat Load (NA)
Tandem-HEAT	Varies

SYSTEM
Alternative Designations: Kryuk ("Hook")
Date of Introduction: 2012-13
Proliferation: Unknown
Description:
Crew: 1
Caliber (mm): 105 main tandem warhead HEAT rocket; approx. 40mm sub-caliber precursor “decoy” rocket.
Weight (kg): 12 (projectile)
Length (mm):
Firing Position: 1135
Travel Position: 1135
Rate of Fire (rd/min): Single-shot disposable

SIGHTS
Type: Raised iron peep site
Sighting Range (m): 50, 100, 150, 200
Night Sights Available: No (can be used with NVG found in OPFOR units). Other sights can be adapted, such as the strap-on British Ring Sight, with NVG.

AMMUNITION
Name:
Caliber (mm): 105 (PG-30)
Type: Tandem-HEAT
Range (m):
Effective: 300
Penetration:
Armor: 900 + behind ERA, 950 + conventional
Brick: 3,000
Reinforced Concrete: 1,500+
Log and Dirt (m): 3,700
Muzzle Velocity (m/s): 120

Russian Infantry Rocket Flame Weapon RPO



Ammunition Types	Typical Combat Load
Rocket Rocket-propelled encapsulated napalm projectile.	**2**

SYSTEM
Alternative Designations: Rys (Lynx). The acronym RPO means "infantry flame weapon". Thus it may be used generically to describe various weapons of this type. But the term is derived from this weapon system of the same name.

Date of Introduction: Late 1970s
Proliferation: FSU

Description:
Crew: 1
Weight (kg):
Empty: 3.5
Pack (launcher and two rounds): 22
Length (ready to fire) (m): 1.44
Rate of Fire (rockets/min): 1
Reaction Time-Travel to Fire (sec): 60
Fire From Inside Building: INA
Tube Life: 100 rounds
Launcher Components: Firing tube, firing mechanism, mechanical sights, collapsing bipod and sling.

PERFORMANCE

Range (m):
Effective: 190
Maximum: 400
Minimum: INA
Accuracy: INA
Muzzle Velocity (m/s): INA

SIGHTS

Name: N/A
Type: Open metal, front and rear
Location: Left side, rear is on-line with rear of grip
Magnification: None
Night Sights Available: INA

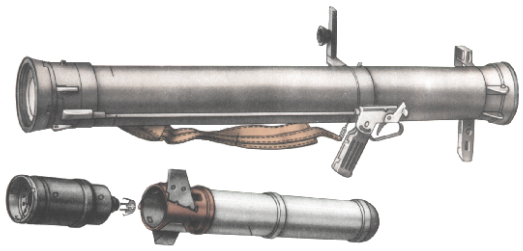
VARIANTS (None)

AMMUNITION

Name: RPO
Type: Incendiary napalm
Warhead Incendiary Fill (liters): 4
Weight of Incendiary in Warhead (kg): 4
Type of Incendiary: Pyrogel
Burn Temperature (°C): 800-1,000
Caliber (mm): 122
Casualty Radius: Fire envelope 10-40 m deep in the direction of The shot with a spray width of 3-4 m.
Components: Container, warhead canister, propulsion unit .

NOTES
The RPO is a combat-tested, shoulder-fired reusable weapon that fires a rocket-propelled encapsulated napalm warhead. It was designed to replace the LPO-50. The RPO is carried in two parts that must be connected to fire. Squeezing the trigger ignites the rocket with an electric spark. Part of the propellant gas enters the container and pushes the canister, kindling the igniter, which in turn ignites the incendiary mixture. The napalm in the RPO ignites at the initial stage of the flight and upon impact burning pieces are scattered all over the target. Although still in use by the OPFOR Flamethrower Bn (Encapsulated) at Corps or Army level (and other armies), the RPO has generally been replaced by the Infantry Rocket Flame Weapon RPO-A Series (RPO-A/D/Z).

Russian Infantry Rocket Flame Weapon RPO-A Series and Shmel-M



RPO-A Weapon System

Ammunition Types	Typical Combat Load
Rocket RPO-A: Thermobaric-flammable mixture RPO-Z: Incendiary RPO-D: Smoke	**2 (separate launchers)**
Rocket, Shmel-M: Thermobaric	**2 (canisters plus mini-gripstock)**

SYSTEM
Alternative Designations: Shmel (Bumblebee). Although "RPO" may be used generically to describe various infantry flame weapons, RPO-A is this specific multi-role flame weapon system.
Date of Introduction: 1984
Proliferation: Widespread
Description:
Crew: 1
Number of Weapons in a Package: 2
Weight of Package (kg): 12
Total weapon (1) weight (kg): 11
Length (mm): 920
Rate of Fire (rockets/min): 2
Reaction Time-Travel to Fire (sec): 30
Fire From Inside Building: Yes. It can be fired in enclosures of $60m^3$ or greater or with a barrier behind the weapon.
Components: Container, ejection motor, warhead.

PERFORMANCE
Range (m):
Direct Fire: 200 with iron sight, 850 with optical sight
Effective: 600
Minimum: 20
Indirect Fire: 1,000
Accuracy @ 200 m: .5 m^2
Muzzle Velocity (m/s): 125

SIGHTS
Name: OPO-1
Type**:** Optical calibrated to 600 m
Location**:** Left, next to grip
Magnification**:** None
Night Sights Available: INA

VARIANTS
Shmel-M/PDM-A Priz: This is a reusable upgrade system adopted in the Russian Army in 2003 to replace the disposable RPO-A. It Includes a reusable mini-gripstock launcher, with a reflex sight and pistol grip. Disposable canisters (with munitions) slide on and serve as the launcher tubes. The Shmel-M is more powerful (50 % more blast = 152/155-mm cannon round) and lighter in weight than RPO-A. Range is 800m, 300 direct fire. Specifications are: caliber 90 mm, length 940 mm, weight 8.8 kg for 2. In time other canister fills (e.g., smoke and incendiary) will be available. Standard issue (2 grenades per launcher) is more compact than 2 RPO-A launchers.

PF-97: Chinese licensed copy of RPO-A, with a lensatic optical sight mounted on some launchers.

BMO-1: Russian "flamethrower operator's combat vehicle". It seats 7 men and holds 30 RPO-A launchers. **BMO-T** is a fire support vehicle on a T-72-based heavy armored personnel carrier chassis.

BMO-T on HAPC chassis

AMMUNITION
Name: RPO-A
Type: Thermobaric (enhanced blast) explosive. The RPO-A is known as the infantryman's pocket artillery because the demolition effect corresponds to 122-mm HE artillery, and 120-mm mortar projectile. It can buckle armor, penetrate rubber seals and enter openings in vehicles, injure or kill personnel, and collapse roofs and doors on bunkers and buildings.
Caliber (mm): 93
Casualty Area: 50 m^2 personnel in the open, 80 m^3 enclosed space
Lightly armored materiel kill probability at 400 m: 0.70
Burn Temperature (°C): 800+
Warhead Explosive Type: Trotyl equivalent (2 kg)
Warhead Mixture Weight (kg): 2.1

Name: RPO-D
Warhead Weight (kg): 2.3
Smoke-Incendiary Type: Based on red phosphorous.
Smokescreen:
Time of Formation (min): 2
Length (m): 55 to 90
Depth and Height (m): INA
Duration (min): 3 to 5
Effective Against: Visual and infrared

Name: RPO-Z
Type: Incendiary
Warhead Mixture Weight (kg): 2.5

NOTES
Designed as a follow-on to the RPO, the RPO-A, -Z, and -D are one-shot, disposable, shoulder-fired, combat tested (Afghanistan, Tajikistan, Chechnya), flame weapons. They are reliable. Any soldier, infantryman, or paratrooper can use this close-combat weapon with minimal instruction. The RPO-A comprises three basic components: container, ejection motor, and case, which is filled, depending on its purpose, with thermobaric (enhanced blast explosive), smoke or incendiary rockets. At any range the blast effects of the thermobaric munitions are much more serious than the thermal effects. The RPO series of flame weapons also serves as an extremely effective counter-sniper weapon. The armor- and mechanized -based OPFOR usually issues one RPO-A per BMP (mechanized infantry squad). They are also found in the Flamethrower Bn (Encapsulated) at Corps or Army level. One squad per infantry platoon has a RPO-A in the infantry-based OPFOR. The RPO-A series of flame weapons are issued more along the lines of ammunition rather than a weapon, therefore the BOI may vary.

Chapter 3
Infantry Vehicles

Infantry vehicles include all military vehicles designed for use by infantry and other tactical units. They vary from unarmored multi-role vehicles to specialized vehicles with armor which rivals or sometimes surpasses that of tanks. Mechanized infantry units use ***light armored fighting vehicles (LAFVs)*** designed as infantry squad carriers. Increasingly, however, mechanized and conventional infantry also use large numbers of vehicles, both armored and unarmored, for fire support, combat support and combat service support missions in and out of combat zones. The intensity of combat on the modern battlefield requires infantry vehicles that are mobile, survivable, as well as lethal. New vehicles are currently being fielded or upgraded to meet modern requirements. Due to budgetary constraints, some forces also use commercial vehicles or military vehicles considered obsolete by modern militaries, but still can serve in a role on the battlefield. The U.S. Army, in its next conflict, is likely to encounter infantry forces with a mix of older, newer, and upgraded infantry vehicles.

VEHICLE CLASSIFICATION

Conventional infantry and motorized forces can use various vehicles to transport units, including LAFVs, multi-purpose ***combat support vehicles (CSVs),*** specialized transport vehicles, and commercial vehicles, such as buses and trucks. The category LAFVs includes armored infantry squad carriers, other LAFVs for support roles, armored CSVs used as infantry team carriers in combat areas, or specialized vehicles for combat support units (reconnaissance, air defense (AD), anti-tank (AT), etc.). For mechanized infantry use the key requirement is to carry troops. In wartime the OPFOR will use all systems available to execute the mission. Any vehicle which is armored and can fit a squad can be used by a military and be labeled an infantry carrier. Armored infantry carriers are discussed first, and fire support vehicles and combat support vehicles later.

INFANTRY CARRIER VEHICLES FOR MECHANIZED INFANTRY

Historically, the two main categories of armored vehicles used in mechanized forces for squad *armored fighting vehicles (AFVs)* are ***armored personnel carriers (APCs)*** **and** ***infantry fighting vehicles (IFVs)***. In OPFOR units, a mechanized infantry squad normally carries a crew of two or three individuals that stay with the vehicle and a dismount team of five or more soldiers. Some mechanized forces divide their squads by team vehicles and maneuver in pairs or separately, based on mission. A common APC/IFV vehicle load is ten soldiers; but some APC/IFVs can carry fewer or more than the average. The lighter, less-protected, and less lethal infantry carrier is an APC. This "battle taxi" can carry soldiers to the close combat zone and dismount them outside of direct fire range.

An IFV is an infantry carrier designed to fight with soldiers onboard, carry the infantry forward without dismounting them if possible, or support the dismounted individuals with direct fires, if necessary. One key difference between an APC and an IFV is that the IFV not only transports soldiers but also can fight on the battlefield. A second difference is that the IFV is designed with enough speed to accompany tanks, can maneuver with tanks on or off the road, and protect tanks from spectrum variety of threats that can engage tanks, including aircraft,

infantry, infantry antitank weapons, and other LAFVs. Any IFV must be able to carry a team or squad and have the three following characteristics:

- Lethality of a medium cannon or automatic grenade launcher to defeat possible threats to armored vehicles.
- Protection against machineguns.
- Mobility to move on and off-road with tanks while firing weapons on the move.

If an infantry carrier cannot meet any of the three capabilities above, it is not a true IFV. Many Armored Fighting Vehicles (AFV) manufacturers call their vehicles infantry combat vehicles or infantry carrier vehicles (ICVs), IFVs, or similar terms. Many vehicles feature one or more of the above features. The addition of medium cannon to a light-armored wheeled APC does not make that vehicle an IFV, because the vehicle may not possess the ability to accompany tanks, fire on the move, or survive first contact with the enemy. Nevertheless, there is wide variation in the lethality, survivability, and mobility capabilities among APCs as well as IFVs. Most IFVs have somewhat greater armor protection and more lethal weapons than APCs and can expect to carry squads closer to the objective prior to dismount. Due to the ever increasing numbers of Anti-Tank (AT) weapons on the modern battlefield that increases the vulnerability of LAFVs, however, IFV squads can increasingly expect to fight dismounted.

A plethora of available upgrade options permit LAFVs to become more mobile, survivable, and lethal. Militaries may upgrade an APC's survivability or lethality capabilities or with both and therefore transform older APCs into IFVs. Many IFVs possess vulnerabilities that limit the vehicle's ability to fight and survive on the modern battlefield. As APCs are increasingly being fitted with heavier armor and medium guns that previously characterize IFVs, and as increasing threats to all LAFVs prompt use of similar tactics by both types of vehicles, distinctions between APCs and IFVs become blurred. Weapons improvements on IFVs cause APCs to compensate by the addition of more powerful AT weapons. Forces are not only upgrading their infantry vehicles, but are modifying them for fire support roles − for organic AD, AT, and area fires. Those are described in the section, ***Infantry Fire Support Vehicles*** at pg 3-55.

A few sources refer to IFVs with better protection as medium armored vehicles (MAVs). Although heavy enough to outweigh battle tanks from World War II era, the majority of IFVs still do not have significantly more protection against most AT weapons than most other LAFVs. Therefore, the term *MAV* is not used in this document. The term, "*heavy"* does apply, however, as noted below. There are specific meanings for categories of heavy systems with infantry forces.

Several countries have taken the next step in protection by converting outdated tank chassis into IFVs or APCs. Others have up-armored their IFVs sufficiently to defeat nearly all IFV weapons, and most anti-tank grenade launcher (ATGL) ammunition. These armored vehicles are suitable as infantry carriers, and are especially suited to accompany tanks since they use the same tread system. These vehicles are referred to as ***heavy infantry fighting vehicles (HIFVs)*** or as ***heavy armored personnel carriers (HAPCs)***. The term "heavy" applies to a vehicle protection capability rather than its weight. Examples include the Israeli Achzarit and the

Russian BTR-T, both made from a tank chassis. When accompanied by weapons to provide supporting fires, HAPCs enable infantry forces to more safely operate in areas where lighter infantry carriers are vulnerable to fires. Russian BMP-3 and US M2 Bradley upgrades might also fit in this category.

Other more specialized APCs and IFVs are available. These include airborne assault IFVs and APCs and amphibious assault APCs and IFVs, such as Russian BMD IFVs, BTR-D APC, and the US AAV7A1 amphibious assault APC. Other Infantry vehicles are being developed specifically for use in urban environments, and for rapid deployment forces.

FIRE SUPPORT AND COMBAT SUPPORT VEHICLES

For infantry units, the most basic requirement for fire protection remains using combined arms formations with direct fire from tanks, indirect fire weapons and organic infantry fire support vehicles (IFSVs). Most common IFSVs have dismount teams with AD and AT assets. Indirect fire vehicles include mortars and combination guns (gun/mortar systems). Other types of vehicles can be included. See pages 3-50 to 3-57 regarding all fire support roles and vehicles.

For firepower when tanks are not available, some forces supplement infantry units with ***heavy armament combat vehicles*** (***HACVs***). They are vehicles on chassis lighter than tank chassis, mounting heavy guns characteristic of tanks (75+ mm). See page 6-42 for more detail. Because their role is fire support using mostly direct fires, they are addressed in Chapter 6, with antitank systems. Another kind of vehicle which is receiving some attention is the ***heavy combat support vehicle (HCSV)***.

Increased technical complexity of vehicles can also limit their rapid *deployability*.
Combat Support Vehicles are a general class of flexible multi-purpose vehicles which can be armored or unarmored, and which can be used for a variety of combat support missions within tactical units. For the variety of roles required in military forces, vehicles must be reliable and flexible, with deployable fuel and maintenance assets. These requirements lead to an increased need for these vehicles wherever forces are located. The vehicles offer a variety of designs to fit tactical and support needs in any environment. There is an increasing need for support vehicles to cross waterways with infantry carriers. With the civilian commercial emphasis on sport utility vehicles and commercial vans, militaries often adapt commercial off the shelf (COTS) vehicles for military roles. Increasingly, some militaries are fitting their CSVs with armor and mine protection to move with and stay up with maneuver units

A wide variety of vehicles can bridge the gap between multi-purpose vehicles and specialized APCs or IFVs. The former-Soviet BTR-152 armored transporter originally was little more than a better armored “gun truck”. Dozens of countries are developing and using APCs derived from armored trucks similar in configuration to the BTR-152. Most of these derivatives also sport gun/grenade launcher pintles or ports for crew-served weapons, such as the Russian BTR-152. Several more recent trucks for infantry use feature hardened suspension and V-shaped hull for better mine resistance. Other countries are converting many of their trucks into “gun trucks”, to move in convoys and provide weapons protection with machine guns (MGs), grenade launchers, or armed troops. Some of these are armored from the suspension up, especially those

designed for mine protection. Others use foraged add-on plate (so-called "hillbilly" armor), with varied success. Military forces arm most trucks with at least a 7.62-mm MG or automatic grenade launcher for self-protection.

Infantry vehicles offer an economical armored vehicle chassis for use on combat support and combat service support vehicles, e.g., AD, artillery, command and control (C^2), reconnaissance, etc. The former Soviet Union designed the MT-LB as a multi-role all-terrain vehicle, although it can be characterized as an APC. Multi-purpose armored chassis can be used as troop and cargo carriers, as platforms for AD or AT weapons, or for various other combat support or combat service support missions. On WEG pages, infantry vehicle variants for other roles are noted in other sections.

Only a representative sampling of the hundreds of infantry vehicles in use today is listed in the chapter. Later in the WEG you will see references to light armored vehicles (LAVs), rather than LAFVs. The former term applies to the larger classification of vehicles by weight and armor rather than by role. Thus, the term *LAVs* includes combat, combat support, and combat service support vehicles with some armor but less than the heavy armor of tanks. They are all vulnerable to a variety of weapons. Anti-armor munitions are no discriminators of vehicles by role; they will defeat light armored support vehicles as easily as they will defeat LAFVs.

APC AND IFV CAPABILITIES

A*rmored fighting vehicle* (AFV) capabilities are commonly divided into three categories: mobility, survivability, and lethality. Every AFV is a compromise among those three competing requirements. Because of the increasing space requirement to transport five or more dismounts plus weapons and gear, and because APCs and IFVs must be flexible for use in a wide range of missions, these vehicles offer a difficult challenge on which of three priorities to compromise.

Mobility. The infantry is expected to be able to go anywhere, regardless of terrain. The mechanized infantry carrier that can rapidly transport the infantry anywhere and operate effectively in more different types of terrains and under all weather conditions possesses the greatest mobility. The most mobile AFVs must operate as well as or better than tanks in difficult terrain, e.g., soft and uneven ground, wet areas such as swamps and arroyos, and across wide gaps. The infantry must be able to operate effectively in rivers, swamps, and coastal areas which fall into its area of operations. Mobility therefore includes many specific automotive capabilities, such as on road and off-road driving speeds, cruising range, and swimming capability. *Ground pressure* is a less important figure on paved roads; but it is critical for trafficability on wet, icy, or loose soil and uneven terrain. Vehicle height and width are critical functions for moving rapidly and safely through urban areas and through tunnels. Dimensions and weight must be considered in crossing bridges. Vehicle dimensions are also an important factor to determine deployment requirements, especially by airplane. Factors such as side slope, gap crossing capability, etc. may seem esoteric; but they matter when moving around hills and across ditches.

Wheeled infantry vehicles cannot go everywhere that tracked vehicles can go because of the better distribution of weight over more ground and the ability to maneuver through rough

terrain. Wheeled infantry vehicles are not as mobile in difficult terrain or in urban areas as tracked vehicles. Even rubble, tree-fall, and ruts can stop wheeled vehicles and are more susceptible to tip over. Even run-flat tires are vulnerable to puncture, with more stoppages than tracked vehicles. On the other hand, wheeled vehicles can often travel faster on improved roads, with less vibration and wear on the troops, and may be able to swim better than tracked counterparts. All of these factors must be considered within the category of mobility. Therefore, vehicle role, conditions of use, intended tactics, and employment environment must be considered when determining mobility criteria for a system.

Note that on datasheets in the WEG, Automotive Performance, *max off-road* denotes speed on dirt roads. The figure *average cross-country* is used for true off-road speed, as it was measured on an approved course. Much of the performance data is provided from vehicle manufacturers, and is not necessarily adjusted for specific vehicle variants or for squad load variations. Although some systems have specified radios based on the original customer, many OPFOR military users will replace them to link with their military radio nets

Survivability. This criterion as it applies to infantry vehicles must include consideration of vehicle integrity, but also crew and passenger protection. Armies have long been looking for ways to balance the need for increased protection with limitations that additional armor brings, and needs for mobility, and lethality (as well as sustainability, deployability, agility and utility). Some forces sacrifice the latter considerations to assure survivability. Other militaries will offset vehicle limitations by mutual support from combined arms integration or exploit advantages (amphibious and over-snow capability, air or fire support superiority, situational awareness) that their vehicles possess. Militaries may also use infantry in lighter *combat support vehicles* to navigate through close and difficult terrain. The OPFOR can also offset their armored vehicle vulnerabilities with increased infantry anti-armor and counter-mobility capabilities to force a mechanized enemy to stop and dismount. When vehicles slow or stop in a kill zone, they are significantly more vulnerable to destruction.

The most likely threat to an LAFV is not another LAFV but will vary depending on the scenario. In urban or uneven terrain, the most likely threats to LAFVs are mines, improvised explosive devices (IEDs), and unexploded ordnance (UXO – e.g., scattered munitions such as artillery and bombs), and infantry weapons (e.g., MGs and AT weapons). Against modern conventional forces in open terrain, the most significant threat to vehicles is aircraft-delivered munitions, followed by AT missiles and guns. Close terrain favors dismounted infantry AT.

There is a variety of sound tactics and protective measures to improve vehicle survivability when infantry have good quality intelligence and know their enemy, enemy locations, and enemy capabilities. The first rule of combat is to engage the enemy in such a way that he cannot apply anti-armor weapons in an overmatch against your vehicles. Survivability may hinge on good battle management systems (BMS) and use. Communications gear (such as BMS display monitors and secure easy-to-use radios) can be critical for providing awareness. Even with the best equipment, however, for most of the time in combat, infantry in a vehicle will not always know what threats are within close range of that vehicle. Modern weapons capabilities cause any infantry vehicle vulnerable to a wide spectrum of threats. Survivability and effectiveness will depend on four responses:

1. Use of combined arms tactics. Tanks and other weapons increase infantry survivability.
2. Detect and neutralize threats rapidly from all directions and all angles.
3. Survive first contact.
4. Do not wait for second contact. Dismount troops. Move the vehicle to a secure area.

Order of the two measures noted in Item 4 above depends on vehicle type and it also affects critical decisions in the vehicle's design. An infantry fighting vehicle must be able to fight its way out of contact - hence the word "fighting". An APC is designed to avoid combat. When engaged by an enemy, an APC normally dismounts its soldiers and then moves to a safe location out of the enemy's line of fire. Factors such as location of cover and assessment of enemy lethality may alter these decisions. A key factor is door or gate design for rapid dismount. Increasing availability of AT weapons makes an IFV's prospect for surviving a firefight less likely than in the past. With the trend toward better armor and weapons on APCs, the distinction between APC and IFV has lessened. Against modern forces soldiers may have to dismount (preferably prior to contact) whether in an APC or IFV. All infantry LAFVs and support vehicles (tactical utility vehicles, etc) need better protection and firepower to survive on today's battlefield.

The most common technical approach to increased infantry vehicle survivability is to add more armor protection. Vehicle protection technologies include armor, vehicle damage mitigation, and countermeasure systems. In past decades vehicle armor was positioned to protect against direct-fire munitions, particularly on the hull front and turret front and to a lesser degree on the side. The APCs are generally protected against 7.62-mm rounds, but not necessarily from all aspects. Some APCs have increased protection against 12.7-mm, with a few claiming more protection over other aspects. Most IFVs have better protection than APCs. A few countries, such as Israel with the Azcharit, have heavy armored APCs (HAPCs). See 3-61 regarding heavy infantry carriers. In most forces, IFVs possess more protection than other infantry vehicles.

A standard for IFVs is to be protected against 20-mm rounds, but the focus is normally on the hull and turret front. Some IFVs can only claim more side and rear protection than APCs against 7.62 mm rounds. A few IFVs can defeat shaped charges from older ATGLs. For a few IFVs, the top protection can "resist" lighter artillery fragmentation. Improvements in artillery munitions, other top-attack munitions, mines, direct-fire weapons, and urban use mean that an IFV can be hit and destroyed from any aspect. How can a "light" vehicle be protected from all of these threats? Physics dictates that total protection is impossible. When vehicles add more armor, a price is usually increased suspension problems and reduced off-road mobility. Another LAFV competing mobility requirement for many forces is swim ability. If protection raises vehicle weight too high (20 mt or more depending on vehicle design), swimming and wading abilities may be reduced or lost.

Protection is increasing, with newer and more armor, and new technologies. The LAFV mission means keeping LAFVs light by selectively upgrading against most likely threats. A wide variety of supplemental protection packages includes active and passive armor, active protection systems and countermeasure systems. No LAFV can consistently protect against modern medium cannon rounds of 25 mm or more; therefore, the trend in vehicles has been focusing on counters to more common threats. Some vehicle weight budgets may permit additional appliqué armor. Several companies offer light explosive reactive armor (ERA), which can be used on LAFVs. But, this upgrade is less likely, because exploding armor fragments are a

hazard to dismounted soldiers, not those inside. Grill or slat armor can protect against some ATGLs. Other forces are looking at spaced or box armor (particularly on the sides), which can provide standoff against ATGLs and some additional KE protection with less weight penalty. Armor that defeats high penetration HEAT munitions may provide much less protection in mm versus KE rounds.

Vehicle developers are also looking at countermeasure (CM) systems to supplement or avoid armor increases on LAFVs. Although many CM are technically possible, many are not tactically sound, or are likely for a specific vehicle application. A trendy CM is active protection systems (APS), firing a grenade to intercept incoming munitions. Many munitions can defeat all APS systems. CM data have too many variables to be reliable for many applications. Still, simple CM such as smoke grenades can counter many sophisticated threats to vehicles. Specific protection upgrades and systems are noted for selected OPFOR systems. See Chapter 14 for additional options. Armored vehicle protection figures on WEG equipment sheets include published data provided for general information use, and may not coincide with simulation penetration data developed by approved agencies.

All wheeled APCs have a common vulnerability - the wheels. No tires are puncture-proof, although some are puncture-resistant. Wheeled vehicles suffer puncture failures more often than tracked vehicles suffer track failures. Tire puncture failures increase when moving off-road and cross-country. Although they have some redundancy in case one wheel is hit, the vehicle could be severely slowed. A machinegun burst which takes out two tires on one side can stop the vehicle. A related vulnerability is in the surrounding wheel area—a substantial area that cannot be armored as well as turret and hull and is vulnerable to grazing fire. Wheeled vehicles are much more vulnerable to obstacle systems than tracked vehicles, since they are less able to move off-road than tracked. Two effective counter-mobility threats are a shovel and an axe.

Damage mitigation is essential for survival as is vehicle protection. Key systems are fire suppression, spall liners, compartmented ammo, secure seats, materiel attachments, and redundant systems. Mines, IEDs and unexploded ordnance are among the highest threats to infantry vehicles. Counters include counter-mine systems, and vehicle mine protection designs.

One of the greatest components to vehicle survivability is having the firepower to engage all threats to the vehicle, with all-aspect 360-degree sensors and situational awareness, *secondary arms* (aka *auxiliary weapons*), and fire controls to employ all vehicle personnel into the role of protecting that vehicle. These developments will be discussed in the following Lethality section.

Lethality. In the 1980s, higher combat power and cost of tanks justified the wide disparity in firepower between tanks and IFVs. Modern IFVs when fully manned and equipped, however, may have combat power similar to or greater than tanks, at a similar cost. Lethality improvements previously afforded only to tanks (particularly in fire control systems - FCSs) are being added to IFVs. A wide variety of lethality upgrades are available for LAFVs. These include larger main weapons, antitank guided missile launchers, and improved FCSs - especially night sights. The simplest, but often most costly upgrade is improved ammunition.

Light armored vehicles are vulnerable to a wide range of threats, sometimes appearing

simultaneously. In urban areas, areas with flora, and uneven terrain, infantry vehicles may also have to engage targets in multiple aspect areas simultaneously. Many older or less costly LAFVs use a single MG. They may be mounted on a pintle or on a small turret. Most LAFVs have consolidated weapons, with main gun (MG, cannon, or AGL) and auxiliary weapons on the turret; usually controlled at the gunner's station. With this configuration, the only other weapons which can be operated onboard are passenger arms using firing ports or crew weapons used outside of hatches. A few LAFVs permit vehicle auxiliary weapons (MG, AGL, SAM, or ATGM) not operated by the gunner. Auxiliary weapons are described on vehicle data sheets and in the section at pg 3-12. In this section, we will focus on vehicle turrets and main guns.

A turret permits the gunner to sit in a fighting compartment above the vehicle hull and move with a rotating gun while still inside the armor envelope. Some turrets are designed for one man to fit hull openings of smaller vehicles, or update specific vehicles using older one-man turrets. The best arrangement for LAFV effectiveness is a two-man turret. The commander's fighting position in the turret means additional sights for responsive surveillance, and better coordination of gunner and commander. A significant upgrade for two-man turrets is ***hunter-killer*** FCS. This arrangement permits the commander to search for new targets, designate the next target while the gunner is firing, or even fire the main gun when needed. With ***hunter-killer*** FCS, the effective rate of fire increases and target response time decreases.

A common way to rapidly upgrade a fighting vehicle is to add a new turret. Modern turrets for LAFVs are complex subsystems, with features like improved armor, a streamlined profile for improved protection, a gun with better integrated fire control, and automated loading. Turrets are often designed around the guns, with stabilization and fire control systems to match. Modular turrets can be designed with various weapons mixes, and fit into a variety of vehicles. More than a dozen ***combat weapon stations***, such as Kliver, are sometimes called *"unified fighting compartments"* or *"drop-in turrets"*. Forces wanting to upgrade vehicles in-country with less cost can perform these upgrades with limited or no hull modification effort.

Use of a 1-man turret (even a modern one) is generally considered a serious limitation for an IFV; because the lack of a commander's surveillance capability means that the gunner, while he concentrates on one target, is blind to other targets and threats. This makes the vehicle vulnerable to other threats and dangerously slow in recognizing, prioritizing, and responding to threats. In the modern environment, combat vehicles need more, not less support from crew and passengers in fighting on the crowded battlefield. The first solution is a 2-man turret.

Modern technology offers new solutions for the 1-man turret. Most are based on developments in remote image display and remote control systems. Displays may use hardened or movable lap-top monitors. Some vehicles use hunter-killer fire control with weapons hand-off or monitoring capability to the commander, or to an assigned passenger. To reduce size and vulnerability of a vehicle fighting compartment, designers may use an ***overhead weapon station (OWS)*** instead of a turret. An OWS places the operator below hull line, reducing vehicle profile and vulnerability. With the proliferation of modular sight units or weapon systems (MGs, cannon, or grenade launchers) with robust sight units, commanders can be seated deep in the vehicle hull and receive images from cameras mounted high on the turret and routed to their workstations. As these remote sight units proliferate, 1-man turrets will be increasingly preferred because of their compact size, ease for armoring, and fast-response capability.

Some vehicles lack space for a fighting compartment, even one under an OWS. For these the main gun can be mounted in a ***remote weapon station (RWS)***. An *RWS* is cable linked to a gunner's station remote-located in the vehicle. Similarly, the RWS may fit a remote sight unit for the commander. Challenges for an RWS are providing panoramic view, retaining a gunner's sense of aspect, and slewing for quick response. Some vehicles such as the modern AMX-10RC have several cameras pointed at various aspects, and transmitted to a commander's multi-screen workstation display, or to passenger stations for remote weapons, or to viewing stations.

Main guns on LAFV are increasing in size and lethality. Most IFVs use medium guns (20-mm to 74-mm) as main guns. Main gun medium calibers are rising beyond 30 mm, with new gun designs and ammunition matures. A few mount large cannon of 100 mm. Most APCs use MGs as main guns. But APC gun calibers are increasing, and many now have medium guns. More and better *auxiliary weapons* or *secondary arms* are needed on LAFVs, to address all targets of and threats to the vehicle. A discussion of these weapons and their use is in the section ***Auxiliary Weapons for Infantry Vehicles***, on pages 3-13 through 3-15.

Improved fire control technology has led to more exotic ammunition solutions, such as computerized FCS and electronically fused frag-HE rounds (timed to detonate close to the target and fire fragmentation forward or to the side with a more efficient pattern), to overwhelm and defeat rotary-wing aircraft and ground-based anti-armor positions beyond stand-off range. Other ammo developments which can affect helicopters and ground vehicles are: proximity-fused rounds, fragmenting rod munitions, and frangible rounds. In fragmenting rod munitions, HE blast also breaks the rod into sections for lethal KE effects on the target. Frangible rounds fly with the high velocity and precision of KE rounds, penetrate like KE rounds, but explode in a target with the lethal fragmentation and HE blast effects of a Frag-HE round.

On a modern battlefield, aircraft are a high threat to LAFVs; so weapons address those threats. Increasingly, main guns (cannons and MGs) are designed to quickly engage any aircraft threat within range. Many infantry vehicles have been fitted with high-angle turret mounts (e.g., BTR-80) and antiaircraft sights (BMP-3). These are also useful against other high-angle threats (e.g., infantry in urban and mountainous areas), and provide quick response. An expensive but effective response to air threats is shoulder-fired SAMs. Most ATGMs can engage low-flying helicopters; and some (e.g., BMP-3 gun-launched ATGM) have higher velocity for use against faster aircraft. A few LAFVs have racks for SAM launchers, or doors on the rear deck for passengers with SAM launchers. A few infantry vehicles feature turrets such as the Russian Kliver, which can launch either ATGMs or man portable SAMs.

Lethality Notes: In order to understand and apply data on capabilities, one must understand what terms mean in against measured standards and criteria. The WEG has provided parametric data suitable for understanding the systems. The portrayal in a specific training simulation requires using specific meaning of terms, and adjusting data to assure that system data used in a simulation reasonably represents the data intent. Thus, a vehicle-mount PKT MG using vehicle sights has a longer effective range than the ground-mount PKM with less capable sights. If the simulation does not play all vehicle weapons available against helicopters (MGs, main gun, and ATGMs), as well as any dismounts, it is not correctly portraying the vehicle lethality.

System lethality is determined by a variety of interrelated functions and considerations in the process of bringing destruction upon enemy forces and equipment. Lethality is addressed on

equipment data sheets under the headings of Armament, Fire Control, Sights, and Main Armament Ammunition. Lethal fires can be delivered by ***direct fire***, in which weapon systems acquire and observe their targets, or by ***indirect fire***, in which weapons use remote aiming to direct their fires. Note: *Direct-fire* systems (such as tanks) can receive remote acquisition reports and engage targets by indirect fire; and *indirect-fire* systems (such as artillery) can employ *direct-fire* sights to fire in *direct-fire* mode. For the WEG, high-angle fires are not interpreted as *indirect fires* as long as the firing weapon uses its *direct-fire* sights to acquire and aim.

Lethality factors considered in the WEG include: various weapons, rates of fire, various ranges, accuracy, acquisition/fire control capabilities, lethality effects, ammunition, and ability to fire on the move. Any of these factors and many more subtle ones may affect lethality in combat. Various rates of fire categories are used based on considerations such as movement status and type of target. ***Maximum*** or ***cyclic*** rate (in bursts) is critical against fast-closing high-lethality targets such as aircraft. Generally, automatic weapon barrel life dictates that, for more than a 3-4 second interval, number of rounds expended will not exceed the ***practical*** rate of fire.

Range is not a fixed figure for most systems. It can be directly affected by four technical factors: gun/launcher configuration, mount (how it is fixed to the system), acquisition capability, and specific munition's ballistics. Range is also related to less tangible factors, such as movement status (moving versus stationary), movement speed, target type, elevation angle (such as for AD weapons), visibility conditions, and terrain.

Each weapon may have different ranges listed by ammunition type and model and specific to a munition. Generally, ranges of direct-fire Frag-HE rounds are greater than for hit-to-kill munitions against point targets, since effects area is greater (permitting more error). With fragmentation and blast effects, a near miss may be sufficient to cause severe damage. Thus, the WEG uses the term ***maximum aimed range***. This range indicates the farthest range for system-on-system aimed direct fire. Maximum aimed range is based on a consideration of tactics, techniques and procedures (TTPs), and on technical factors noted above: gun/launcher, mount, acquisition system, and ammunition ballistics. This direct-fire range may exceed the weapon's ***maximum effective range***. *Maximum effective range/night* denotes the effective range for a round with available night acquisition capabilities. The TTPs may also call for a "salvo range", which exceeds other ranges and requires one or more volleys of a platoon against a single point target. "Salvo range" is less tangible, based on shifting TTP, and is not included in the WEG.

Probability of hit (Ph) accuracy data is included. Accuracy for weapons, munitions, and acquisition systems decreases with range. *Antitank guided missiles are an exception; they usually have a singular Ph for all ranges, based on technical precision capability.* Limitations, vulnerabilities, and countermeasures can affect performance, as noted on equipment pages.

Lethality performance given a hit is measured in radius of effects (for fragmentation/blast effects) against soft targets, and penetration distance (through steel) against hard targets. The fragmentation and blast effects of a Frag-HE round are less against hard targets, such as heavily armored vehicles. Another consideration is the level of destruction required. For many adversary forces, the critical requirement against armored vehicles is not a 100% or catastrophic kill. A mobility kill or firepower kill can render a system combat-ineffective, and may be used in lethality data. The OPFOR can use a mix of lethal and nonlethal methods. Fires of degrading (versus destructive) munitions such as smoke, mines, and radio frequency jammers can be used

to suppress units and support the effort. Note the discussion of CE versus KE penetrations at pg 5-2.

Other Capabilities: In our modern operational environment, other factors are regarded as nearly as important as *mobility, survivability, and lethality*. Those factors are **Deployability, Sustainability, and Utility**. Most military forces today may not have to be as ready for power projection and rapid deployment as are U.S. and European forces. U.S. and NATO recognize the need for those capabilities, but at the same time the requirement to react to threats in inhospitable areas hundreds of kilometers away. Thus, the OPFOR will have air-deployable, airborne, and amphibious systems. Military forces rely on a mix of wheeled and tracked vehicles to balance priorities for off-road mobility (tracks) with long road range and better fuel economy (wheels).

TECHNICAL NOTES

The following notes apply to all LAFVs, including those in other chapters (used for reconnaissance, tank/assault, antitank, AD, and artillery roles). Weapon, fire control, and munitions-related narrative may apply to towed and ground weapon systems. On each equipment sheet, the top of the page provides an illustration of the system and a summary of weapons and munitions. Note that a Typical Combat Load, may be estimated. In actuality, ammunition load depends on specific country holdings, on time frame, and on scenario tactical considerations. Vehicle protection figures in WEG equipment sheets include best available open source data, and may not coincide with simulation penetration data developed by approved agencies.

System and Variants sections provide basic data on system status, proliferation, and possible upgrade options. Under Description**,** gun tube length is not included in vehicle dimensions. Information on vehicle upgrades can be found on the system data sheets. Featured variants reflect upgraded versions of vehicles in specific OPFOR contingencies, and to describe OPFOR vehicle capabilities in those contingencies. Additional information on upgrade options for armored vehicles can be found in Volume 1, Chapter 15 of this document. Questions and comments on data listed in this chapter should be addressed to:

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Selection Matrix for Infantry Carriers in a Military Force

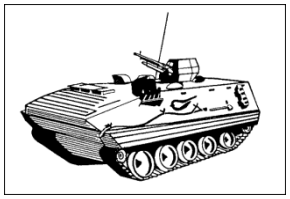
Factors which impact on the selection of the right vehicles for use in a military force vary widely, and can lead to practical or impractical choices. Limitations such as military budget constraints, production capabilities of the commercial industrial base, and political-military-industrial alliances can have as much impact on vehicle choices, as can a rational analysis of requirements and considerations noted below. The following table offers engineering and employment considerations for use in selecting vehicles used in military maneuver and support units. An OPFOR squad size is 9-10, counting vehicle crew. Team size is considered as 3-4, counting vehicle crew. "Infantry" here includes SOF and other maneuver forces.

Factor	Tracked IFV	Wheeled IFV	Tracked APC	Wheeled APC	Lt Wheeled APC	Armored TUV	Light Strike Veh
Role	Fight with squad onboard/dismount, provide lethal fires	Fight with squad onboard/dismount, provide lethal fires	Carry squad to dismount, give fire cover	Carry squad to dismount, give fire cover	Carry squad to dismount, fire protection	Team carrier and multi-role, fire protection	Team carrier and multi-role, fire protection
Costs	High, high operating costs	High, medium operating costs	Medium, low operating costs	Low-high, L-M operating costs	Low, low operating costs	Low, low operating costs	Very low, low operating costs
Weight (mt)	@ 20-35	@ 20-25	@ 11-13	@ 10-15	@ 6-8	@ 4	@ 1.5
Time Deploy and Move	Fast dash, slow over distance	Slow dash, fast over distance	Fast dash, slow over distance	Med dash, fast over distance	Med dash, fast over distance	Med dash, fast over distance	Fast dash, fast over distance
Terrain	Good off-road, most swim	Poor off-road, some swim	Good off-road, all swim	Fair off-road, all swim	Med off-road, most swim	Good off-road, swim/ high ford	Good off-road, most high ford
Threat to Vehicle (frontal protection)	Aircraft, AFV, AT wpn, mine/IED, artillery, flame, some obstacles 20 mm round	Same as left, 5.56+mm MG to tires, obstacles 14.5-20 mm rd	Same as left, some obstacles, 12.7 mm rd	Same as left, 5.56+mm MG to tires, many obstacles 12.7 mm rd	Same as left, 5.56+mm MG to tires, some obstacles 7.62 mm rd	Same as left, 5.56+mm MG to tires, a few obstacles 7.62 mm rd	Same as left, 5.56+mm MG to tires, almost no obstacles 5.56 mm rd
Targets for Weapons	All targets 30-mm gun, ATGM, AGL, MG	All targets 30-mm gun, ATGM, AGL, MG	Aircraft, LAV, personnel, 12.7-30 mm gun, MG	Aircraft, LAV, personnel, 12.7-30 mm gun, MG	Aircraft, LAV, personnel, 12.7 mm MG	Aircraft, LAV, personnel, 7.62-12.7 mm MG	Aircraft, LAV, personnel, 7.62-12.7 mm MG
Support Required	High fuel use, load limits for aircraft	Med fuel use, load limits for aircraft	Low fuel use, can load on aircraft	Low fuel use, can load on aircraft	Low fuel use, can load on aircraft	Low fuel use, can load on aircraft	Low fuel use, can load on aircraft
Social Impact	Road size, noise, damage	Road size , block traffic if stuck	Road noise	Road size, block traffic if stuck	None	None	None
Example	BMP-2M	BTR-90M	Type 85	BTR-80A	Otokar Cobra	VBL	Spider
EG Page	3-35	3-21, see Notes	3-27	3-19	3-69	3-66	3-70

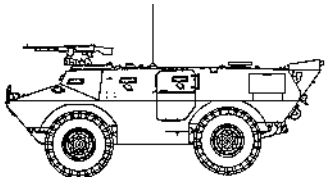
Auxiliary Weapons for Infantry Vehicles

The modern lethal battlefield offers a wide array of threats to armored fighting vehicles. A variety of antitank weapons for aircraft, infantry, and supporting systems can challenge tanks. All of these and more systems, including improvised weapons, can destroy infantry vehicles and the soldiers inside. Therefore, one counter used for tanks, adding auxiliary weapons, is also used for infantry LAFV weapons. Please note that many APCs and infantry support vehicles do not have a medium cannon for a main gun. The most common auxiliary weapons are machineguns and automatic grenade launchers, although a few have added rocket launchers, mortars, ATGM launchers, SAM launchers, and other weapons.

The simplest application is to add a pintle at a vehicle cupola or on the roll bar, then attach a typical ground mount weapon. Many turrets on LAFVs will have a main gun as well as a coaxial MG, mounted in line (see Type 85 sketch to the right). On modern vehicles these are electronically fired and use main gun sights. With these assists, a vehicle MG version (such as the Russian 7.62-mm PKT) will have greater range than its ground version (PKM). Also, a vehicle with a FCS may permit use of its night sights.



Most tanks and a variety of other vehicles such as HACVs and various infantry vehicles have added an anti-aircraft MG (AAMG) on a pintle at the commander's (and/or loader's) cupola. A variety of light cupolas can be fitted to vehicle roofs, permitting hand-slewed MGs to be used by a passenger. These MGs include guns in 12.7 mm or more. Chain guns (driven by an electric motor) offer high rates of fire, and minimum recoil permitting higher precision fires. China has previously displayed a 23-mm chain gun for pintle mounting on light strike vehicles. For many multi-purpose APCs and combat support vehicles, guns to 12.7 mm, coupled with light anti-armor weapons, offer sufficient firepower to ward off most threats without interfering with the combat mission. Most pintle-mount guns must be sighted and fired by hand, making the operator vulnerable to a variety of weapons.



Lessons from jungle and urban combat since the 1960s (and analyses on conventional combat) demonstrated a need for all-aspect awareness and fires for infantry vehicles, to rapidly engage the enemy to prevent him from engaging the vehicle with weapons which can overmatch its limited protection, especially from side and rear. Additional developments were needed for LAFVs to gain all-aspect 360-degree surveillance and firepower. In some cases, vehicle commanders or loaders also have access to their own auxiliary MG. This has been true for tanks more than for LAFVs. More auxiliary weapons are needed to address threats from all angles.

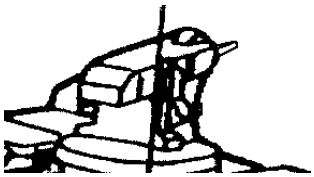
Key to the requirement for all-aspect firepower protection is to utilize the passengers to share the burden of all-aspect protection, and not burden the gunner. In the 1960s, one response was the U.S./Israeli M113 Armored Cavalry Assault Vehicle (ACAV), an APC with main MG and two or more additional MGs to cover flanks and rear. The severe vulnerability of personnel exposed outside of armor protection (even with gun shields)

has generally doomed acceptance of this configuration by most militaries.

Many infantry vehicles offer firing ports for side and rear protection; but those are generally deficient in providing vision and effective firepower to counter threats from all aspects and angles. Also, trends of adding armor and required swim capability may reduce use of these ports for some vehicles. A similar response to these threats is to add passenger-operated crew weapons which fire from behind armor. These include bow-mount MGs manned by passengers on the Russian BMD-3 and BMP IFVs. This capability supports fires until passengers dismount.

Recently offered vehicle upgrades include pintle gun mounts and add-on turrets. The Ukrainian BAU-23 x 2 features the twin gun turret and gun shield. This gun is similar to ZU-23 and adds an effective AA gun to armored vehicles. It can fit on the hull of vehicles. At least one application adds the turret on top of existing BMP-1 IFV turrets. The Chinese have displayed a 23-mm chain gun light enough for pintle to mount on roll bars of light strike vehicles, and be hand-operated and slewed for responsive fires. Another Russian vehicle has a 57-mm gun turret for AD and AT fires which can be fitted on IFVs/APCs.

A significant trend for modern vehicles is the addition of remotely fired MGs, with remote sights. The German experience led them in a similar direction with the Marder IFV, with periscopes for all passengers and a passenger-operated 7.62-mm rear-mounted MG. Earlier MG OWS were awkward, with centralized placement blocking access to passage-ways and restricting passenger space. New technologies now offer new solutions, especially with the variety of RWSs. Using lap-top screens, robust servo-motor mounts and stabilized computerized fire control, a variety of multiple *RWS* can be used, and operator stations rigged to be remotely fired from anywhere in vehicles by onboard passengers. These RWS can link to multiple EO day/night optics for remote-operated MGs and AGLs, to quickly engage threats. Since these weapons will often be manned by members of the dismount team, they must be considered as supplemental to crew systems. In some cases, when passengers dismount, one or more must remain behind to load weapons and supplement vehicle security by manning extra weapons.



Other types of weapons have been added to infantry vehicles. Russian BTR-90 and BMP-2M IFV vehicles have an AG-17 AGL. Many countries are adding automatic grenade launchers to supplement MG fires. As noted with coaxial MGs, when an AGL is incorporated into the turret fire control (such as AG-17 on BMP-2M), it has a longer operating range (1,700m versus 1,200 on the ground version). Light mortars, ATGM launchers, lethal grenade launchers, SAM launchers, and rocket launchers have been added to infantry vehicles for offensive and defensive use.

The combat power of IFVs made them high valuable targets for combat aircraft and tanks. Some developers avoided using ATGMs on LAFVs because of the idea that infantry vehicles should not attack tanks – they will normally lose that engagement. Mechanized forces in a maneuver fight with tanks, however, cannot easily dismount AT weapons for a well arranged and well planned fight. Therefore, the requirement for vehicle-mounted ATGMs has won out. The

limitation remains for most ATGM launchers, they work only on stopped vehicles. However, most IFVs can halt in a few seconds and launch an ATGM to "long range" (3,500+ m), beyond the accurate range for tank guns. Early ATGMs were designed against tanks, but could be used against slow-flying helicopters. Restrictions on ATGMs are the limited number of missiles onboard IFVs, and general focus on tank threats. More recently, the battlefield-wide increase in AT systems has liberated ATGMs for design against a wider range of targets. Many ATGMs (e.g., Kornet HE option and Hellfire) offer area blast effects for use against buildings, aircraft, and dismounts.

Conventional wisdom has long held that IFVs may have antitank guided missile launchers, but APCs would not. That wisdom is still generally valid; but there are exceptions.

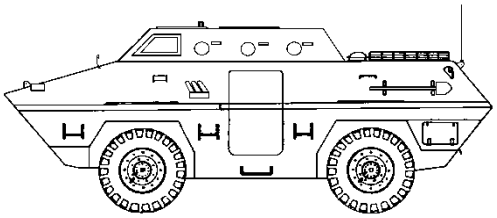
The Russians have mounted ATGMs on APCs such as the BTR-90 and the BTR-T Russia, China, the Ukraine, and other countries offer drop-in turret packages for BTRs and other vehicles, with ATGM launchers. Pintle mounts for auxiliary weapons can easily be tack-welded onto vehicles. Light tripod-mounted or shoulder-launched ATGMs, such as Eryx, AT-7, and AT-13 can be launched from raised hatches or infantry vehicle cupolas.

Modern IFVs are equipped with more advanced ATGMs. These include gun-launched ATGMs for BMP-3 variants, and for vehicles using the BMP-3 fighting compartment, such as BMD-4 and the Chinese ZBD-97 amphibious IFV. Gun-launch ATGMs, such as LAHAT and Arkan offer higher velocities and superior accuracy for use against helicopters and vehicles, and can out-fly adversary missiles for first kill at longer range. The newest systems feature well-stabilized guns and stabilized fire control. Therefore they have a capability which separates them from other ATGM launchers; they can launch on the move (see BMP-3M). Still they will not launch at speeds above 20 km per hour, or while traveling on rough terrain.

Newer BMP-2 upgrades and vehicles with the Kliver turret can use the Kornet laser-beam rider ATGM. The turret can also launch SA-18 SAMs from the IFV. Thus, a Kliver turreted IFV (BMP) or APC (BTR) can serve in a mechanized battalion or at brigade in the air defense battalion, and carry dismounted SAM launch teams. It can also support those teams by linking to AD nets, passing air warnings, acquiring targets with the Kliver FCS, and supporting their fires by launching SA-18 SAMs. Some Klivers will be fitted as specialized AD/AT vehicles for use in AD and AT units. The Israeli Spike ATGM is noted to be well suited for use against helicopters, with IR homing and lock-on after launch. Turrets such as the RWS can be mounted on infantry vehicles. With the current proliferation of beyond line-of-sight (BLOS) ATGMs, it is likely that they soon will be mounted on selected infantry vehicles. They will enable those vehicles to engage threats from outside of enemy view and beyond direct-fire range.

Another special system available for use with LAFVs is the Starstreak kinetic energy high-velocity missile system. It can be used in anti-aircraft as well as anti-armor roles. It out-ranges most ATGMs, with a flight time to 7 km in less than 6 seconds, to protect against nearly 5 all air and ground vehicle threats except main battle tanks. Turrets include Thor and others.

Yugoslavian Armored Personnel Carrier BOV-M



Weapons & Ammunition Types	Typical Combat Load
7.62-mm MG, M86 Ball-T, API, API-T	(est) **2,000**

SYSTEM
Alternative Designations: Sometimes referred to as "BOV"
Date of Introduction: 1984
Proliferation: At least 3 countries
Description:
Crew: 2
Troop Capacity: 8
Combat Weight (mt): 7.0 -9.0, depending on the variant
Chassis Length Overall (m): 6.0
Height Overall (m): 2.34 to top of cabin
Width Overall (m): 2.53
Ground Pressure (kg/cm^2): INA
Drive Formula: 4 x 4

Automotive Performance:
Engine Type: 148-hp Diesel
Cruising Range (km): 800
Speed (km/h):
Max Road: 95
Max Off-Road: INA
Average Cross-Country: 40
Max Swim: N/A
Fording Depths (m): 1.1

Radio: INA

Protection:
Armor, Turret Front (mm): 6-10 mm, defeats 7.62 mm AP at 300 m
Appliqué Armor (mm): Grill armor over windows, sides on variants
Explosive Reactive Armor (mm): N/A
Active Protection System: N/A
Mineclearing Equipment: N/A
Self-Entrenching Blade: N/A
NBC Protection System: Available
Smoke Equipment: 3 smoke grenade launchers on each side

ARMAMENT
Main Armament: (See NOTES)
Caliber, Type, Name: 7.62-mm (7.62x 54R) M86 MG
Rate of Fire (rd/min): 250 practical / 650 cyclic, 2-10 round bursts
Loader Type: Belt-feed (100-rd belts)
Ready/Stowed Rounds: INA
Elevation (°): INA
Fire on Move: Yes

Auxiliary Weapon: N/A
ATGM Launcher: N/A
Firing Ports: 3 firing ports on each side, plus 1 for commander

FIRE CONTROL
FCS Name: N/A
Main Gun Stabilization: N/A
Rangefinder: N/A
Infrared Searchlight: Yes, on MG
Sights w/Magnification:
Gunner:
Day: Optical sight, INA
Field of View (°): INA
Acquisition Range (m): 1,500
Night: IR night sight on MG
Commander Fire Main Gun: No

VARIANTS
BOV-M: APC was produced in the republic of Slovenia. Some APCs have a 12.7-mm MG.
BOV-VP: Security version with metal grates on the sides which can be swung out to direct crowds.
BOV-1/Polo M-83: ATGM launcher vehicle w/6 x AT-3 launchers.
BOV-3: Air defense variant with 3 turret-mounted 20-mm cannon.
BOV-30: Air defense vehicle with 2 turret-mounted 30-mm cannon.

BOV-30 National War College Photo

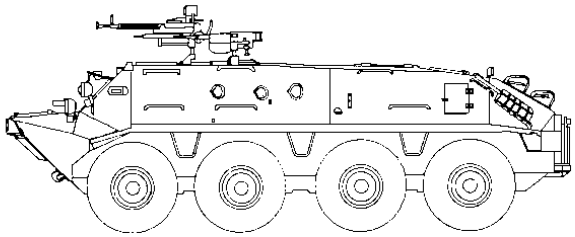
BOV-SN ambulance: Ambulance variant.
LOV: Croatian APC variant without the raised compartment, with a 12.7-mm MG and optional increased hull protection. The family of LOV vehicles includes recon and NBC recon vehicles, command vehicle, rocket launcher, EW vehicle, and AA missile vehicle.

MAIN ARMAMENT AMMUNITION
Caliber, Type, Name:
7.62-mm API, API-T
Maximum Aimed Range (m): 1,500
Max Effective Range (m):
Day: 1,000/400-500 on the move
Night: 200-800
Tactical AA Range: 1,000
Armor Penetration (mm): 8 (RHA) at 500 m

Other Ammunition Types: Light Ball, Ball-T, Heavy Ball, Incendiary

NOTES
The M86 MG is a license-built copy of the Russian PKT. Vehicle has central tire inflation system. Many vehicles have steel mesh screen over the windows.

Russian Armored Personnel Carrier BTR-60PA



Weapons & Ammunition Types	Typical Combat Load
12.7-mm DShK MG	**500**
APDS, API, API-T,	250
HE-T, HEI, I-T	250
2 x 7.62-mm PKT MG	**3,000**
Lt Ball, Ball-T	
API, API-T	

SYSTEM
Alternative Designations: BTR-60-PK
Date of Introduction: 1963
Proliferation: At least 30 countries (including variants)
Description:
Crew: 2
Troop Capacity: 12
Combat Weight (mt): 10.1
Chassis Length Overall (m): 7.22
Height Overall (m): 2.06
Width Overall (m): 2.82
Ground Pressure (kg/cm^2): INA
Drive Formula: 8 x 8

Automotive Performance:
Engine Type: 2 x 180-hp Gasoline
Cruising Range (km): 500
Speed (km/h):
- Max Road: 80
- Max Off-Road: 60
- Average Cross-Country: INA
- Max Swim: 10

Fording Depths (m): Amphibious

Radio: INA
Protection:
Armor, Turret Front (mm): 7-9mm hull front (no turret)
Other protection (appliqué armor, explosive reactive armor, active protection system, mineclearing equipment, self-entrenching blade, and smoke equipment) are absent.
NBC Protection System: Collective

ARMAMENT
Main Armament:
Caliber, Type, Name: 12.7-mm (12.7 x 108) heavy MG, DShK
Rate of Fire (rd/min): 80-100 (practical)
Loader Type: Belt feed
Ready/Stowed Rounds: INA
Elevation (°): -10/+80
Fire on Move: Yes

Auxiliary Weapons:
Caliber, Type, Name: 2 x 7.62-mm machinegun PKT
Mount Type: Vehicle top
Maximum Aimed Range (m): 1,500
Max Effective Range (m):
- Day: 1,000 day only

Fire on Move: Yes
Rate of Fire (rd/min): 250 practical / 650 cyclic, in 2-10 rd bursts
When 7.62-mm MGs are mounted, they are right and left of hatch. Gunners must be at least shoulder high out of the vehicle to operate weapons.

ATGM Launcher: N/A
Firing Ports: 3 on each side

FIRE CONTROL
FCS Name: N/A
Main Gun Stabilization: N/A
Rangefinder: N/A
Infrared Searchlight: N/A
Sights w/Magnification:
Gunner:
- Day: K10-T, day only
  - Field of View (°): INA
  - Acquisition Range (m): 1,500 (est) day only

Commander Fire Main Gun: No

VARIANTS
This vehicle is a roofed variant of the BTR-60P open-hatch armored carrier. It is widely fielded in original and modified form. A variety of armament variants for the vehicle were used, including single 7.62-mm PKT MG, or 12.7-mm MG, or no MG.

Artillery command and reconnaissance vehicles. ACRV **1V18** is a command and observation vehicle (COP). ACRV **1V19** is a fire direction center (FDC).

BTR-60PB: The most widely fielded variant has a one-man turret, a 14.5-mm KPV-T MG, a coaxial 7.62-mm MG and day/night sights.
BTR-60 PU-12/ -12M: Air defense associated ACV and its upgrade
BTR-60 R-975: Forward air controller turreted variant.
BTR-60 PU/R-145BM: Armored command vehicle (ACV) variant with R-111, R-123, and R-130M radios, often the distinctive Clothesline (front-to-rear rail antenna for mobile use), and a radio antenna with 10-m collapsible telescoping mast.

MTP-2: Armored recovery vehicle

12.7-mm, API/API-T Type 54
- Maximum Aimed Range (m): 1,500
- Max Effective Range (m) Day Only:
  - Day: 1,500 unarmored ground / 800 armored
- Tactical AA Range: 1,500

Other Ammunition Types: Incendiary-T, HE-T Type MDZ, HEI Type ZP, Russian Duplex/Duplex-T, Ch Type 54 APDS

Russian Armored Personnel Carrier BTR-60PB

National War College

Weapons & Ammunition Types	Typical Combat Load
14.5-mm turret MG API, API-T	**500**
7.62-mm coax PKT MG Light ball, Ball-T, API, API-T, I-T	**2,000**

SYSTEM
Alternative Designations: INA
Date of Introduction: 1966
Proliferation: At least 33 countries
Description:
Crew: 2
Troop Capacity: 8
Combat Weight (mt): 10.3
Chassis Length Overall (m): 7.22
Height Overall (m): 2.3
Width Overall (m): 2.82
Ground Pressure (kg/cm^2): 0.90
Drive Formula: 8 x 8

Automotive Performance:
Engine Type: 2x 90-hp Gasoline
Cruising Range (km): 500
Speed (km/h):Max Road: 80
Max Off-Road: INA
Average Cross-Country: INA
Max Swim: 10
Fording Depths (m): Amphibious
Radio: R-123

Protection:
Armor, Turret Front (mm): 7
Applique Armor, explosive reactive armor, mmineclearing equipment, self-entrenching blade, active protection system: N/A
NBC Protection System: Collective
Smoke Equipment: N/A

ARMAMENT
Main Armament:
Caliber, Type, Name: 14.5-mm (14.5 x 114) heavy MG, KPVT
Rate of Fire (rd/min): 150 practical
Loader Type: Belt-fed
Ready/Stowed Rounds: 50/450
Elevation (°): -5 to +30
Fire on Move: Yes

Auxiliary Weapon:
Caliber, Type, Name: 7.62-mm machinegun, PKT
Mount Type: Coax
Maximum Aimed Range (m): 2,000
Max Effective Range (m):
Day: 1,000/ 400-500 on the move
Night: N/A
Fire on Move: Yes
Rate of Fire (rd/min): 250 practical/650 cyclic, 2-10 round bursts
ATGM Launcher: N/A
Firing Ports: 3 on each side

FIRE CONTROL
FCS Name: N/A
Main Gun Stabilization: N/A
Rangefinder: N/A
Infrared Searchlight: Yes
Sights w/Magnification:
Gunner:
Day: PP-61AM, 2.6x
Field of View (°): 23
Acquisition Range (m): 2,000
Night: N/A
Commander Fire Main Gun: No

VARIANTS
BTR-60PBK: Command APC variant, with three additional radios.
BTR-60PB FAC: Turreted forward air control variant without gun.
BTR-60PZ: Final production model, with 1PZ-2 roof-mounted periscope and high angle-of-fire turret.

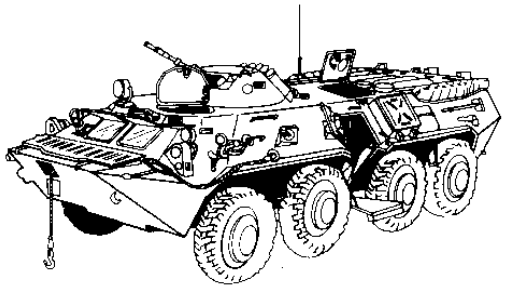
National War College Photo

BTR-70: Similar design with greater dimensions (11.5 mt), two improved gas engines (total 240 hp), added side doors between wheels.
BTR-70M: Upgrade BTR-70 with single diesel engine, smoke grenade launchers, and option of 30-mm gun turret (like BTR-80A).
BTR-80: Upgrade from BTR-70 (see pg 3-18).

MAIN ARMAMENT AMMUNITION
Caliber, Type, Name:
14.5-mm API-T, BZT-44M
Maximum Aimed Range (m): 2,000
Max Effective Range (m):
Day: 2,000
Night: INA
Tactical AA Range: 2,000
Armor Penetration (mm KE): 20 at 1,000 m/ 30 at 500 m
Other Ammunition Types: API, I-T

NOTES
The APC has self-sealing tires and a central tire inflation system. One vulnerability is that it lacks side or rear doors (loading hatch only), and troops must dismount from the top. In Afghanistan a variety of weapons were used, such as the AGS-17 automatic grenade launcher instead of the main gun. Current options include several one-man turrets, such as the Modular Weapons Station (as on BTR-80A, with a 30-mm gun), or Kliver (with a 30-mm gun, 7.62-mm coax MG, thermal sights, superior day sights, and four Kornet ATGM launchers).

Russian Armored Personnel Carrier BTR-80



Weapons & Ammunition Types	Typical Combat Load
14.5-mm turret MG API, API-T	**500**
7.62-mm coax PKT MG Light ball, Ball-T, API, API-T, I-T	**2,000**

SYSTEM
Alternative Designations: GAZ-5903
Date of Introduction: 1984
Proliferation: At least 22 countries
Description:
Crew: 2
Troop Capacity: 8
Combat Weight (mt): 13.6
Chassis Length Overall (m): 7.55
Height Overall (m): 2.41
Width Overall (m): 2.95
Ground Pressure (kg/cm^2): INA
Drive Formula: 8 x 8

Automotive Performance:
Engine Type: 260-hp Diesel
Cruising Range (km): 600
Speed (km/h): Max Road: 85
Max Off-Road: 60
Average Cross-Country: 40
Max Swim: 10
Fording Depths (m): Amphibious

Radio: R-173
Protection:
Armor, Turret Front (mm): Against 12.7mm
Appliqué Armor (mm): Available
Explosive Reactive Armor (mm): N/A
Active Protection System: N/A
Mineclearing Equipment: N/A
Self-Entrenching Blade: N/A
NBC Protection System: Collective
Smoke Equipment: 6 x 81-mm smoke grenade launchers

ARMAMENT
Main Armament:
Caliber, Type, Name: 14.5-mm (14.5 x 114) heavy MG, KPVT
Rate of Fire (rd/min): 150 practical
Loader Type: Belt-fed
Ready/Stowed Rounds: 50/450
Elevation (°): -4/+60
Fire on Move: Yes

Auxiliary Weapon:
Caliber, Type, Name: 7.62-mm machinegun, PKT
Mount Type: Coax
Maximum Aimed Range (m): 1,500
Max Effective Range (m): 1,000 day only
Fire on Move: Yes
Rate of Fire (rd/min): 250 practical/650 cyclic, 2-10 round bursts

ATGM Launcher: N/A
Firing Ports: 3 on each side

FIRE CONTROL
FCS Name: N/A
Main Gun Stabilization: N/A
Rangefinder: N/A
Infrared Searchlight: OU-3GA2M
Sights w/Magnification:
Gunner:
Day: 1P3-6, 1.2x/4x
Field of View (°): 49/14
Acquisition Range (m): 2,000
Night: N/A
Commander Fire Main Gun: No

VARIANTS
BTR-80: Similar design to BTR-70, with additional upgrades: boat tail replaced by high rear deck, larger side doors, new radio, single more powerful diesel engine, smoke grenade launchers high angle-of-fire turret, and new firing ports. More than three dozen variants are fielded.

BTR-80K: Command variant w/ added R-173, R-173P, and R-159 (portable) radios, R-174intercom, navigation aids, and an 11-m mast

Some versions of the BTR-80 mount auto-cannons. These include the **BTR-80A** with a 30-mm gun, the Ukrainian **BTR-94**, and two different versions called **BTR-4**. For information on these, see the next page.

BTR-80S: The upgrade APC has the BTR-80A new turret and fire control (TNP-3 day/night sights), but the pre-existing 14.5-mm gun.

BTR-82: Russian Arzamas has a BTR-80 upgrade (see next page for details). It retains the existing 14.5 mm gun, but has a new loader which holds 500 rounds. It and the 30-mm auto-cannon version, **BTR-82A**, are due for production in 2010.

2S23: 120-mm self-propelled combination gun (howitzer/mortar)
BREM-K: Armored recovery vehicle
RKhM-4: NBC reconnaissance vehicle
UNSh/K1Sh1/GAZ-59032: Russian expanded chassis for a dozen or more support vehicles, e.g., PU-12M6 AD CP, BMM ambulance series, 1V152 ACRV, RKhM-4-01 CBR recon vehicle, Kredo-S recon vehicle, and Kushetka-B command and staff vehicle (photo at pg 9-10).
BMM: Medical series on UNSh chassis, with BMM-1 ambulance, and BMM-2 (battalion) and BMM-3 (brigade) medical aid station s.

MAIN ARMAMENT AMMUNITION
Caliber, Type, Name:
14.5-mm API-T, BZT-44M
Maximum Aimed and Effective Range (m):
Day: 2,000
Night: INA
Tactical AA Range: 2,000
Armor Penetration (mm KE): 20 at 1,000 m/ 30 at 500 m
Other Ammunition Types: API, I-T

NOTES
Options include the Kliver turret with a 30-mm gun, 7.62-mm coax MG, thermal sights, superior day sights, and (four) Kornet ATGM launchers.

Russian Armored Personnel Carrier BTR-80A

National War College

Weapons & Ammunition Types	Typical Combat Load
30-mm automatic gun HEI-T, Frag-HE-T AP-T, APDS-T, APFSDS-T	**300**
7.62-mm coax MG	**2,000**

SYSTEM
Alternative Designations: GAZ-59034, BTR-80H in Hungary
Date of Introduction: 1994
Proliferation: At least 3 countries
Description:
Crew: 2
Troop Capacity: 8
Combat Weight (mt): 14.6
Chassis Length Overall (m): 7.65
Height Overall (m): 2.80
Width Overall (m): 2.90
Ground Pressure (kg/cm^2): INA
Drive Formula: 8 x 8

Automotive Performance:
Engine Type: 260-hp Diesel
Cruising Range (km): 800
Speed (km/h):
Max Road: 90
Max Off-Road, Average Cross-Country: INA
Max Swim: 10
Fording Depths (m): Amphibious

Radio: R-163-50U VHF, R-163-UP receiver, R-174 intercom

Protection:
Armor, Turret Front (mm): Can defeat 12.7-mm
Applique armor, explosive reactive armor, mineclearing equipment, self-entrenching blade, active protection system: N/A
NBC Protection System: Collective
Smoke Equipment: 6 x 81-mm smoke grenade launchers

ARMAMENT
Main Armament:
Caliber, Type, Name: 30-mm automatic gun, 2A72
Rate of Fire (rd/min): 200-330 variable cyclic in bursts
Loader Type: Dual-belt feed
Ready/Stowed Rounds: 300/ 0
Elevation (°): -5 to +70
Fire on Move: Yes

Auxiliary Weapon:
Caliber, Type, Name: 7.62-mm machinegun PKT
Mount Type: Coax
Maximum Aimed Range (m): 1,500
Max Effective Range (m):
Day: 1,000 Night: 800+
Fire on Move: Yes
Rate of Fire (rd/min): 250 practical/650 cyclic, 2-10 round bursts

ATGM Launcher: N/A
Firing Ports: 4 right side, 3 left side

FIRE CONTROL
FCS Name: N/A
Main Gun Stabilization: 2-plane
Rangefinder: INA
Infrared Searchlight: OU-5
Sights w/Magnification:
Gunner:
Day: 1P3-9, 1.2x/4x
Field of View (°): 49/14 (est)
Acquisition Range (m): 4,000
Night: TPN3-42 II/IR
Field of View (°): INA
Acquisition Range (m): 800-1200
Commander Fire Main Gun: No

VARIANTS
BTR-80A: Upgrade to BTR-80 with stabilized turret containing a new gun, and TNP-3 day/night sights.

BTR-3U/GUARDIAN: Ukrainian upgrade of **BTR-94** has the Shkval one-man turret with 30-mm gun, twin AT-5 ATGM launcher, automatic grenade launcher, and 7.62-mm MG. Jordanian variant has a twin 23-mm gun, and is being donated to new Iraqi armed forces.
BTR-3E1: This export version of -3U, with the improved Shturm turret and a new engine, has proliferated.

BTR-4: Ukrainian Morozov upgrade with a Grom overhead weapon station. Weapons are in a pivoting armored module above the hull, and include 30-mm auto-cannon, MG, 30-mm AGL, and 4 x AT-5/-5B ATGMs (4,000 m, mounted on the underside of the module).

A later Ukrainian upgrade is now called **BTR-4**. It features the Parus remote weapon station with 30-mm 3TM-1 auto-cannon, 40-mm auto-grenade launcher, 7.62-mm MG, and 2x Barrier 5,500-m range ATGM launchers.

BTR-82A: Russian Arzamas will produce a 30-mm cannon version of the BTR-82 APC upgrade (pg 3-18), starting 2010. Both vehicles will feature a new 300-hp engine, air conditioning, digital GPS navigation and fire control, day/night sights, screen display, and digital automated communications. The vehicle was designed to avoid mobility and reliability problems associated with the Ukrainian BTR-94 variant. This is the likely Russian Near-Term standard APC.

MAIN ARMAMENT AMMUNITION
Caliber, Type, Name:
The 30-mm rounds are same as BMP-2. See pg 3-33 for more details.

NOTES
Some analysts have referred to BTR-80A as an IFV; but it lacks sufficient protection to warrant that classification.
The drop-in gun/turret package (Modular Weapon System) is offered for export, to upgrade a wide variety of vehicles to BTR-80A standard.
BTR-80A can mount K1-126 bullet-resistant tires. High-angle-of-fire gun can fire at nearly 90-degrees.

Russian Armored Personnel Carrier BTR-90

Weapons & Ammunition Types	Typical Combat Load
30-mm automatic gun	**500**
HEI-T, Frag-HE-T	340
APFSDS-T, FAPDS	160
30-mm auto grenade lchr	**400**
ATGM lchr (Tier 1)	**4**
AT-5b/Konkurs-M	
7.62-mm coax MG	**2,000**

SYSTEM
Alternative Designations: GAZ-5923, Model 051
Date of Introduction: 1994
Proliferation: At least 1 country
Description:
Crew and Troop Capacity: 3 +7
Combat Weight (mt): 20.92
Chassis Length Overall (m): 7.64
Height Overall (m): 2.975
Width Overall (m): 3.20
Ground Pressure (kg/cm^2): INA
Drive Formula: 8 x 8

Automotive Performance:
Engine Type: 510-hp Diesel
Cruising Range (km): 800
Speed (km/h):
- Max Road: 100, 50+ average
- Max Off-Road: INA
- Average Cross-Country: Claimed equal to tracked vehicles
- Max Swim: 9

Fording Depths (m): Amphibious

Radio: R-163-50U VHF, R-163-UP receiver, R-174 intercom
Protection:
Armor, Turret Front (mm): Defeat 12.7-20 mm rds with appliqué armor (mm): Added option. Mine protected hull
Explosive Reactive Armor (mm): Optional
Mineclearing Equipment: No
Self-Entrenching Blade: No
Active Protection System: Optional
NBC Protection System: Collective
Smoke Equipment: 6 x 81-mm smoke grenade launchers

ARMAMENT
Main Armament:
Caliber, Type, Name: 30-mm automatic gun, 2A42
Rate of Fire (rd/min): 550 cyclic in bursts/200-300 practical
Loader Type: Dual-belt feed
Ready/Stowed Rounds: 500/ 0
Elevation (°): -5 to +75
Fire on Move: Yes

Auxiliary Weapon:
Caliber, Type, Name: 7.62-mm machinegun PKT
Mount Type: Coax
Maximum Aimed Range (m): 2,000
Max Effective Range (m):
- Day: 1,000
- Night: 800+

Fire on Move: Yes
Rate of Fire (rd/min): 250 practical/650 cyclic, 2-10 round bursts
Auto Grenade Launcher: AG-17 See BMP-2M for data

ATGM Launcher:
Name: 9P135M1/M3
Launch Method: Tube-launched
Guidance: SACLOS, encoded beacon jammer countermeasure
Command Link: Wire
Rate of Launch (missiles/min): 2-3 depending on range
Launcher Dismountable: Yes
Firing Ports: 4 right side, 3 left side

FIRE CONTROL
FCS Name: BPKZ-42
Main Gun Stabilization: 2-plane
Rangefinder: Laser in FCS
Infrared Searchlight: Yes
Sights w/Magnification:
Gunner:
- Day: BPKZ-42
  - Field of View (°): 8
  - Acquisition Range (m): 4,000
- Night: BPK-M thermal sight
  - Acquisition Range (m): 2,500

Commander Fire Main Gun: No

VARIANT
Some early versions lack the ATGM launcher.

BTR-90 Rostock or BTR-90M: Variant with BTR-90 chassis and BMP-3M turret. Weapons are 100-mm, 30-mm guns, 30-mm AGL, gun-launch ATGMs. Thermal sight range is 4-5 km. As APC/IFV, it seats 10. As a fire support vehicle, ammo/ATGM load may be more.

MAIN ARMAMENT AMMUNITION
Caliber, Type, Name:
30-mm APFSDS-T, M929
- Maximum Aimed Range (m): 2,500
- Max Effective Range (m): 2,500 day and night
- Tactical AA Range: 2,500
- Armor penetration (mm KE): 55 at 1,000 m/45 at 2,000 m

30-mm Frag-HE
- Maximum Aimed Range (m): 4,000
- Max Effective Range (m):
  - Day: 4,000
  - Night: 2,500
- Tactical AA Range: 4,000
- Armor Penetration (mm): INA

Antitank Guided Missiles
Name: AT-5b/Konkurs-M
- Warhead Type: Tandem shaped charge (HEAT)
- Armor Penetration (mm CE): 925 (RHA)
- Range (m): 4,000 day, 2,500 night

Other Missiles: AT-5B/Konkurs-M Thermobaric

NOTES
Because BTR-90 has medium cannon and can mount an ATGM launcher, it can be classed as an IFV versus APC. When an ATGM is used, on APCs, change the organization structure to IFV versus APC. A designated company/battalion FSV (e.g., MANPADS vehicle) has racks for 2 missile launchers and 12-14 missiles, depending on type. Other munitions are available (FAPDS, HEI-T rounds, and Milan-ER ATGMs).

Russian Armored Transporter BTR-152

BTR-152V2

Weapons & Ammunition Types	Typical Combat Load
7.62-mm SGMB MG Lt ball, ball-T, API	**1,250**
or 12.7mm MG	
Optional in side mounts **2x 7.62-mm SGMB MG** Lt ball, ball-T, API	**1,250-1,750**

SYSTEM
Alternative Designations: BTR-140, Chinese Type 56
Date of Introduction: 1950
Proliferation: At least 20 countries
Description:
Crew: 2
Troop Capacity: 17
Combat Weight (mt): 9.0
Chassis Length Overall (m): 6.83
Height Overall (m): 2.04
Width Overall (m): 2.32
Ground Pressure (kg/cm^2): 3.7
Drive Formula: 6 x 6

Automotive Performance:
Engine Type: 110-hp Gasoline
Cruising Range (km): 650
Speed (km/h):
Max Road: 65
Max Off-Road: INA
Average Cross-Country: INA
Max Swim: N/A
Fording Depths (m): 0.80
Radio: 10RT-12 or R-123

Protection:
Armor, Turret Front (mm): 11-15 on hull front (no turret)
Appliqué Armor (mm): Available
Other protection, such as explosive reactive armor, active protection system, mineclearing equipment, self-entrenching blade, NBC protection system and smoke equipment are N/A.

ARMAMENT
Main Armament: Note: 12.7-mm MG can be used instead.
Caliber, Type, Name: 7.62-mm (7.62x 54R) machinegun, SGMB
Rate of Fire (rd/min): 250 practical
Loader Type: Belt-fed
Ready/Stowed Rounds: 250 in box, 1,000 ready/0
Elevation (°): -6 to +23.5
Fire on Move: Yes

Auxiliary Weapon: (Optional)
Caliber, Type, Name: 2x 7.62-mm (7.62x 54R) machinegun, SGMB
Mount Type: Optional MGs on side pintle mounts
Maximum Aimed Range (m): 2,000
Max Effective Range (m):
Day: 1,000/ 400-500 on the move
Night: II sights available
Fire on Move: Yes
Rate of Fire (rd/min): 250 practical each/650 cyclic, 2-10 rd bursts
Firing Ports: 3 on each side, 2 in rear doors

FIRE CONTROL
FCS Name: N/A
Main Gun Stabilization: N/A
Rangefinder: N/A
Infrared Searchlight: No
Sights w/Magnification:
Gunner:
Day: Optical sight
Field of View (°): INA
Acquisition Range (m): 2,000
Night: II and IR sights available
Commander Fire Main Gun: No

VARIANTS
BTR-152: Basic APC; many of which would later be covered and converted for other uses, such as fire support vehicles, "gun trucks" in convoys, ambulances, radio stations, and engineer vehicles. This vehicle could be regarded as a high-end model for "technicals" and gun trucks. Versions for AA use include an Egyptian M53 gun (4x 12.7 mm) mount, and PLO-held ZU-23-2 gun mount.

BTR-152A: Anti-aircraft version with twin 14.5-mm MG turret
BTR-152D and E: Anti-aircraft versions with 4x 14.5-mm MGs
BTR-152I: BTR-152V version for artillery command vehicle.
BTR-152K: Version similar to **BTR-152V3** but with armored roof
BTR-152V: APC variant has central tire inflation system.
BTR-152U: Command vehicle with high rear structure
BTR-152V1: BTR-152V version with winch
BTR-152V2: BTR-152V version without winch
BTR-152V3: BTR-152V with winch and infrared driving lights

MAIN ARMAMENT AMMUNITION
Caliber, Type, Name:
7.62-mm API
Maximum Aimed Range (m): 2,000
Max Effective Range (m):
Day: 1,000
Night: INA
Tactical AA Range: 1,000
Armor Penetration (mm): 8 at 500 m

Other Ammunition Types: Light ball, ball-T, hvy ball, API-T, I-T

NOTES
Vehicles are early examples of armored transporters and "gun trucks" built from converted truck chassis (ZIL-151, and later ZIL-157).

Tigr-M Improved Light Tactical Vehicle

Tigr on parade in May 2008

Weapons & Ammunition Types	Typical Combat Load
7.62mm MG, Pecheneg Ball (57-N-323S); AP (7N13); Tracer (7T2); API (7BZ-3); and Sniper (7N1). Other Variants can mount a 12.7mm MG; a 30mm automatic grenade launcher; or the Kornet-EM Multipurpose Missile System.	**INA**

SYSTEM
Alternative Designations: GAZ-2330, but earlier versions had other numbers such as the GAZ-2975; Tiger
Date of Introduction: 2004
Proliferation: At least 8 countries
Description:
Crew: 2
Troop Capacity: 5-10 passengers dependent on variant
Combat Weight (mt): 7.8
Chassis Length Overall (m): 5.7
Height Overall (m): 2.40
Width Overall (m): 2.400
Drive Formula: 4 x 4
Central tire inflation system: Yes

Automotive Performance:
Engine Type: B205 Diesel with a GAZ JSC 5-Speed or Allison LCT-100 automatic transmission
Cruising Range (km): 1,000
Speed (km/h):
- Max Road: 140
- Off Road: INA
- Max Swim: NA

Fording Depth (m): 1.30
The vehicle is An-124 transportable.

Radio: INA, man-portable /vehicle, as needed by the customer.

Protection:
Armor, Turret Front (mm): 5.0 with spall liner; 7.62-mm protection, to STANAG Level II (Armor versions only)
Self-Entrenching Blade: No
Mine protection: Yes; to STANAG Level I
NBC Protection System: No
Smoke Equipment: No

ARMAMENT
Main Armament(s):
Armament varies with configuration. Below is for standard version.
Caliber, Type, Name: 7.62mm MG, Pecheneg
Rate of Fire (rd/min): 600-800 cyclic
Loader Type: Belt-fed (100, 200, or 250-round boxes)
Ready/Stowed Rounds: INA
Elevation (°): INA
Fire on Move: Yes
Firing Ports: SPM-2 Special Police Vehicle Variant Only

FIRE CONTROL
Sights w/Magnification: Open turret model APC Gunner (m):
- Day: INA
  - Acquisition Range (m): 1,500
- Night: INA

Commander Fire Main Gun: No

VARIANTS
2330 (standard); 2975 (police); 233034 or SPM-1 (police with 2 crew members & 7 passengers); 233036 or SPM-2 (SPM-1 with widow firing ports); SPM-2 Tigr Alpha BB (level 5 ballistic protection) 233301 or 233011 (unarmored pickup truck with 4 door, 4 seats, and closed rear compartment); 233002 or 233012 (2-door pickup); 233003 or 233013 (3-door SUV with sedan body; 233014-000186 and 233014-0000184 (armored variants); 233114 (upgraded engine and armor); Tigr-AR Assault Ramp Vehicle (scales vertical obstacles to 8.0 m in height with hydraulic and special cutting tools); R-145BMA (command and control vehicle with special communication equipment); Kornet-D/EM (Tigr with Kornet-EM missile system with 2 launchers for 8 missiles)); MKTK REI PP (mobile electronic warfare); Scout Vehicle (telescopic radar); Tigr-M (YaMZ-534 diesel engine with seats for 9 passengers instead of 8); MK-BLA-01 (UAV carrier) and SP46 (2-door parade vehicle with cabriolet body for ease of boarding);

MAIN ARMAMENT AMMUNITION
Caliber, Type, Name:
7.62 x 54mmR Ball (57-N-323S)
- Maximum Aimed Range (m): 1,500
- Max Effective Range (m):
  - Day: 1,500
  - Night: 1,200 (est)
- Armor Penetration: 6mm steel plate at 520 m and body armor at 110 m

7.62 x 54mmR AP (7N13)
- Maximum Aimed Range (m): 1,500
- Max Effective Range (m):
  - Day: 1,500
  - Night: 1,200 (est)
- Armor Penetration: 6 mm steel plate at 660 m and body armor at 800 m

Other Ammunition Types: Ball (57-N-323S); AP (7N13); Tracer (7T2); API (7BZ-3); and Sniper (7N1)

Dingo All-Protected Vehicle (APV)

Dingo 2 with RC mounted MG3 Machine Gun

Weapons & Ammunition Types	Typical Combat Load
7.62mm Rheinmetall Maschinengewehr Modell 3 (MG3) MG Other Variants can mount a 12.7mm MG, 50-caliber, or the 40-mm automatic grenade launcher.	**INA**

SYSTEM
Alternative Designations: Dingo 2 (upgraded variant); Multi-Purpose Protected Vehicle or MPPV (Belgium)
Date of Introduction: 2004
Proliferation: 7 countries (all Europe) with deliveries scheduled for Israel.
Description:
Crew: 2
Troop Capacity: 3-8 passengers dependent on variant
Combat Weight (mt): 12.5
Chassis Length Overall (m): 6.8 (other versions longer)
Height Overall (m): 2.50 (to roof)
Width Overall (m): 2.39
Drive Formula: 4 x 4
Central tire inflation system: Yes

Automotive Performance:
Engine Type: 215 horsepower diesel
EPS/EAS transmission
Cruising Range (km): 1,000
Speed (km/h):
- Max Road: 100
- Off Road: INA
- Max Swim: NA

Fording Depth (m): 1.00
The vehicle is C-130 or C-160 transportable.

Radio: INA, man-portable /vehicle, as needed by the customer.

Protection:
Armor, Turret Front (mm): INA; protection against hand-held weapons, artillery fragments up to 155-mm.
Self-Entrenching Blade: No
Mine protection: Yes; features an oblique blast deflector floor to provide protection against heavy anti-tank mines and buried IEDs.
NBC Protection System: Yes
Smoke Equipment: INA

ARMAMENT
Main Armament(s):
Armament varies with configuration. Below is for standard version.
Caliber, Type, Name: 7.62mm Rheinmetall MG in a remote control turret. Versions also available with a gunner instead of remote control turret.
Rate of Fire (rd/min): 1000-1300; 650 cyclic
Loader Type: Belt-fed (50 or 100-round disintegrating belt)
Ready/Stowed Rounds: INA
Elevation (°): INA
Fire on Move: Yes
Firing Ports: No

FIRE CONTROL
Sights w/Magnification: Remote Control Turret Gunner (m):
- Day: INA
  - Acquisition Range (m): 1,500
- Night: INA

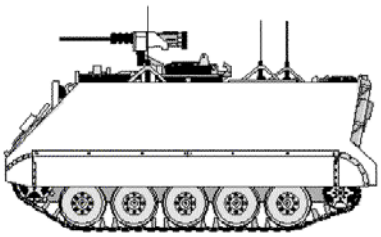
Commander Fire Main Gun: No

VARIANTS
Patrol (Base Version); Ambulance (3 litter or 4 ambulatory patients); Command Post (variable configurations); EOD (remote control arm); GSI (Badge Damage Repair-Repair Shop on Wheels); HD (Heavy Duty-up to 3 ton payload); Mine Roller (front-mounted clearance device); Psychological Operations (1 km speaker range); NBC Reconnaissance; Pick Up (Canvas cover or twist locks with payload up to 3 tons); Reconnaissance (BÜR-Ground Surveillance Radar (GSR)); Police (up to 8 passengers); Recovery Vehicle (6X6 with 10-ton winch); and Dingo 1 (original version produced before 1996 with lesser capabilities).

MAIN ARMAMENT AMMUNITION
Caliber, Type, Name:
7.62 x 51mm NATO
- Maximum Aimed Range (m): 3,000
- Max Effective Range (m):
  - Day: 1,200
  - Night: 800 (est)
- Armor Penetration: INA

Other Ammunition Types: M59 Ball (US-150.5 grain); M61 Armor Piercing (US-150.5 grain); M62 Tracer (US-142.0 grain); M80 Lead Free 9US-114.5 grain); M993 Armor Piercing (US-126.6 grains); L2A1 Ball (UK with 3 sub-variants); L5A1 Tracer (UK with 4 sub-variants); L42A1 Ball (UK-155.0 grains); L44A1 Ball (UK-144.0 grains); Patrone AB22 DM 111 *Weichkern* Ball (Germany-147.0 grains); Patrone DM111A1 Ball (Germany); Patrone AM32 DM18A1B1 *Übung* (Germany-10.0 grains)

U.S. Armored Personnel Carrier M113A1



Weapons & Ammunition Types	Typical Combat Load
.50 cal cupola MG Slap, API, API-T, Ball, Ball-T, Incendiary, I-T	**2,000**

SYSTEM
Alternative Designations: INA
Date of Introduction: 1964
Proliferation: At least 46 countries
Description:
Crew: 2
Troop Capacity: 11 passengers
Combat Weight (mt): 11.20
Chassis Length Overall (m): 4.90
Height Overall (m): 1.80
Width Overall (m): 2.70
Ground Pressure (kg/cm^2): .55

Automotive Performance:
Engine Type: 215-hp Diesel
Cruising Range (km): 483
Speed (km/h):
- Max Road: 64
- Max Off-Road: INA
- Average Cross-Country: INA
- Max Swim: 5.8

Fording Depths (m): Amphibious

Radio: Various, including intercom

Protection:
Armor, Turret Front (mm): N/A—No turret, defeats 7.72x39mm rd
Appliqué Armor (mm): Yes—anti-mine armor on bottom
Explosive Reactive Armor (mm): Available
Active Protection System: N/A
Mineclearing Equipment: N/A
Self-Entrenching Blade: N/A
NBC Protection System: N/A
Smoke Equipment: N/A

ARMAMENT
Main Armament:
Caliber, Type, Name: .50 cal (12.7 x 99) heavy machinegun, M2HB
Rate of Fire (rd/min): 450-550 cyclic
Loader Type: Belt feed
Ready/Stowed Rounds: 250/1750
Elevation (°): -20/+60
Fire on Move: Yes

Auxiliary Weapon: N/A
ATGM Launcher: N/A
Firing Ports: None

FIRE CONTROL
FCS Name: N/A

Main Gun Stabilization: N/A
Rangefinder: N/A
Infrared Searchlight: N/A
Sights w/Magnification:
Gunner:
- Day: Open ladder sight, 1x
  - Field of View (°): INA
  - Acquisition Range (m): 2,000
- Night: N/A

Commander Fire Main Gun: No

VARIANTS
More than 100 variants have been produced in numerous countries, with 7.62-mm MGs, 40-mm automatic grenade launchers, 90-mm recoilless rifles, and turrets with 20-to-76-mm cannons. The following are US variants. Command variants are **M577** and **M114** (C&R). Self-propelled mortars are **M125 (**81-mm) and **M106A2** (4.2-inch). The **M901/ ITV** ATGM launcher vehicle is a common variant. The **M163** SP air defense gun has a 20-mm Vulcan cannon; and **M730** is a Chaparral AD missile launcher. Other variants include ambulances, recovery and engineer vehicles.

M113A2: This multi-national variant features mobility improvements. One version is being developed with the Giat TS90 90-mm cannon. **M113A3:** Changes for this multi-national variant include a new power train and increased armor protection.

AIFV: The multi-national IFV variant has M113A3 armor upgrades, a stabilized turret with 25-mm gun, and a 7.62-mm MG.

VCC-1: Italian M113 copies are supplemented by this variant

MAIN ARMAMENT AMMUNITION
Caliber, Type, Name:
.50 cal AP
- Maximum Aimed Range (m): 2,000
- Max Effective Range (m):
  - Day: 2,000
  - Night: INA
- Armor Penetration (mm): 11@30° at 1,500 m

.50 cal Ball
- Maximum Aimed Range (m): 2,000
- Max Effective Range (m):
  - Day: 2,000 personnel, 1,000 vehicles
  - Night: INA
- Armor Penetration (mm): 20 at 100

Other Ammunition Types: Ball-T, Incendiary, I-T, API, API-T

NOTES
The M113A1 is a variant of the gasoline-powered **M113**. Armors available include Rafael Enhanced Add-on Armor Kit (EAAK), Creusot-Marrel plate armor, and SNPE explosive reactive armor. Thermal and TV sights are also available.

Austrian Armored Personnel Carrier Pandur

Austrian Armed Force Photograph

Weapons & Ammunition Types	Typical Combat Load
12.7mm MG, M2HB SLAP, API, API-T, Ball, Ball-T, Incendiary, I-T	**1,000**
7.62-mm MG, FN-MAG Ball-T, API, API-T	**1,600**

SYSTEM
Alternative Designations: System featured is MICV 1/127 version
Date of Introduction: 1996
Proliferation: At least 3 countries, 2 more to follow, and the UN
Description:
Crew: 3
Troop Capacity: 8-9
Combat Weight (mt): 11.3
Chassis Length Overall (m): 5.70
Height Overall (m): 2.64 top of cupola
Width Overall (m): 2.50
Ground Pressure (kg/cm^2): INA
Drive Formula: 6 x 6

Automotive Performance:
Engine Type: 210-hp Diesel/265-hp in upgrade
Cruising Range (km): 650
Speed (km/h):
Max Road: 105
Max Off-Road: INA
Average Cross-Country: INA
Max Swim: 9/11 with Amphibious Vehicle
Fording Depths (m): 1.2

Radio: INA
Protection:
Armor, Turret Front (mm): 12.7-mm on front 30°, 7.62-mm other
Appliqué Armor (mm): Add-on protection to 14.5 mm available
Explosive Reactive Armor (mm): N/A
Active Protection System: N/A
Mineclearing Equipment: N/A
Self-Entrenching Blade: N/A
NBC Protection System: Yes
Smoke Equipment: 6-12 smoke grenade launchers

ARMAMENT
Main Armament: Note:
Caliber, Type, Name: .50 cal (12.7 x 99) heavy MG, M2HB
Rate of Fire (rd/min): 450-550 cyclic
Loader Type: Belt-fed
Ready/Stowed Rounds: 250 /750
Elevation (°): -15 to +50
Fire on Move: Yes

Auxiliary Weapon:
Caliber, Type, Name: 7.62-mm (7.62 x 51) machinegun, FN-MAG
Mount Type: Turret/cupola mount
Maximum Aimed Range (m): 2,000
Max Effective Range (m):
Day: 1,500
Night: II sights available
Fire on Move: Yes
Rate of Fire (rd/min): 250 practical each/650-1000 cyclic, in bursts
ATGM Launcher: N/A
Firing Ports: 2 on each side, for several APC variants.

FIRE CONTROL
FCS Name: N/A
Main Gun Stabilization: N/A
Rangefinder: N/A
Infrared Searchlight: No
Sights w/Magnification:
Gunner:
Day: Optical sight, Swarovski F-450, 2x
Field of View (°): INA
Acquisition Range (m): 2,000
Night: II and IR sights available, thermal for cannon variants
Commander Fire Main Gun: No

VARIANTS
Pandur offers a wide variety of configurations on a modern 6x6 vehicle chassis, with weights varying 9-15t. Base vehicle is the APC, with flat hull top and 2- and 3-step hull top configurations. A recent variant is **Amphibious Vehicle**, stretched flat-hulled APC with slab sides and minimal preparation time for amphibious operation. Options include 1-3 cupolas and/or drop-in turrets with weapons: 7.62- and/or 12.7-mm MGs, 25-, 30-, or 35-mm auto-cannon, 40-mm AGL, and 90-mm cannon. Other variants include recon, fire support, TOW, Hellfire, and HOT ATGM launchers, engineer, command and control, NBC, ambulance, mortar, and logistics vehicles. A recent 8x8 fire support chassis prototype was displayed with a 105-mm gun.

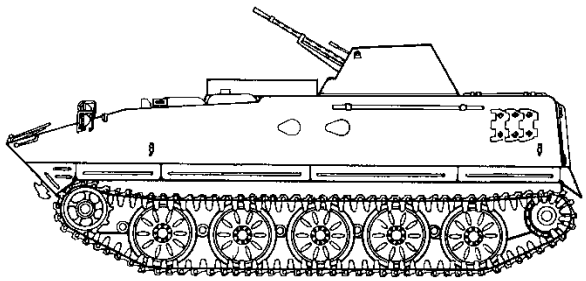
MAIN ARMAMENT AMMUNITION
Caliber, Type, Name:
.50 cal AP
Maximum Aimed Range (m): 2,000
Max Effective Range (m):
Day: 2,000
Night: INA
Armor Penetration (mm): 11@30° at 1,500 m

.50 cal Ball
Maximum Aimed Range (m): 2,000
Max Effective Range (m):
Day: 2,000 personnel, 1,000 vehicles
Night: INA
Armor Penetration (mm): 20 at 100

Other Ammunition Types: Ball-T, API, API-T, Incendiary, I-T

NOTES
A spall liner and mine protection carpet are included on the APC.

North Korean Armored Personnel Carrier VTT-323



Weapons & Ammunition Types	Typical Combat load
2 x 14.5-mm KPVT MG	**1,000**
API, API-T	500
HE-T	500
*AT Vehicle	
AT-3-Type ATGM	**4**
HEAT	
HE	
SA-7/-14/16 MANPAD	**2**

SYSTEM
Alternative Designations: M1973
Date of Introduction: 1973
Proliferation: At least one country

Description:
Crew: 3
Troop Capacity: 9 passengers
Combat Weight (mt): 13.5
Length Overall (m): 6.20
Height Overall (m): 2.50
Width Overall (m): 3.06
Ground Pressure (kg/cm^2): 0.58

Automotive Performance:
Engine Type: 260-hp Diesel
Cruising Range (km): 450
Speed (km/h):
Max Road: 80
Max Off-Road: 70-80
Average Cross-Country: INA
Max Swim: 10
Fording Depths (m): Amphibious
Radio: INA

Protection:
Armor, Turret Front (mm): 24
Appliqué Armor (mm): No
Explosive Reactive Armor (mm): No
Active Protection System: No
NBC Protection System: No
Smoke Equipment: No

ARMAMENT
Main Armament:
Caliber, Type, Name: 2 x 14.5-mm (14.5x114) Heavy MGs, KPVT
Rate of Fire (rd/min): 300 practical (2 x 150)
Loader Type: Belt
Ready/Stowed Rounds: INA
Elevation (°): -5 to +60
Fire on Move: Yes
Auxiliary Weapon: None
Firing Ports: 2 on each side

ATGM Launcher:
Name: 9P111-type
Launch Method: Rail-launched
Guidance: MCLOS
Command Link: Wire
Launcher Dismountable: Yes

FIRE CONTROL
FCS Name: No
Main Gun Stabilization: No (est.)
Rangefinder: No
Infrared Searchlight: No
Sights w/Magnification:
Gunner:
Day: INA
Field of View (°): INA
Acquisition Range (m): 1,500
Night: INA
Commander Fire Main Gun: No

VARIANTS
VTT-323 is a variant of Chinese Type 70-I SP howitzer/Type 63-1 APC chassis (pg 3-24). An infantry FSV variant mounts an AT-3-type ATGM launcher, and carries SA-7b/14/16MANPADS.

Other vehicles using the chassis are the **PT-85** light tank, a 120-mm combination gun, a 122-mm SP howitzer, 107-mm MRLs (12/18/24 tubes), a 4-barreled 14.5-mm SP AA Gun, the M1985 (AT-3-type 4-rail) ATGM launcher vehicle, and 82- and 120-mm SP mortars.

MAIN ARMAMENT AMMUNITION
Caliber, Type, Name: 14.5-mm API-T
Max Aimed Range (m): 2,000 (EST)
Max Effective Range (m):
Day: 1,500
Night: INA
Tactical AA Range: 1,500
Armor Penetration (mm CE): 20 at 1,000 m
30 at 500 m, 38 at muzzle
Other Ammunition Types: API, I-T, HE-T Type MDZ

ANTITANK GUIDED MISSILES See AT-3 for ATGM types.
Name: AT-3c Imp/ Polk (Slovenian)
Warhead Type: Tandem HEAT
Armor Penetration (mm CE): 580 (RHA)
Range (m): 3,000

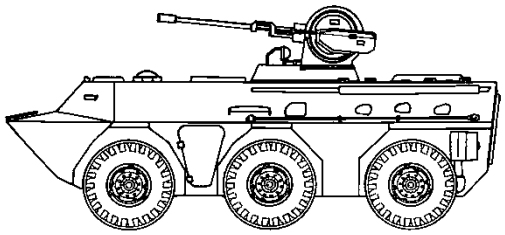
Name: Red Arrow-73A (Chinese)
Warhead Type: HEAT
Armor Penetration (mm CE): 500 RHA
Range (m): 3,000

Name: Red Arrow-73B/C (Chinese)
Warhead Type: HEAT
Armor Penetration (mm CE): 600 RHA
Range (m): 3,000

Other ATGMs: I-RAAD (Iranian), Malyutka-2 HE (Russian)

NOTES
Thermal sights are available. Slovenian TS-M ATGM thermal night sight ranges are: detection 4,500 m, recognition 2,000 m.
The HE-Blast ATGM is used for killing personnel and destroying bunkers and other fortifications.

Chinese Armored Personnel Carrier WZ 551A/Type 92



Type 92 w/25-mm gun

Weapons & Ammunition Types	Typical Combat Load
25-mm automatic gun	***600**
API	240
HE	360
7.62-mm coax MG	**1,000**
	*mix estimate

SYSTEM
Alternative Designations: Type 92 is often called an IFV, solely because of the main gun. A near-identical version with a MG is Type 92A (see VARIANTS). They have few other differences. For distinguishing them, terms IFV/APC are used. Overall system description comparing to other armored fighting vehicles is APC.
Date of Introduction: 1994 IFV, 1997 APC
Proliferation: At least 3 countries
Description:
Crew: 3 IFV/2 APC
Troop Capacity: 9 IFV/10 APC
Combat Weight (mt): 15.3
Chassis Length Overall (m): 6.63
Height Overall (m): 2.89
Width Overall (m): 2.80
Ground Pressure (kg/cm^2): INA
Drive Formula: 6 x 6

Automotive Performance:
Engine Type: 320-hp BF8L413F Diesel
Cruising Range (km): 800
Speed (km/h):
Max Road: 95
Max Off-Road: INA
Average Cross-Country: INA, good cross-country mobility
Max Swim: 8
Fording Depths (m): Amphibious

Radio: VRC-83, VIC-83 telephone
Protection:
Armor, Turret Front (mm): 10 mm
Appliqué Armor (mm): N/A
Explosive Reactive Armor (mm): N/A
Mineclearing Equipment: No
Self-Entrenching Blade: No
Active Protection System: N/A
NBC Protection System: Collective
Smoke Equipment: 8 smoke grenade launchers

ARMAMENT
Main Armament:
Caliber, Type, Name: 25-mm automatic overhead turreted gun
Rate of Fire (rd/min): 100/200 in bursts, or semi-automatic
Loader Type: Drum feed
Ready/Stowed Rounds: 200/400
Elevation (°): -8 to +55
Fire on Move: Yes, reduced range (est.)

Auxiliary Weapon:
Caliber, Type, Name: 7.62-mm coaxial machinegun PKT
Rate of Fire (rd/min): 250 practical/ 650 cyclic, 2-10 round bursts
Max Aimed Range (m): 2,000
Max Effective Range (m):
Day: 1,000
Night: 800+
Fire on Move: Yes
ATGM Launcher: N/A
Firing Ports: 4

FIRE CONTROL
FCS Name: N/A
Main Gun Stabilization: INA
Rangefinder: INA
Infrared Searchlight: II/IR sight w/searchlight optional
Sights w/Magnification:
Gunner: Day/night sight
Day: INA
Field of View (°): INA
Acquisition Range (m): 2,000+
Night: II
Field of View (°): INA
Acquisition Range (m): 800 est
Commander Fire Main Gun: No

VARIANTS
Type 92A: APC version with 12.7-mm MG. Other versions include other guns, and other MGs.
WZ 91: Red Arrow-8 ATGM launcher vehicle (4x4).
WZ 550: Red Arrow-9 ATGM launcher vehicle (4x4).
WZ 551/Type 86: Original model with 256-hp engine.
WZ 554: Twin 23-mm self-propelled anti-aircraft gun**.**
WZ 901: Riot patrol vehicle.
BK-1970 and BK-1990: 105-mm 6- and 8-wheeled SP AT guns. There are also prototype 120-mm 6- and 8-wheeled SP AT guns.
DK-9/WZ 551D: SAM launcher vehicle with PL-9C missile.
Other vehicle types include: C3 vehicle, ambulance, an engineer vehicle, recovery vehicle, and a 120-mm combination gun-mortar.
PLL05: 120-mm SP combo gun version (see 2S23, pg 7-57).
PTL02: 6-wheeled SPAT gun with 100-mm gun, ATGM-capable.

MAIN ARMAMENT AMMUNITION
Caliber, Type, Name: 25-mm API
Max Aimed Range (m): INA
Max Effective Range (m):
Day: 2,000 (est.)
Night: 800
Tactical AA Range: 2,000 (est)
Armor Penetration (mm): INA

Caliber, Type, Name: 25-mm HE
Max Aimed Range (m): INA
Max Effective Range (m):
Day: 2,000+ (est)
Night: 800
Tactical AA Range: 2,000 (est)
Armor penetration (mm): INA

NOTES
The tires have run-flat capability. China recently revealed a MANPADS launcher vehicle with the WZ 551 mounting a **Yitian/TY-90** launcher turret. It holds 8 TY-90 (similar to Mistral/FN-5) missile launchers, 12.7-mm MG, EO tracker, and 3-D radar. The system is offered for export.

Chinese Armored Personnel Carrier YW 531A/531C

National War College Photo

Weapons & Ammunition Types	Typical Combat Load
12.7-mm MG	**1,120**
APDS, API, API-T,	500
HE-T, HEI	620

YSTEM: Data is for YW 531A
Alternative Designations: Type 63-II, North Korean M1967
Date of Introduction: 1968 for YW 531A
Proliferation: At least 9 countries
Description:
Crew: 4
Troop Capacity: 10 passengers
Combat Weight (mt): 12.60
Chassis Length Overall (m): 5.48
Height Overall (m): 2.85
Width Overall (m): 2.98
Ground Pressure (kg/cm^2): 0.44 with 4 road wheels, 2 driving/side

Automotive Performance:
Engine Type: 260-hp Diesel/320-hp Diesel YW 531C
Cruising Range (km): 500
Speed (km/h):
- Max Road: 42/66
- Max Off-Road: 32/40
- Average Cross-Country: INA
- Max Swim: 6.0

Fording Depths (m): Amphibious

Radio: Type 889

Protection:
Armor, Turret Front (mm): 14, front glacis
Applique Armor (mm): N/A
Explosive Reactive Armor (mm): N/A
Mineclearing Equipment: N/A
Self-Entrenching Blade: N/A
Active Protection System: NA
NBC Protection System: N/A
Smoke Equipment: N/A

ARMAMENT
Main Armament:
Caliber, Type, Name: 12.7-mm x 108 MG, Type 54 (DShKM copy)
Rate of Fire (rd/min): 80-100 practical/600 air targets in bursts
Loader Type: Belt feed
Ready/Stowed Rounds: INA
Elevation (°): -5 to +85
Fire on Move: Yes

Auxiliary Weapon: N/A
ATGM Launcher: N/A
Firing Ports: 2 left side, 1 right, 1 in the rear/1 each side and rear

FIRE CONTROL
FCS Name: N/A
Main Gun Stabilization: N/A
Rangefinder: N/A
Infrared Searchlight: N/A
Sights w/Magnification:
Gunner:
- Day: Open ladder sight, optical sight, NFI
  - Field of View (°): INA
  - Acquisition Range (m): 3,300
- Night: N/A

Commander Fire Main Gun: No

VARIANTS
YW 531/Type 63/K-63: Original system 1963, with 7.62-mm MG.
YW 531A/Type 63A: Production model 1968, with 12.7-mm MG.
Type 63-1: 5- road wheel version for YW 70-I 122-mm SP howitzer
VTT-323: North Korean Type 63-1 variant (See pg 3-24).
Type 63-2: Upgrade 4x2 APC with gun shield. Variants are: **WZ 701** command vehicle with 7.62-mm MG, **Type 70** 130-mm (19-tube) MRL, and Red Arrow-8 ATGM launcher vehicle with 4-rail launcher and 4 stowed ATGMs.

YW 531C/Type 63C: Upgrade 4x2 APC with gun shield, and better vision ports, 320-hp engine, and ventilation. The **C, D** and **E** variants differ in intercom sets and firing ports. **Type 63C and Type 701** APCs for use in high sea-state amphibious operations. Variants using this chassis include **YW 750** ambulance, and **YW 701A/B** command APC with 12.7-mm MG. Two SP mortars - **Type YW 304** (82-mm M-1937 type with 120 rounds to 3,040 m) and **Type YW 381** (120-mm, with 50 rds to 7,700 m).

YW 531H/Type 85, Type 89, and Type 90: Expanded 5-roadwheel variants. For the **-H** variant and vehicle series, see below datasheet.

MAIN ARMAMENT AMMUNITION
Caliber, Type, Name:
12.7-mm, APDS (Tungsten Core), Type 54
Max Aimed Range (m): 2,000 (est)
Max Effective Range (m):
- Day: 2,000 vehicles and personnel
- Night: INA

Tactical AA Range: 1,600
Armor Penetration (mm): INA

12.7-mm, API, Type 54
Max Aimed Range (m): 2,000 (est)
Max Effective Range (m):
- Day: 2,000 Unarmored vehicles and personnel
  1,500 armored vehicles
- Night: INA

Tactical AA Range: 1,600
Armor Penetration (mm): 21 (RHA) at 500 m, 13 at 1,000 m

Other Ammunition Types: API-T, Russian Duplex, Russian Duplex-T, Incendiary-T, HE-T Type MDZ, HEI Type ZP

NOTES

Chinese Armored Personnel Carrier YW 531H and Vehicle Series Type 85

Type 85 APCs National War College Photo

Weapons & Ammunition Types	Typical Combat Load
12.7-mm MG	**1,120**
APDS, API, API-T,	500
HE-T, HEI	620
Missile Launcher	**8**
(ATGM vehicle)	
HEAT ATGM	

SYSTEM: Data is for APC. ATGM vehicle noted where different.
Alternative Designations: Type 85 export vehicle series. Type 89 vehicle series for the Chinese army.
Date of Introduction: 1986
Proliferation: At least 4 countries
Description:
Crew: 2 / 4
Troop Capacity: 13 / 0 passengers
Combat Weight (mt): 13.6 / 13.8 ATGM launcher
Chassis Length Overall (m): 5.9
Height Overall (m): 2.85 / INA
Width Overall (m): 2.98
Ground Pressure (kg/cm^2): 0.59

Automotive Performance:
Engine Type: 320-hp Diesel
Cruising Range (km): 500
Speed (km/h):
Max Road: 65 / 60
Max Off-Road: 46
Average Cross-Country: 35
Max Swim: 6.0
Fording Depths (m): Amphibious

Radio: Type 889 / Type 889 or VRC 83

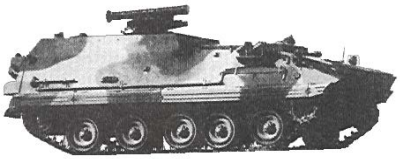
Protection:
Armor, Turret Front (mm): 14 front glacis
Applique armor, explosive reactive armor, mineclearing equipment, self-entrenching blade, active protection system, and NBC collective protection system: N/A
Smoke Equipment: 2 x 4 grenade launchers, some versions

ARMAMENT
Main Armament:
Caliber, Type, Name: 12.7-mm (12.7 x 108), heavy MG, Type 54
Rate of Fire (rd/min): 80-100 practical/600 air, in bursts / 2-3
Loader Type: Belt feed
Ready/Stowed Rounds: 4/4 for ATGM launcher vehicle
Elevation (°): -4 to +82 / -7 to +13
Fire on Move: Yes / No

Auxiliary Weapon: N/A
ATGM Launcher: N/A
Firing Ports: 6-7 (3 on each side, 1 in rear door, Thai version)

FIRE CONTROL
Sights w/Magnification:
Gunner:
Day: Open ladder sight / day periscope
Field of View (°): INA
Acquisition Range (m): 2,000 / 4,000
Night: No

VARIANTS
Type 85: Domestic/export vehicle series is derived from the C-series APC expanded with addition of a 5th road wheel. Combat versions include **YW 531H** APC and **YW 703H** command APC. The Thai -531H APC has a .50 cal M2HB MG versus 12.7-mm Type 54 MG. **YW 309** is an IFV with a 73 mm gun. Combat support vehicles include the **Type 70-1**/ **YW 302** 122-mm SP howitzer and **YW 306** 130-mm MRL. Support vehicles include **WZ 751** ambulance, and **Type 85** engineer and recovery vehicles. Sources indicate that there are also Type 85 82-mm and 120-mm self-propelled mortar vehicles.



Type 85 ATGM launcher vehicle: Raised hull variant with 4-rail launcher turret for Red Arrow-8 SACLOS wire-guided ATGM. Rate of fire is 2-3 rd/min. See launcher data sheet for ATGM data.

Type 89/YW 534/WZ-534: A 5-wheeled APC and vehicle series for export and fielding in Chinese ground forces. It has a 250 mm longer and 74 mm wider chassis, improved engine and mobility. It also has improved swim capability and night sights. The **YW 307** (25-mm gun), and **NVH-1** (25- or 30-mm gun) and **NVH-4** IFV prototypes (25-mm gun) use this chassis. Vehicle family includes the **ZDF 89** ATGM launcher vehicle for the Red Arrow-8. Other combat and support vehicles will be added.

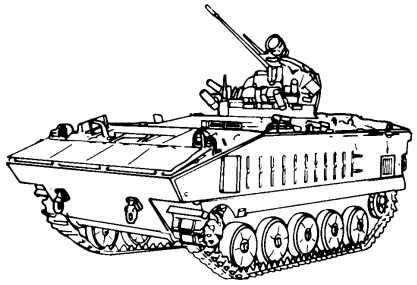
ZDF-1: 120-mm combination gun on Type 85/89 chassis.

MAIN ARMAMENT AMMUNITION
Caliber, Type, Name:
12.7-mm, APDS (Tungsten Core), Type 54
Max Aimed Range (m): 2,000
Max Effective Range (m):
Day: 2,000 vehicles and personnel
Night: INA
Tactical AA Range: 1,600
Armor Penetration (mm): INA

12.7-mm, API, Type 54
Max Aimed Range (m): 2,000
Max Effective Range (m):
Day: 2,000 Unarmored vehicles and personnel
1,500 armored vehicles
Night: INA
Tactical AA Range: 1,000
Armor Penetration (mm): 21 (RHA) at 500 m, 13 at 1,000 m

Other Ammunition Types: API-T, Russian Duplex, Russian Duplex-T, Incendiary-T, HE-T Type MDZ, HEI Type ZP

French Infantry Fighting Vehicle AMX-10P



Weapons & Ammunition Types	Typical Combat Load
20-mm Cannon	**760**
APDS-T, API-T	(est) 260
HEI, HEI-T	500
7.62-mm coax MG	**2,000**
Tracer, AP, API, Incendiary	
Milan ATGM (Optional use)	**5**

SYSTEM
Alternative Designations: INA
Date of Introduction: 1973
Proliferation: At least 3 countries
Description:
Crew: 3
Troop Capacity: 8 passengers
Combat Weight (mt): 14.5
Length Overall (m): INA
Height Overall (m): 2.57
Width Overall (m): 2.78
Ground Pressure (kg/cm^2): 0.53

Automotive Performance:
Engine Type: 300-hp Diesel
Cruising Range (km): 600
Speed (km/h):
- Max Road: 65
- Max Off-Road: INA
- Average Cross-Country: INA
- Max Swim: 7

Fording Depths (m): Amphibious
Mineclearing Equipment: N/A
Self-Entrenching Blade: N/A

Radio: INA
Protection:
Armor, Turret Front (mm): 12.7-mm frontal
Appliqué Armor (mm): N/A
Explosive Reactive Armor (mm): Available
Active Protection System: N/A
NBC Protection System: Yes
Smoke Equipment: 4 smoke grenade launchers

ARMAMENT
Caliber, Type, Name: 20-mm automatic cannon M693 F1
Rate of Fire (rd/min): 740
Loader Type: Dual belt feed
Ready/Stowed Rounds: INA
Elevation (°): -8/+50
Fire on Move: INA

Auxiliary Weapon:
Caliber, Type, Name: 7.62-mm (7.62 x 51) MG, AAT 52 NF1
Mount Type: Coax
Maximum Aimed Range (m): INA
Max Effective Range:
- Day: INA
- Night: INA

Fire on Move: Yes
Rate of Fire (rd/min): INA

ATGM Launcher: (Optional use)
Name: Milan 2 (Tier 3, Milan 3 or Milan-ER for upgrades)
Launch Method: Tube launch from canister
Guidance: SACLOS
Command Link: Wire
Rate of Launch (missiles/min): 2-3 depending on range
Launcher Dismountable: Yes, vehicle mount usually not available

Firing Ports: None

FIRE CONTROL
FCS Name: INA
Main Gun Stabilization: INA
Rangefinder: INA
Infrared Searchlight: Yes
Sights w/Magnification:
Gunner:
- Day: OB 40 Day/ night sight
  - Field of View (°): INA
  - Acquisition Range (m): INA
- Night: OB 40 Day/ night sight
  - Field of View (°): INA
  - Acquisition Range (m): 800-1,300 est

Commander Fire Main Gun: No

VARIANTS
AMX-10P: OPFOR variant portrayed, with Milan ATGM launcher
AMX-10P/Milan: ATGM launcher vehicle, with two launchers
AMX/HOT: ATGM launcher vehicle (Toucan II turret, 4 launchers)
AMX-10 TM: Mortar carrier towing 120-mm RT-61 mortar
AMX-10 PAC 90: Fire support/AT variant with Giat 90-mm gun
AMX-10P Marine: Improved swim variant w/ 12.7/25/90-mm gun
AMX-10 PC: Command variant with varied command stations
AMX-10 RC: Wheeled (6 x 6) fire support vehicle with 90-mm gun
AMX-10 RAC: The same fire support chassis with 105-mm gun

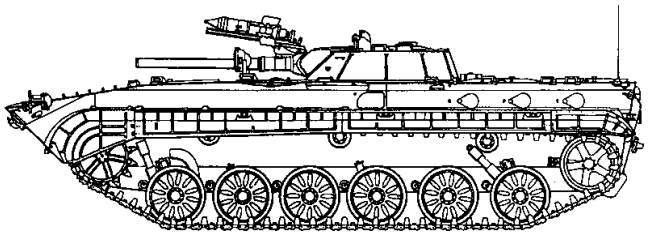
MAIN ARMAMENT AMMUNITION
Caliber, Type, Name: 20-mm (20x139) APDS-T
- Maximum Aimed Range (m): INA
- Max Effective Range (m):
  - Day: 1,300
  - Night: 800 est
- Tactical AA Range: INA
- Armor Penetration (mm): INA

Other Ammunition Types: API, API-T, HEI, HEI-T

ATGM: MILAN-2 for Tier 3 (see page 6-26)
Other MILAN missile versions are available.

NOTES
A French SNPE explosive reactive armor (ERA) kit and others are available for use on theAMX-10P. However, during dismounted troop movement, ERA would be a hazard. Thus, passive armor is more likely; and ERA application is doubtful.

Russian Infantry Fighting Vehicle BMP-1



Weapons & Ammunition Types	Typical Combat load
73-mm gun	**40**
HEAT	20
HE	20
AT-3/a/b/c/Imp ATGM	**4**
HEAT	
HE	
7.62-mm coax MG	**2,000**

SYSTEM
Alternative Designations: BMP Model 1970**,** Korshun
Date of Introduction: 1970
Proliferation: At least 33 countries
Description:
Crew: 3
Troop Capacity: 6 passengers (+2)
Combat Weight (mt): 13.3
Length Overall (m): 6.74
Height Overall (m): 2.15
Width Overall (m): 2.94
Ground Pressure (kg/cm^2): 0.57

Automotive Performance:
Engine Type: Diesel
Cruising Range (km): 600
Speed (km/h):
Max Road: 65
Max Off-Road: 40-45
Average Cross-Country: INA
Max Swim: 7
Fording Depths (m): Amphibious
Mineclearing Equipment: KMT-10 mine plow available
Self-Entrenching Blade: No
Radio: R-123, R-M or R-173

Protection:
Armor, Turret Front (mm): 19-23
Appliqué Armor (mm): Available
Explosive Reactive Armor (mm): Available
Active Protection System: No
NBC Protection System: Collective protection
Smoke Equipment: Vehicle engine exhaust smoke system (VEESS)

ARMAMENT
Main Armament:
Caliber, Type, Name: 73-mm smoothbore gun 2A28/Grom
Rate of Fire: 7-8 rd/min
Loader Type: Autoloader
Ready/Stowed Rounds: 40 / 0
Elevation (°): -4 to +33
Fire on Move: Yes, but only 10 km/h or less (est.)

Auxiliary Weapon:
Caliber, Type, Name: 7.62-mm (7.62x 54R) Machinegun PKT
Mount Type: Coax
Max Aimed Range (m): 1,300
Max Effective Range (m):
Day: 1,000 / 400-500 on the move
Night: 800
Fire on Move: Yes
Rate of Fire: 250 rpm (practical, in 2-10 round bursts)
Firing Ports: 4 on each side, 1 in left rear door

ATGM Launcher:
Name: 9P111
Launch Method: Rail-launched
Guidance: MCLOS
Command Link: Wire
Rate of Launch (missiles/min): 2
Launcher Dismountable: Yes

FIRE CONTROL
FCS Name: INA
Main Gun Stabilization: No
Rangefinder: Laser
Infrared Searchlight: Yes
Sights w/Magnification:
Gunner:
Day: 1PN22M1, 8x
Field of View (°): 15
Acquisition Range (m):
Night: 1PN22M1, 6x
Field of View (°): 6
Acquisition Range (m): 800-1,000, based on light
Commander Fire Main Gun: No

VARIANTS
The prototype IFV, known as BMP, was not fielded. Initial BMP production variant, BMP-A, was produced in small numbers from 1966, but production was halted after insignificant numbers. The standard BMP-1 (**Model 1970**) features improved fume venting, NBC protection, and swim features, and the AT-3/Malyutka antitank guided missile.

BMP-1K: Company command IFV, with added R-126 and R-107 transceivers. Firing ports and most periscopes are blocked.

BMP-1KSh: Russian regiment or division command and staff vehicle, with turret mounted erectable 10-meter radio mast. Radios include R-130, R-111, and R-173.

BMP-1M: Iranian variant with drop rear gate versus double doors.

BMP-1P: Widely fielded and copied IFV (see pp. 2-35 and 2-36) with an AT-4/-5 ATGM launcher replacing the AT-3 launcher. The vehicle also added smoke grenade launchers. This variant should generally be portrayed where OPFOR calls for the BMP-1. Copies include the Chinese **WZ 501/Type 86,** Czech **BVP-1,** and Polish **BWP-1.**

BMP-1PG: Recently offered upgrade similar to BMP-1P with an AG-17 automatic grenade launcher and other options (see p. 2-21).

BMP-1PK: Command variant for BMP-1P (see p. 3-31).

BPzV: Czechoslovakian reconnaissance variant with a TALL MIKE external tripod mounted radar.

Russian Infantry Fighting Vehicle BMP-1 continued

BREM-2: Light recovery and repair vehicle with a light crane.

BREM-4: Armored recovery vehicle. Czech version is VPV

BRM-1, BRM-1K: Reconnaissance command variants with improved sensors and low-profile 2-man turret (see p. 3-7).

BRM-23: Bulgarian reconnaissance variant with a 23-mm cannon, AT-3 ATGM, navigation system, NBC and artillery reconnaissance devices, and image intensifier night sights.

IRM: Engineer underwater reconnaissance vehicle, with mine detectors and mapping capabilities.

MLI-84: Romanian APC variant with a 12.7-mm MG.

MP-31: Modernized command and staff vehicle.

OT-90: Czech APC variant with 14.5-mm and 7.62-mm MGs.

PRAM-S: Former-Czechoslovakian self-propelled 120-mm mortar.

PRP-3/PRP-4: Artillery reconnaissance vehicle (see p. 6-10).

Snezka: Czech stretched version battlefield surveillance vehicle, with a sensor suite (including radar) mounted on a telescoping arm.

SVO: Former-Czechoslovakian turret less mine clearing variant with 24 large rocket-propelled line charges.

Type 86/WZ-501: Chinese IFV with BMP-1 turret. **Type 86A** upgrade has bow extension for use in high sea-state amphibious operations. A variety of IFVs/APCs and support vehicles have been developed using this chassis. For instance, the Chinese **WZ 503** is a raised hull APC variant replacing the 73-mm gun with a 12.7-mm MG. The **WZ 504** is an ATGM launcher vehicle with 4-rail AT-3 type ATGM launcher. **WZ 506** is a regimental command and staff vehicle. **NIFV-1** is a prototype IFV with M242 25-mm gun. Recently NORINCO displayed a replacement turret on the **Type 86M** upgrade, with a 30-mm gun and HJ-73D or HJ-73T ATGM.

VP90: Czech reconnaissance vehicle with 14.5 and 7.62-mm MGs

MAIN ARMAMENT AMMUNITION
Caliber, Type, Name: 73-mm HEAT-FS, PG-9
Max Aimed Range (m): 1,300
Max Effective Range (m):
Day: 800, but 600 or less on the move in 2-4 rd bursts
Night: 800
Tactical AA Range: INA
Armor Penetration (mm CE): 335 (RHA)

73-mm HEAT-FS, PG-15VNT (Tandem HEAT)
Maximum Aimed Range (m): 1,300
Max Effective Range (m):
Day: 1,000, but 600 or less on the move
Night: 800-1,000
Tactical AA Range: INA
Armor Penetration (mm CE): 550-700 (RHA)

Caliber, Type, Name: 73-mm HE, OG-9M1
Max Aimed Range (m): 4,500
Max Effective Range (m):
Day: 1,300/ 600-1,000 on the move
Night: 800-1,000
Tactical AA Range: INA
Armor penetration (mm): INA

Other Ammunition Types: OG-9, OG-9M

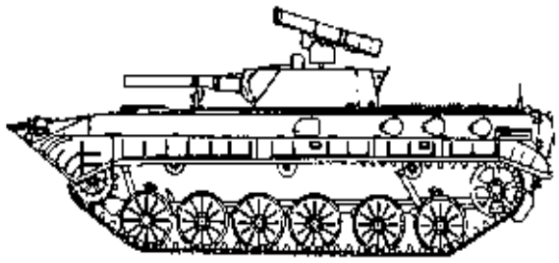
Antitank Guided Missiles:
Name: AT-3 variants For data, see pg 6-27

NOTES
Thermal gunner sights are available; however, most upgrades involve adding a thermal sight with an improved gun and improved fire control system. The Slovenian TS-M ATGM thermal night sight has a detection range of 4,500 m and a recognition range of 2,000 m.

Russian AG-17 30-mm AGL modification is available for use on BMP-1. A French SNPE ERA kit and others are available for use on the BMP-1. Other options are added armor, improved tracks, spall liners, air-conditioning, smoke grenade launchers/laser warning receivers, and a more powerful engine (360 hp).

A variety of gun and turret upgrade packages are available for the BMP-1. A key limitation for the BMP-1 is its 1-man turret (discussion at pg 3-7). For lower tier (Tier 3) upgrades, see pg 3-34, Notes. A variety of upgrades which include a 2-man turret can be used to bring the BMP-1 to the capability of the BMP-2, or to surpass that capability.

Russian Infantry Fighting Vehicle BMP-1P



Weapons & Ammunition Types	Typical Combat Load
73-mm gun	**40**
HEAT-FS	(est) 16
HE	24
ATGM	**4**
AT-5	
7.62-mm coax MG	**2,000**

SYSTEM
Alternative Designations: BWP-1 (Poland), see NOTES
Date of Introduction: 1974
Proliferation: At least 7 countries
Description:
Crew: 3
Troop Capacity: 6 passengers
Combat Weight (mt): 13.3
Chassis Length Overall (m): 6.74
Height Overall (m): 2.15
Width Overall (m): 2.94
Ground Pressure (kg/cm^2): 0.57

Automotive Performance:
Engine Type: 300-hp Diesel
Cruising Range (km): 600
Speed (km/h):
- Max Road: 65
- Max Off-Road: 40-45
- Average Cross-Country: INA
- Max Swim: 7

Fording Depth (m): Amphibious

Radio: R-123, or R-173

Protection:
Armor, Turret Front (mm): 19-23
Appliqué Armor (mm): N/A
Explosive Reactive Armor (mm): Available
Active Protection System: N/A
Mineclearing Equipment: KMT-8 plow available
Self-Entrenching Blade: N/A
NBC Protection System: Collective
Smoke Equipment: Six 81-mm smoke grenade launchers, VEESS

ARMAMENT
Main Armament:
Caliber, Type, Name: 73-mm smoothbore gun 2A28/Grom
Rate of Fire (rd/min): 7-8
Loader Type: Autoloader
Ready/Stowed Rounds: 40 / 0
Elevation (°): -4/+33
Fire on Move: Yes, but only 10 km/h or less (est)

Auxiliary Weapon:
Caliber, Type, Name: 7.62-mm (7.62x 54R) machinegun, PKT
Mount Type: Coax
Maximum Aimed Range (m): 1,300
Max Effective Range (m):
- Day: 1,000 / 400-500 on the move
- Night: 800

Fire on Move: No
Rate of Fire (rd/min): 250 practical / 650 cyclic, 2-10 round bursts

ATGM Launcher:
Name: 9P135M2
Launch Method: Tube-launched
Guidance: SACLOS
Command Link: Wire
Rate of Launch (missiles/min): 2-3, depending on range
Launcher Dismountable: Yes

Firing Ports: 4 on each side, 1 in left rear door

FIRE CONTROL
FCS Name: 1PN22M1
Main Gun Stabilization: N/A
Rangefinder: Stadiametric
Infrared Searchlight: OU-3GK
Sights w/Magnification:
Gunner:
- Day: 1PN22M1, 8 x
  - Field of View (°): 15
  - Acquisition Range (m): 1,300
- Night: 1PN22M1, 6.7x
  - Field of View (°): 6
  - Acquisition Range (m): 800-1,000 based on light

Commander Fire Main Gun: No

VARIANTS
BMP-1P Tier 4 portrayal ATGM is AT-5. For applications where a robust and modernized OPFOR is expected, use AT-5b ATGM.

BMP-1PG: This recently offered Russian upgrade is similar to BMP-1P with an added AG-17 30-mm automatic grenade launcher and other options, including thermal sights.

BMP-1PK: Command variant, with addition of R-126 and R-107 transceiver. A small telescoping antenna is mounted on right rear. Firing ports and telescopes on right side are blocked off.

MAIN ARMAMENT AMMUNITION
Caliber, Type, Name:
73-mm HEAT-FS, PG-9
- Maximum Aimed Range (m): 1,300
- Max Effective Range (m):
  - Day: 800, but 600 or less on the move in 2-4 round bursts
  - Night: 800-1,000
- Tactical AA Range: INA
- Armor Penetration (mm CE): 335 (RHA)

73-mm HEAT-FS, PG-15VNT (Tandem HEAT)
- Maximum Aimed Range (m): 1,300
- Max Effective Range (m):
  - Day: 1,000, but 600 or less on the move
  - Night: 800-1,000
- Tactical AA Range: INA
- Armor Penetration (mm CE): 550-700 (RHA)

Russian Infantry Fighting Vehicle BMP-1P continued

73-mm HE, OG-9M1
- Maximum Aimed Range (m): 4,500
- Max Effective Range (m):
  - Day: 1,300/ 600-1,000 on the move
  - Night: 800-1,000
- Tactical AA Range: INA
- Armor penetration (mm): INA

Other Ammunition Types: OG-9, OG-9M

Antitank Guided Missiles:
Name: AT-5/Konkurs
- Warhead Type: Shaped charge (HEAT)
- Armor Penetration (mm CE): 650 (RHA)
- Range (m): 4,000

Name: AT-5b/Konkurs-M
- Warhead Type: Tandem shaped charge (HEAT)
- Armor Penetration (mm CE): 925 (RHA)
- Range (m): 4,000

Name: AT-4/Fagot
- Warhead Type: Shaped charge (HEAT)
- Armor Penetration (mm CE): 480 (RHA)
- Range (m): 2,000

Name: AT-4b/Faktoriya
- Warhead Type: Tandem Shaped charge (HEAT)
- Armor Penetration (mm CE): 550 (RHA)
- Range (m): 2,500

Other Missiles: AT-4/-4b/-5b/Konkurs-M and Thermobaric
The AT-4/AT-4b ATGMs are less likely to be employed on this vehicle than AT-5/AT-5b.

NOTES
A wide variety of upgrades are available for all BMP IFV models. Options include improved tracks, spall liners, air-conditioning, smoke grenade launchers/laser warning receivers, and a more powerful engine (360 hp). A French SNPE explosive reactive armor (ERA) kit and others are available for use on the BMP-1. However, during dismounted troop movement, ERA would be a hazard. Thus, passive armor is more likely; and ERA application is doubtful. Additional armor application may jeopardize amphibious capability.

The KBP launcher for Kornet ATGMs can be mounted on other BMP-1 variants. Russian AG-17 and AG-30 30-mm automatic grenade launcher modifications are available for use on BMP-1P.

Thermal gunner sights are available; however, most upgrades involve adding a thermal sight with an improved gun and improved fire control system. The Russian Alis thermal gunner's sight is available. The Slovenian TS-M ATGM thermal night sight has a detection range of 4,500 m and a recognition range of 2,000 m.

Tier 4 IFV systems include BMP-1, BMP-1P, and BMP-1PG. Their distinguishing feature is the 73-mm cannon. The most singular improvement is replacement with a 30-mm or other main gun. The Russian Volgograd Tractor Plant offers the BMP-1/B30 package with a B30 turret (a drop-in one-man turret with 2A42 30-mm gun, 7.62-mm coax MG, BMP-2-type fire control system, PZU-8 AA sight, and a 9P135M ATGM launcher for AT-4/-5 ATGM). Russian KBP offers a drop-in one-man turret, called Kliver, with a stabilized 2A72 30-mm gun, a 4 x Kornet ATGM launcher, thermal sights, and improved fire control system (pgs 3-49 and 3-50). Use of a 1-man turret remains a serious limitation for an IFV; because the lack of a commander's surveillance capability makes the vehicle vulnerable to other threats and dangerously slow in recognizing, prioritizing, and responding to threats (see pg 3-7).

A variety of gun and turret upgrade packages are available for the BMP-1. A key limitation for the BMP-1 is its 1-man turret (discussion at pg 3-7). For lower tier (Tier 3) upgrades, see pg 3-34, Notes. A variety of upgrades which include a 2-man turret can be used to bring the BMP-1 to the capability of the BMP-2, or to surpass that capability (see pgs 3-35 through 3-36). Russian BMP-2 two-man turrets with gun and fire control system are being marketed for BMP-1 customers. The firm KBP offers the Unified Fighting Compartment, with the BMP-2 two-man turret, ready for drop-in installation. Virtually any country has sufficient facilities to make this installation. The most difficult part of the job is widening the opening for the 2-man turret. For capabilities of a BMP-1 type upgraded with 30-mm gun and 2-mm turret to the BMP-2 standard, use BMP-2, as described on the next two pages.

Russian Infantry Fighting Vehicle BMP-2

Weapons & Ammunition Types	Typical Combat Load
30-mm automatic gun	**500**
HEI-T, Frag-HE	340
AP-T, APDS-T, APFSDS-T	160
ATGM	**4**
AT-5b HEAT	
HE	
7.62-mm coax MG	**2,000**

SYSTEM
Alternative Designations: Yozh (Russia), Sarath (India)
Date of Introduction: 1980
Proliferation: At least 20 countries
Description:
Crew: 3
Troop Capacity: 7 passengers
Combat Weight (mt): 14.3
Chassis Length Overall (m): 6.72
Height Overall (m): 2.45
Width Overall (m): 3.15
Ground Pressure (kg/cm^2): 0.63

Automotive Performance:
Engine Type: 300-hp Diesel
Cruising Range (km): 600
Speed (km/h):
- Max Road: 65
- Max Off-Road: 45
- Average Cross-Country: 35
- Max Swim: 7

Fording Depth (m): Amphibious

Radio: R-123M transceiver or R-173

Protection:
Armor, Turret Front (mm): 23-33
Appliqué Armor (mm): On BMP-2D
Explosive Reactive Armor (mm): Available, see NOTES
Active Protection System: N/A
Mineclearing Equipment: KMT-8 mine plow available
Self-Entrenching Blade: N/A
NBC Protection System: Collective
Smoke Equipment: 6 smoke grenade launchers, VEESS

ARMAMENT
Main Armament:
Caliber, Type, Name: 30-mm automatic gun, 2A42
Rate of Fire (rd/min): 550 cyclic in bursts/ 200-300 practical
Loader Type: Dual-belt feed
Ready/Stowed Rounds: 500/0
Elevation (°): -5 to +74
Fire on Move: Yes

Auxiliary Weapon:
Caliber, Type, Name: 7.62-mm (7.62x 54R) machinegun, PKT
Mount Type: Turret coax
Maximum Aimed Range (m): 2,000
Max Effective Range (m):
- Day: 1,000
- Night: INA

Fire on Move: Yes
Rate of Fire (rd/min): 250 practical/650 cyclic, 2-10 round bursts

ATGM Launcher:
Name: 9P135M1/M3
Launch Method: Tube-launched
Guidance: SACLOS
Command Link: Wire
Rate of Launch (missiles/min): 2-3, depending on range
ATGM Loading: 1 ready/4 stowed, hand loading from an open hatch.
Launcher Dismountable: Yes

Firing Port: 4 on left side, 3 on right side, 1 in left rear door

FIRE CONTROL
FCS Name: BPK-1-42 or BPK-2-42
Main Gun Stabilization: 2-plane
Rangefinder: Laser
Infrared Searchlight: Yes
Sights w/Magnification:
Gunner:
- Day: BPK-1-42 or BPK-2-42
  - Field of View (°): 8
  - Acquisition Range (m): 2,500-4,000 (est)
- Night: BPK-1-42 or BPK-2-42 II/IR
  - Field of View (°): INA
  - Acquisition Range (m): INA

Commander Fire Main Gun: No

VARIANTS
BMP-2K: Command variant with additional radio

Many countries have upgrade packages to bring older BMP-1s, copies, and variants up to BMP-2 standard. Several countries have replaced the 73-mm Grom gun with auto-cannons in 23-mm, 25-mm, 30-mm and other calibers. To replace a 1-man turret (BMP-1) with a 2-man turret, rework facility must cut a larger opening and install a larger turret ring. This can be executed in many indigenous industries.

Other selective upgrades have been made to improve both BMP-1s and BMP-2s beyond the original BMP-2's standard. They include armor, new 30-mm rounds, new ATGMs, fire control, thermal sights, gun stabilization, improved engines and armors, secondary arms such as grenade launchers, and air conditioning.

Russian Infantry Fighting Vehicle BMP-2 continued

BMP-2D: Variant with add-on plate armor, but which cannot swim. This vehicle was seen in Afghanistan.

BMP-2E: Variant with 6-mm steel plates added and track skirts

BMP/Kliver: Description of the option is at pg 3-49. The limitation of a 1-man turret is somewhat offset by its superior (and expensive) turret system. It launches 4 missiles, either ATGMs or MANPADS, and is a superior choice for AD/AT fire support vehicle.

BMP-2/LAHAT: Russian tests are underway with the Israeli ATGM (pg 6-59), for sale of this IFV to a South American customer.

BMP-1U: Ukrainian BMP-1 upgrade with Shkval turret, 30-mm gun, twin AT-5 launcher, thermal sight, and AG-17 AGL.

BMP-1/COBRA-S: Ukrainian BMP-1 with 1-man overhead weapon station, 30-mm gun, and AT-5 launcher option. It is used in some Ukrainian units.

BMP-23 and **BMP-30:** Bulgarian IFVs. The former uses an MT-LB chassis and 23-mm auto-cannon for BMP-2 type design but inferior lethality and protection. The latter has a BMP-2 turret on a heavier chassis (20 mm protection) similar to BMP-2, but with 7 road wheels.

MAIN ARMAMENT AMMUNITION
Caliber, Type, Name:

30-mm AP-T
- Maximum Aimed Range (m): 2,500
- Max Effective Range (m):
  - Day: 1,500
  - Night: 1,300
- Tactical AA Range: 4,000
- Armor Penetration (mm KE): 18 (RHA, 60°) at 1,500 m

30-mm APDS
- Maximum Aimed Range (m): 2,500
- Max Effective Range (m):
  - Day: 2,000
  - Night: 1,300
- Tactical AA Range: 4,000
- Armor Penetration (mm KE): 25 (RHA) at 60° 1,500 m

30-mm APFSDS-T M929
- Maximum Aimed Range (m): 2,500
- Max Effective Range (m):
  - Day: 2,000+
  - Night: 1,300
- Tactical AA Range: 4,000
- Armor penetration (mm KE): 55 (RHA) at 1,000m
  45 at 2,000m

30-mm Frag-HE
- Maximum Aimed Range (m): 4,000/ 2,500 point target
- Max Effective Range (m):
  - Day: 4,000
  - Night: 1,300
- Tactical AA Range: 4,000
- Armor Penetration (mm): INA

Other Ammunition Types: 30-mm HEI-T

Antitank Guided Missiles:

Name: AT-5/Konkurs
- Warhead Type: Shaped charge (HEAT)
- Armor Penetration (mm CE): 650 (RHA)
- Range (m): 4,000

Name: AT-5B/Konkurs-M
- Warhead Type: Tandem shaped charge (HEAT)
- Armor Penetration (mm CE): 925 (RHA)
- Range (m): 4,000

Name: AT-4/Fagot (less likely)
- Warhead Type: Shaped charge (HEAT)
- Armor Penetration (mm CE): 480 (RHA)
- Range (m): 2,000

Name: AT-4B/Faktoriya (less likely)
- Warhead Type: Tandem shaped charge (HEAT)
- Armor Penetration (mm CE): 550 (RHA)
- Range (m): 2,500

Other Missiles: AT-4/-4b/5 and 5b/Konkurs-M HE thermobaric.

NOTES

A wide variety of upgrades are available for all BMP IFV models. Options include improved tracks, spall liners, air-conditioning, smoke grenade launchers/laser warning receivers, and a more powerful engine (360 hp). A French SNPE explosive reactive armor (ERA) kit and others are available for use on the BMP-1. However, during dismounted troop movement, ERA would be a hazard. Thus, passive armor is more likely; and ERA application is doubtful. Additional armor application may jeopardize amphibious capability.

Thermal gunner sights are available; however, most upgrades involve adding a thermal sight with an improved gun and improved fire control system. The Russian Alis thermal gunner's sight is available. The Slovenian TS-M ATGM thermal night sight has a detection range of 4,500 m and a recognition range of 2,000 m.

Ukrainian KBA Unified Battle Module is a drop-in OWS with a 30-mm KBA cannon, 2 x Konkurs ATGM launchers, and an AGL.

Russian KBP offers a drop-in one-man turret, called Kliver, with a stabilized 2A72 30-mm gun, a 4-Kornet ATGM launcher, thermal sights, and improved fire control system (pgs 3-49 and 3-50). Although the vehicle features superior weapons and fire control, use of a 1-man turret remains a serious limitation for an IFV; because the lack of a commander's surveillance capability makes the vehicle vulnerable to other threats and dangerously slow in recognizing, prioritizing, and responding to threats (see pg 3-7).

The KBP Kvartet 4-missile launcher for Kornet ATGMs can be mounted on BMP-1 or BMP-2 chassis.

Indian Flame-V adaptor kit permits the BMP-2 system to launch Milan, Milan-2, and Milan-3 ATGMs.

A variety of modernized BMP-2 IFVs and modernization packages for adaptation to BMP-2s are offered fielded.

Russian Infantry Fighting Vehicle BMP-2M and BMP-2M Berezhok

BMP-2M Berezhok

Weapons & Ammunition Types	Typical Combat Load
30-mm automatic gun	**500**
HEI-T, Frag-HE	340
APFSDS-T	160
ATGM	
Kornet BMP-2M Berezhok	**6**
AT-5B BMP-2M	**4**
Automatic Grenade Launcher	**400**
AG-30 BMP-2M Berezhok	
AG-17 BMP-2M	
7.62-mm coax MG	**2,000**

SYSTEM
Alternative Designations: BMP-2M is an early BMP-2 upgrade. A later package is **BMP-2M Berezhok**, above. This represents the OPFPOR Tier 1 surrogate, with a mix of options.
Date of Introduction: 1995
Proliferation: BMP-2 M is used by at least 1 country and has been marketed since 1995. Upgrades are planned in at least 3 countries. Berezhok is contracted for export to 2 countries.

Description:
Crew: 3
Troop Capacity: 7 passengers
Combat Weight (mt): 14.3
Chassis Length Overall (m): 6.72
Height Overall (m): 2.45
Width Overall (m): 3.15
Ground Pressure (kg/cm^2): 0.63

Automotive Performance:
Engine Type: 360-hp UTD-23 Diesel , 400 upgrade (VARIANTS)
Cruising Range (km): 600
Speed (km/h):
Max Road: 65+
Max Off-Road: 45+
Average Cross-Country: 35+
Max Swim: 7
Fording Depth (m): Amphibious

Radio: R-123M transceiver or R-173

Protection:
Armor, Turret Front (mm): 23-33 KE
Appliqué Armor (mm): 23+ On Kurgan Upgraded IFV and BMP-2D. Add to BMP-2M Berezhok for Near Term OPFOR IFV
Explosive Reactive Armor (mm): Available, see NOTES
Active Protection System: N/A
Mineclearing Equipment: KMT-8 mine plow available
Self-Entrenching Blade: N/A
NBC Protection System: Collective
Smoke Equipment: 6 smoke grenade launchers, VEESS

ARMAMENT
Main Armament:
Caliber, Type, Name: 30-mm (30 x 165) automatic gun, 2A42
Rate of Fire (rd/min): 550 cyclic in bursts/ 200-300 practical
Loader Type: Dual-belt feed
Ready/Stowed Rounds: 500/0
Elevation (°): -5 to +74
Fire on Move: Yes

Auxiliary Weapon:
Caliber, Type, Name: 7.62-mm (7.62x 54R) machinegun, PKT
Mount Type: Turret coax
Maximum Aimed Range (m): 2,000 day and night
Max Effective Range (m): 1,000-2,000 day and night
Fire on Move: Yes
Rate of Fire (rd/min): 250 practical/650 cyclic, 2-10 round bursts

Auxiliary Weapon:
Caliber, Type, Name: 30-mm AGL, AG-30 BMP-2M Berezhok
30-mm AGL, AG-17 BMP-2 M
Mount Type: Turret side
Range (m): 1,700 day and night
Fire on Move: Yes
Rate of Fire (rd/min): 50-100 practical/ to 400 cyclic, 2-10 rd bursts

ATGM Launcher:
Name: Kornet on BMP-2M Berezhok
Launch Method: Tube-launched, from 4 mounted missile canisters, one inside
Guidance: SACLOS, cannot be jammed
Command Link: Laser beam rider
Rate of Launch (missiles/min): 3-4, depending on range
Launcher Dismountable: No

Name: 9P135M1/M3 on Tier 2 BMP-2M
Launch Method: Tube-launched. ATGM load is 4 ready (one on the launcher and three inside), hand loaded from an open hatch
Guidance: SACLOS, encoded beacon jammer countermeasure
Command Link: Wire
Rate of Launch (missiles/min): 2-3, depending on range
Launcher Dismountable: Yes

Firing Port: 4 on left side, 3 on right side, 1 in left rear door

FIRE CONTROL
Sights w/Magnification:
FCS Name: INA, BMP-2M Berezhok
Main Gun Stabilization: Improved 2-plane
Rangefinder: Laser
Infrared Searchlight: Not used with thermal sight, yes with IR
Gunner:
Day: TV with IR auto-tracker, 12x/2.5x
Field of View (°): 4.5/20
Acquisition Range (m): 7,000
Night: Catherine thermal, 2nd gen thermal
Field of View (°): 2.25 x 3.0/6.75 x 9.0
Acquisition Range (m): 5,500
Commander Fire Main Gun: Yes

Russian Infantry Fighting Vehicle BMP-2M and BMP-2M Berezhok continued _____

FCS Name: INA, TV for BMP-2M
Main Gun Stabilization: Improved 2-plane
Rangefinder: Laser
Infrared Searchlight: Not used with thermal sight, yes with IR
Gunner:
Day: BPK-M (less expensive BPK-3-42 available)
Field of View (°): 8
Acquisition Range (m): 4,000
Night: Sanoet-1 thermal 4.6x/9.2x
Field of View (°): INA
Acquisition Range (m): 2,500, 4,000 detection
Commander Fire Main Gun: No

VARIANTS
The BMP-2 and older BMP-1 have been upgraded in various ways.

The **BMP-2M** is a 2-man version of the BMP-1/B30 upgrade to the 1-man BMP-1, which generally brought it up to BMP-2 standard. Original sight is BPK-3-42 with laser searchlight (aka laser radar). Later options included a 360-hp engine and Sanoet-1 thermal sight.

BMP-2 Upgraded Infantry Fighting Vehicle: Private venture design by Russian Kurganmashzavod. This is a more recent BMP upgrade over the above BMP-2M. It features substantial plate armor on the hull and skirts, 30-mm gun, 30-mm AGL, and two ATGM launchers. Fire control includes the Rubezh-M system, with 4,700 m range on 2nd gen thermal sight, and two ATGM launchers.

BMP-2M Berezhok: Upgrade BMP-2 with KBP **Berezhok** 2-man turret. The turret fits BMP-1and -2, but can be mounted on other chassis. It uses the 2A42 30-mm gun and two twin-missile Kornet launchers (total 4 versus one AT-5B in the Malyshev design), and the recent AG-30 30-mm AGL. The system also has a 2nd gen thermal night sight, an IR auto-tracker, and hunter-killer FCS (which permits the commander to fire the main gun). It will be exported to Algeria and one other country. India is evaluating it since it fits Indian upgrade goals for its Sarath (BMP-2 copy) IFVs. This the representative system for the OPFOR Tier 1 IFV, with noted turret, 400-hp UTD-23 turbocharged diesel engine, improved running gear, modular Kurgan armor, and air conditioning.

BMP/Kliver: Description of the option is at pg 3-49. The limitation of a 1-man turret is somewhat offset by its superior (and expensive) turret system. It launches 4 missiles, either ATGMs or MANPADS, and is a superior choice for infantry (AD/AT) fire support vehicle.

"BMP-2M": Another competing Russian design uses the BMP-3M unified (modular) turret, with 100-mm gun, gun-launch ATGM, 30-mm gun coaxial gun, and 7.62-mm antipersonnel coaxial gun. It has a superior thermal night sight and an IR auto-tracker. Initial reports were that this turret would be used to upgrade Russian BMPs, which would be called BMP-4. Official confirmation of this statement and fielding status are unknown. Those reports were probably premature. The large fighting compartment limits space for a dismount team. This arrangement suits a HACV or infantry FSV, but is less satisfactory for an IFV. The ATGM load for infantry FSV role would be 6-8.

MAIN ARMAMENT AMMUNITION
30-mm Gun:
30-mm APFSDS-T M929
Maximum Aimed Range (m): 2,500
Max Effective Range (m):
Day: 2,500
Night: 2,500
Tactical AA Range: 2,500
Armor penetration (mm KE): 55 (RHA) at 1,000m
45 at 2,000m

30-mm Frag-HE
Maximum Aimed Range (m): 4,000/ 2,500 point target
Max Effective Range (m):
Day: 4,000
Night: 2,500
Tactical AA Range: 4,000
Armor Penetration (mm): INA

Other Ammunition Types: 30-mm HEI-T. FAPDS-T (frangible-T)
Note: Gun can also fire earlier types of 30x165 ammunition

Antitank Guided Missiles:
Name: Kornet-LR for BMP-2M Improved
Alternative Designation: 9M133
Missile Weight (kg): 27
Warhead Type: Tandem Shaped Charge (HEAT)
Armor Penetration (mm CE): 1,100
Min/Max Range (m): 100/5,500 day, 3,500 night
Probability of Hit (%): 90
Average Velocity (m/s): 550
Time of Flight to Max Range (sec): 22

Name: AT-5b/Konkurs-M for BMP-2M
Warhead Type: Tandem shaped charge (HEAT)
Armor Penetration (mm CE): 925 (RHA)
Range (m): 4,000

Other Missiles: Kornet-LR HE (thermobaric, 9M133F)
AT-5b/Konkurs-M Thermobaric

NOTES
A wide variety of upgrades are available for all BMP IFV models. Options include improved tracks, air-conditioning, smoke grenade launchers/laser warning receivers, and a more powerful engine (360 hp). A French SNPE explosive reactive armor (ERA) kit and others are available for use on the BMP-1. However, during dismounted troop movement, ERA would be a hazard. Thus, passive armor is more likely; and ERA application is doubtful. Other options are spall liners, grill armor, and plate armor.

German Infantry Fighting Vehicle Marder 1

National War College

Weapons & Ammunition Types	Typical Combat Load
20-mm automatic cannon HEI/HEI-T API-T or APDS-T	**1,250**
7.62-mm coax MG Coaxial rear/remote turret	**5,000**
Milan ATGM Launcher	**5**

SYSTEM
Alternative Designations: See Variants
Date of Introduction: 1971
Proliferation: At least 2 countries
Description:
Crew: 4 (3+1 squad member, who dismounts with the squad)
Troop Capacity: 5
Combat Weight (mt): 29.2/35.0* for Marder 1A3
Chassis Length Overall (m): 6.79/6.88*
Height Overall (m): 2.99/3.02*
Width Overall (m): 3.24/3.38*
Ground Pressure (kg/cm^2): 0.83/0.94*

Automotive Performance:
Engine Type: 590-600-hp Diesel
Cruising Range (km): 520
Speed (km/h):
- Max Road: 75
- Max Off-Road: 65
- Average Cross-Country: 35
- Max Swim: N/A

Fording Depth (m): 1.5/2.0 with preparation

Radio: INA

Protection:
Armor, Turret Front (mm): Against 20 mm/30 mm*
Appliqué Armor (mm): Available/Standard*
Explosive Reactive Armor (mm): Brenus ERA available
Active protection system, mineclearing equipment, and self-entrenching blade: N/A
NBC Protection System: Collective
Smoke Equipment: 6 smoke grenade launchers

ARMAMENT
Main Armaments:
Caliber, Type, Name: 20-mm automatic cannon (92 Cal), Rh202
Rate of Fire (rd/min): 800-1,000
Loader Type: Dual belt feed/manual for Milan
Ready/Stowed Rounds: 345 HE and 75 AP/830 stowed
Elevation (°): -17 to +65
Fire on Move: No

Auxiliary Weapon:
Caliber, Type, Name: 7.62-mm (7.62x 51) machinegun, MG3
Mount Type: Turret coax
Maximum Aimed Range (m): 2,000
Max Effective Range (m): 1,500 day and night
Fire on Move: Yes
Rate of Fire (rd/min): INA

Caliber, Type, Name: 7.62-mm (7.62x 51) machinegun, MG3
Mount Type: Rear/ turret remote
Maximum Aimed Range (m): 2,000
Max Effective Range (m):
- Day: INA
- Night: INA

Fire on Move: Yes
Rate of Fire (rd/min): INA

ATGM Launcher:
Name: Milan, Milan 2, Milan 3
Launch Method: Tube (from canister)
Guidance: SACLOS
Command Link: Wire
Rate of Launch (missiles/min): 2-3, depending on range
Launcher Dismountable: Yes, with attached folded tripod.

Firing Ports: Two on each side

FIRE CONTROL
FCS Name: INA
Main Gun Stabilization: N/A
Rangefinder: Laser
Infrared Searchlight: Yes/removed in later variants
Sights w/Magnification:
Gunner:
- Day: PERI Z 11, 2x and 6x
  - Field of View (°): INA
  - Acquisition Range (m): INA
- Night: Thermal sight* for Marder 1A3
  - IR and white light/II PERI Z 59 for Marder 1A1
  - Mira Thermal sight for MILAN, all Marder IFVs
  - Field of View (°): INA
  - Acquisition Range (m): INA

Commander Fire Main Gun: Yes

VARIANTS
Marder 1A1: Original IFV, with remote MG in rear.
Marder 1A3: Most IFVs have upgrade with appliqué armor, 7.62-mm MG moved to left side coaxial turret mount, three upper hull doors. In addition the suspension and turret interior were upgraded. Extra armor blocks the firing ports. Thermal sight.

Roland: German air defense missile launcher vehicle with Marder chassis.

Notes:
* Data for Marder 1A3

German Infantry Fighting Vehicle Marder 1 continued

VCTP: Argentine Army IFV with a Marder chassis, a 720-hp engine, a 20-mm gun on a two-man turret, and two 7.62-mm MGs.

TAM: Argentine Army tank uses the Marder chassis and a 105-mm gun.

MAIN ARMAMENT AMMUNITION
Caliber, Type, Name:
20-mm (20x139) APDS-T, DM43A1
Maximum Aimed Range (m): INA
Max Effective Range (m):
Day: 2,000
Night: 2,000
Tactical AA Range: INA
Armor Penetration (mm KE): 32 at 1,000 m

20-mm HEI, DM51A2/HEI-T, DM81
Maximum Aimed Range (m): INA
Max Effective Range (m):
Day: 2,000+
Night: 2,000
Tactical AA Range: INA
Armor Penetration (mm): INA

20-mm Shrapnel, DM111 (canister with forward fragment dispense)
Maximum Aimed Range (m): INA
Max Effective Range (m):
Day: INA
Night: INA
Tactical AA Range: INA
Armor Penetration (mm): INA

Other Ammunition Types: DM63 APDS-T, canister

Antitank Guided Missiles
Name: Milan
Warhead Type: Shaped charge (HEAT)
Armor Penetration (mm CE): 600 (RHA)
Range (m): 25-2,000

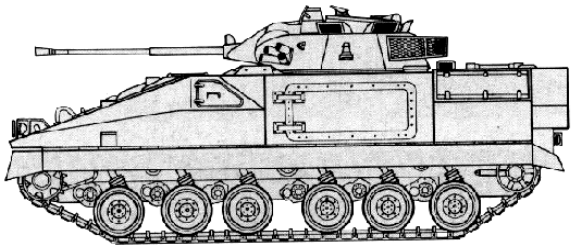
Name: Milan 2
Warhead Type: Tandem Shaped charge
Armor Penetration (mm CE): 800 (RHA)
Range (m): 20-2,000

Name: Milan 3
Warhead Type: Tandem Shaped charge with precursor charge
Armor Penetration (mm CE): 880 (RHA)
Range (m): 20-1,920

NOTES
German Brenus ERA and others are available for use on the Marder 1. However, during dismounted troop movement ERA would be a hazard. Thus, passive armor is more likely and ERA application is doubtful.

All Milan launchers will fire all ATGMs. However, Milan 3 countermeasures will only function with the Milan 3 launcher. All Milan launchers can mount (and many are fitted with) the MIRA thermal night sight.

British Infantry Fighting Vehicle Warrior


Sketch of the original Warrior

Weapons & Ammunition Types	Typical Combat Load
30-mm auto gun	**228**
HEI-T	
APDS-T, APSE-T	
7.62-mm coax MG	**2,200**
Ball, Ball-T	

SYSTEM
Alternative Designations: FV 511, MCV-80
Date of Introduction: 1988
Proliferation: At least two countries
Description:
Crew: 3
Troop Capacity: 7 passengers
Combat Weight (mt): 24.00
Chassis Length Overall (m): 6.34
Height Overall (m): 2.79
Width Overall (m): 3.03
Ground Pressure (kg/cm^2): 0.65

Automotive Performance:
Engine Type: 550-hp Diesel
Cruising Range (km): 660
Speed (km/h):
- Max Road: 75
- Max Off-Road: 60
- Cross-Country: 48
- Max Swim: N/A

Fording Depth (m): 1.3 Unprepared

Radio: INA

Protection:
Armor, Turret Front (mm): Against 14.5-mm gun
Appliqué Armor (mm): Available (see VARIANTS)
Explosive Reactive Armor (mm): N/A
Active Protection System: N/A
Mineclearing Equipment: N/A
Self-Entrenching Blade: N/A
NBC Protection System: Yes
Smoke Equipment: Smoke grenade launchers (4 each side of turret)

ARMAMENT
Main Armament:
Caliber, Type, Name: 30-mm automatic cannon, RARDEN L21A1
Rate of Fire (rd/min): 80-90 cyclic
Loader Type: Feed tray, clip-fed (3-round clips)
Ready/Stowed Rounds: 228/0
Elevation (°): -10/+45
Fire on Move: INA

Auxiliary Weapon:
Caliber, Type, Name: 7.62-mm chain gun, L94A1
Mount Type: Turret coax
Maximum Aimed Range (m): INA
Max Effective Range: INA
Fire on Move: Yes
Rate of Fire (rd/min): 520-570

ATGM Launcher: N/A

Firing Ports: None

FIRE CONTROL
FCS Name: INA
Main Gun Stabilization: N/A
Rangefinder: INA
Infrared Searchlight: Yes
Sights w/Magnification:
Gunner:
- Day: INA
  - Field of View (°): INA
  - Acquisition Range (m): INA
- Night: SPAV L2A1 II sight
  - Field of View (°): INA
  - Acquisition Range (m): INA

Commander Fire Main Gun: No

VARIANTS
Command variant is outfitted with radios, map boards, other staff support equipment, and Vickers Defence Turret.

Desert Warrior: Variant with the 2-man turret from LAV-25, with US M242 Bushmaster 25-mm automatic cannon, coaxial MG and 1-2 ATGM launchers. Other modifications are additional passive armor and three periscopes for improved vision. Sold to Kuwait.

Desert Storm Variant: Changes included passive armor added to hull sides and a pintle mount for a Milan-2 ATGM launcher.

Mechanized Artillery Observation Vehicle (MAOV): It resembles an IFV, but is fitted with a dummy cannon, improved artillery reconnaissance and automation systems, and land navigation. Options include an Osprey 8-power optical and thermal sight with Nd: YAG laser designator for the observer.

MAIN ARMAMENT AMMUNITION
Caliber, Type, Name:
30-mm APDS-T, L14
- Maximum Aimed Range (m): 4,000
- Max Effective Range (m):
  - Day: 1,100
  - Night: 800-1,100
- Armor Penetration (mm KE): INA

Other Ammunition Types: 30-mm APSE-T (AP Secondary Effects-T L5, HEI-T L13

NOTES
Variants available but not in production include engineer, recovery, mortar vehicles, armored fighting vehicles with 90-mm and 105-mm guns, an APC with 7.62-mm chain gun, ATGM launcher vehicles for Milan, HOT and Trigat, and a low-profile chassis for a reduced signature IFV.

Specialized Infantry Carriers

Many countries use infantry carriers for specific forces, roles, or terrain and weather conditions. Equipment must fit those conditions. For economic reasons, many forces use standard IFVs, APCs, and combat support vehicles, but modify them for those specialized uses.

Airborne vehicles for rapid deployment are limited by carry capacity of transport aircraft. Russian forces also require parachute-drop capability for some units, restricting vehicle weight even further. Vehicles such as BMDs and BTR-Ds are very light, lightly armored, and restricted in carry capacity (restricting squad size). BTR-D also sacrifices fighting ability for capacity. The later BMD-3 is better-armed with increased squad capacity; but the budget crunch and competing upgrade designs such as BMD-4M limited fielding to selected units.

Many forces insist on swim capability for mechanized infantry carriers; because all forces have water hazards in their areas of operations. In many forces, almost all infantry vehicles swim. The MT-LB swims easily; and its low ground pressure is specially suited for marshy areas. Russian forces combined airborne transportability and high sea-state (3+) swim capability for coastal operations by naval infantry, *Spetsnaz*, etc. in its airborne carriers. Such a compromise is usually unnecessary. Amphibious APCs and IFVs are usually larger, for more displacement, capacity, and armor, for effectiveness in any terrain. BMP-3 variants are suited for this role. Infantry forces will use many of the support assets noted in Vol 3 Ch 3, when operating in littoral zones. China, U.S., and others designed vehicles well-suited for use in amphibious forces as well as land operations in coastal and marshy areas. Most can use guns and missiles while swimming. BMP-3F, and especially BMMP are specially designed for high sea-state operations. The Chinese Type 90 tracked APC and tracked IFV offer high sea-state swim capacity. The U.S. AAV7A1 APC is widely used. There are also amphibious tanks (Type 63 and Type 99), fire and combat support vehicles (such as the 2S1) and trailers for amphibious use.

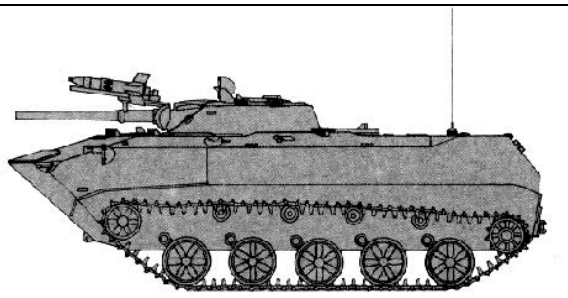
Special requirements include operation in cold weather with deep snow. The Russian MT-LB is derived from an over-snow vehicle and is well-suited for this role. With low ground pressure and variable-height suspension, it can operate in all terrains. Articulated and tracked CSV like the Bv206 (photo pg 3-66) and armored BvS210 carry troops, supplies, and weapons.

Forces that must operate in urban or high-defilade environments may choose to up-armor their carriers into heavy IFVs and APCs (HIFVs and HAPCs). The U.S. Bradley and Russian BMP-3/BMP-3M could fit this category. The tank-based Israeli Nehmer and Jordanian Temsah IFV are HAPCs. A Russian T-72-based HAPC holds 9 and is used for variants like the BMO-T flamethrower vehicle. Heavy IFVs/APCs can be used in other terrains and roles.

Urban conflicts and internal security requirements generated development of a variety of light armored vehicles for use by military and paramilitary forces, as well as by commercial and personal security customers. Most of these are light armored variants on truck chassis, e.g., S-55. Armored truck chassis can be modified for a variety of other military roles.

Recent conflicts display the need for infantry carriers with increased mine protection. Many have raised and better armored underbodies and heavier truck-based suspension to withstand impact from explosions of heavier mines and IEDs. Examples include the South African Casspir and RG-31, German Dingo, Turkish Cobra, and Belgian ACMAT. Most of the vehicles sacrifice side armor protection, mobility, and lethality for the role.

Russian Airborne Fighting Vehicle BMD-1, BMD-1P and BMD-2



BMD-1

Weapons & Ammunition Types	Typical Combat Load
73-mm gun	**40**
HEAT	(est) 16
HE	24
ATGM (AT-3c/AT-5/AT-5b)	**4**
HEAT	
HE	
7.62-mm coax MG	**2,000**
2x 7.62-mm bow MG (1 x BMP-2)	**4,000**

SYSTEM
Alternative Designations: It is also used as an amphibious IFV
Date of Introduction: 1969
Proliferation: At least 11 countries
Description:
Crew: 2
Troop Capacity: 5 passengers (+1)
Combat Weight (mt): 7.6
Chassis Length Overall (m): 5.4
Height Overall (m): 1.97, hydro-pneumatic suspension for variable ground clearance, 100-450 mm
Width Overall (m): 2.63
Ground Pressure (kg/cm^2): 0.5

Automotive Performance:
Engine Type: 240-hp Diesel
Cruising Range (km): 500
Speed (km/h):
Max Road: 61
Max Off-Road: 40-45
Average Cross-Country: INA
Max Swim: 10
Fording Depth (m): Amphibious

Radio: R-123M/R-173 for BMD-1P

Protection:
Armor, Turret Front (mm): 23 or anti-bullet
Appliqué Armor (mm): See NOTES
Explosive Reactive Armor (mm): See NOTES
Active Protection System, Mineclearing Equipment or Self-Entrenching Blade: N/A
NBC Protection System: Collective
Smoke Equipment: VEESS

ARMAMENT
Main Armament:
Caliber, Type, Name: 73-mm smoothbore gun, 2A28/Grom
Rate of Fire (rd/min): 7-8
Loader Type: Autoloader
Ready/Stowed Rounds: 40 / 0
Elevation (°): -4/ +33
Fire on Move: Yes, but only 10 km/h or less (est)

Auxiliary Weapons:
Caliber, Type, Name: 7.62-mm (7.62x 54R) machinegun, PKT
Mount Type: Coax
Maximum Aimed Range (m): 1,300
Max Effective Range (m):
Day: 1,000/400-500 on the move
Night: 800
Fire on Move: Yes
Rate of Fire (rd/min): 250 practical / 650 cyclic, 2-10 round bursts

Caliber, Type, Name: 7.62-mm machinegun, PKT
Mount Type: Bow (ball-mounted)
Maximum Aimed Range (m): 1,000
Max Effective Range (m):
Day: 1,000/ 400-500 on the move
Night: N/A
Fire on Move: Yes
Rate of Fire (rd/min): 250 practical / 650 cyclic, 2-10 round bursts

ATGM Launcher:
Name: 9P111for BMD-1
ATGM: AT-3c and HE or other variant. For data see pg 6-27.
Launch Method: Rail-launched.
Guidance: MCLOS
Command Link: Wire
Rate of Launch (missiles/min): 2
Launcher Dismountable: Yes (dismount launcher carried aboard)

ATGM Launcher:
Name: 9P135M or 9P135M1 on BMD-1P
ATGM: AT-5/Konkurs and Konkurs-M thermobaric, or other variant. For data see pg 6-30.
Launch Method: Tube-launched
Guidance: SACLOS
Command Link: Wire
Rate of Launch (missiles/min): 2-3 depending on range
Launcher Dismountable: Yes
Optional 9P135M2/AT-5b upgrade launcher has a thermal sight.

Other Missiles: AT-5b/Konkurs-M Thermobaric
Flame-G adaptor can be fitted, which permits mounting a MILAN-2 or MILAN-ER man-portable ATGM.

Firing Ports: 1 on each side, 1 in left rear door

FIRE CONTROL
FCS Name: INA
Main Gun Stabilization: N/A
Rangefinder: Stadiametric
Infrared Searchlight: Yes
Sights w/Magnification:
Gunner:
Day: 1PN22M1, 8x. Sanoet-1 thermal sight is available
Field of View (°): 15
Acquisition Range (m):
Night: 1PN22M1, 6.7x.
Field of View (°): 6
Acquisition Range (m): 800-1,000, based on light

Commander Fire Main Gun: No

Russian Airborne Fighting Vehicle BMD-1, BMD-1P, and BMD-2 continued_____

VARIANTS

BMD-1P: Widely fielded version with AT-5/5b replacing AT-3c.

BMD-1K: Command IFV with added R-126 and R-107.

BMD-1KShM: Command and staff - see BTR-D APC & Ch 9

BMD-1M: Variant with improved ventilation and road wheels.

BMD-1PK: Company commander variant of BMD-1P.

BMD-2: Widely fielded 1985 upgrade with a new 1-man turret and 30-mm 2A42 automatic gun. Weight is slightly greater (8.0 mt) than for BMD-1; but mobility and protection are about the same. Fire control is about the same as on BMD-3. The vehicle has a 7.62-mm coax MG and a bow MG. Ammo combat load is 300 30-mm rounds, 2,940 7.62-mm rounds, and 3 ATGMs. The ATGM is AT-5b, used on BMP-1P and BMD-3. See BMD-3 (pg 3-431) for lethality and ammo data.

BMD/Kliver: AKA BMD-1M, IFV with Kliver replacement turret (See pg. 3-49, and Chapter 16 Upgrade Table)

BTR-D: Stretched (6-road wheel) armored multipurpose transporter variant (pg 3-51), with two 7.62-mm hatch MGs but no turret. This chassis has been used for a variety of other airborne vehicles.

MAIN ARMAMENT AMMUNITION FOR BMD-1, BMD-1P
Caliber, Type, Name:

73-mm HEAT-FS, PG-15VNT (tandem HEAT)
- Maximum Aimed Range (m): 1,300
- Max Effective Range (m):
  - Day: 1,300, but 600 or less on the move
  - Night: 800-1,000
- Tactical AA Range: INA
- Armor Penetration (mm CE): 550-700 (RHA)

73-mm HEAT-FS, PG-15
- Maximum Aimed Range (m): 1,300
- Max Effective Range (m):
  - Day: 800, but 600 or less on the move
  - Night: 800-1,000
- Tactical AA Range: INA
- Armor Penetration (mm CE): 335 (RHA)

73-mm HE, OG-15BG1
- Maximum Aimed Range (m): 1,300, 600 or less on the move
- Max Effective Range (m):
  - Day: 1,300, but 600 or less on the move
  - Night: 800-1,000
- Tactical AA Range: INA
- Armor penetration (mm): INA, can damage/defeat APC.

73-mm HE, OG-15VM
- Maximum Aimed Range (m): 4,500
- Max Effective Range (m):
  - Day: 1,300, but 600 or less on the move
  - Night: 800-1,000
  - Tactical AA Range: INA
- Armor Penetration (mm): INA, can damage/defeat APC

Other Ammunition Types: OG-15

NOTES

Vehicle can be parachute-landed with airborne troops onboard. Height can be lowered.

See BMP-1 for upgrade options. The Russian Volgogrod Tractor Plant offers the B30 turret (a drop-in one-man turret with 2A42 30-mm gun, 7.62-mm coax MG, and a 9P135M launcher for AT-5/5B ATGM). Russian AG-17 30-mm automatic grenade launcher is available for BMD-1. Other options are spall liners, air conditioning, and a more powerful engine.

A French SNPE explosive reactive armor (ERA) kit and others are available for use on BMD series vehicles. However, during dismounted troop movement, ERA would be a hazard. The added weight could affect swim capability. Thus, passive armor is more likely; and ERA application is doubtful. For amphibious use, additional armor application is unlikely.

The Slovenian TS-M ATGM thermal night sight has a detection range of 4,500m and a recognition range of 2,000m.

Russian Airborne Fighting Vehicle BMD-3 and BMD-4M

BMD-3

Weapons & Ammunition Types	Typical Combat Load
30-mm automatic gun	**860**
HEI-T, Frag-HE	340/240
AP-T, APDS-T, APFSDS	160/120
ATGM launcher	**4**
7.62-mm coax MG	**2,000**
30-mm grenade launcher	**551**
5.45-mm light MG	**2,325**

SYSTEM
Alternative Designations: N/A. Also used as an amphibious IFV.
Date of Introduction: 1992
Proliferation: At least 1 country
Description:
Crew: 3 (commander can dismount)
Troop Capacity: passengers: 4 (+1 with commander)
Combat Weight (mt): 12.9
Length Overall (m): 6.00
Height Overall (m): 2.25 hydro-pneumatic suspension for variable ground clearance, 130-530 mm
Width Overall (m): 3.13
Ground Pressure (kg/cm^2): 0.32 (wide track) / 0.48 (standard track)

Automotive Performance:
Engine Type: 450-hp 2V-60-2 Diesel, 500-hp on BMD-4M
Cruising Range (km): 500
Speed (km/h):
Max Road: 70
Max Off-Road: 45
Average Cross-Country: INA
Max Swim: 10
Fording Depth (m): Amphibious

Radio: R-173
Protection:
Armor, Turret Front (mm): "Antibullet" (7.62)
Appliqué Armor (mm): N/A
Explosive Reactive Armor (mm): Available
Active Protection System: N/A
Mineclearing Equipment: KMT-8 plow or -10 roller
Self-Entrenching Blade: N/A
NBC Protection System: Collective
Smoke Equipment: 6 smoke grenade launchers
Vehicle engine exhaust smoke system (VEESS)

ARMAMENT
Main Armament:
Caliber, Type, Name: 30-mm automatic gun, 2A42
Rate of Fire (rd/min): 550 cyclic in bursts/ 200-300 practical
Loader Type: Dual-belt feed
Ready/Stowed Rounds: 500/ 360
Elevation (°): -5 to +74
Fire on Move: Yes

Auxiliary Weapons:
Caliber, Type, Name: 30-mm automatic grenade launcher, AG-17
Mount Type: Bow left side
Maximum Aimed Range (m): 1,700
Max Effective Range (m):
Day and Night: 1,200
Fire on Move: Yes
Rate of Fire (rd/min): 60-100 practical, bursts of ≤ 5 to 10 rounds.
Stowed/Ready Grenades: 290 ready rounds and 261 in the rack.

Caliber, Type, Name: 7.62-mm (7.62 x 54R) machinegun, PKT
Mount Type: Turret coax
Maximum Aimed Range (m): 2,000
Max Effective Range (m):
Day: 2,000
Night: 1,000
Fire on Move: Yes
Rate of Fire (rd/min): 250 practical / 650 cyclic, 2-10 round bursts

Caliber, Type, Name: 5.45-mm light machinegun, RPK-74
Data same as shoulder-mount version, pg. 2-15.

ATGM Launcher:
Name: 9P135M2 for Konkurs-M/AT-5b
Launch Method: Tube-launched
Guidance: SACLOS
Command Link: Wire
Rate of Launch (missiles/min): 2-3 depending on range
Ready/Stowed Missiles: 4 ready (one on the launcher)
Launcher Dismountable: Yes

BMD-4M Main Armament:
Caliber, Type, Name: 100-mm rifled gun 2A70gun
Caliber, Type, Name: 30-mm automatic gun 2A72 gun
ATGM Launcher: 2A70 100-mm gun for Arkan/AT-10b
See BMP-3M, pg 3-47 for data.
Secondary Arms: 7.62-mm PKT MG, 5.56-mm RPKS MG

FIRE CONTROL
FCS Name: INA
Main Gun Stabilization: 2-plane
Rangefinder: Laser
Infrared Searchlight: Yes
Sights w/Magnification:
Gunner:
Day: BPK-2-42
Field of View (°): 8
Acquisition Range (m): INA
Night: Sanoet-1 thermal sight
Field of View (°): INA
Acquisition Range (m): 2,500 m
BPK-2-42 II/IR was the original sight.

Russian Airborne Fighting Vehicle BMD-3 and BMD-4M continued

ATGM launcher: Day sight 9Sh119M1 range 4,000 m
Night sight 1PN86 range 2,500 m
Commander Fire Main Gun: No

VARIANTS
The vehicle is used for airborne units and some amphibious forces.

BMD/Kliver Russian KBP offers a drop-in one-man turret, called Kliver, with a stabilized 2A72 30-mm gun, a 4 x Kornet ATGM launcher, thermal sights, a coaxial 7.62-mm MG and improved fire control system

BMD-4/Bakhcha: New Russian airborne IFV, initially called BMD-3M. It combines the BMD-3 chassis and the Bakhcha-U Universal Combat Turret derived from the BMP-3M IFV. Features include a 100-mm cannon, 30-mm auto-cannon, 30-mm AGL, gun-launch Arkan ATGM, and 7.62-mm coax MG. It has an improved FCS with thermal night sight from the BMP-3M (pg 3-47), and an IR auto-tracker. In addition to the superior firepower, use of a two-man turret gives it superior awareness, flexibility, and responsiveness over previous BMD vehicles. For lethality and ammunition data, see BMP-3M. See also Notes below. Weight is slightly greater with the new turret. When in the infantry FSV role, ATGM load is 6. Initial version was exported to one country for amphibious forces.
No more of the early version will be produced.

BMD-4 Early version

BMD-4 Upgrade/BMD-4M: The production version features a modified hull front (similar to BMP-3) with more armor, added compartment, a modified rear with the open space over the engine area squared off, and an exit door added in the rear. Passenger space increased from 4 to 5 (6 dismounts). The 500-hp UTD-29 from BMP-3 replaced the original engine, with an engine layout similar to BMP-3. Weight is 13.5 mt.

BTR-MT: Turret less airborne APC based on the BMD-4 hull. It is expected to replace the BTR-D in Russian airborne forces.

MAIN ARMAMENT AMMUNITION FOR BMD-3
Caliber, Type, Name:
30-mm APFSDS-T M929
Maximum Aimed Range (m): 2,500
Max Effective Range (m):
Day: 2,500+
Night: 2,000+
Tactical AA Range: 4,000
Armor penetration (mm KE): 55 (RHA) at 1,000m
45 at 2,000m

30-mm APDS
Maximum Aimed Range (m): 2,500
Max Effective Range (m):
Day: 2,500
Night: 2,500
Tactical AA Range: 4,000
Armor Penetration (mm KE): 25 (RHA) at 60° 1,500 m

30-mm AP-T
Maximum Aimed Range (m): 2,500
Max Effective Range (m):
Day: 1,500
Night: 1,500
Tactical AA Range: 4,000
Armor Penetration (mm KE): 18 (RHA) at 1,500m
30-mm Frag-HE
Maximum Aimed Range (m): 4,000
Max Effective Range (m):
Day: 4,000
Night: 2,500
Tactical AA Range: 4,000
Armor Penetration (mm): INA

Other Ammunition Types: 30-mm HEI-T

Antitank Guided Missiles:
Name: AT-5b/Konkurs-M
Warhead Type: Tandem shaped charge (HEAT)
Armor Penetration (mm CE): 925 (RHA)
Range (m): 4,000

Other Missiles: AT-5b/Konkurs-M Thermobaric

MAIN ARMAMENT AMMUNITION FOR BMD-4M
See BMP-3M, pg 3-47.

NOTES
A French SNPE explosive reactive armor (ERA) kit and others are available for use on BMD series vehicles. However, during dismounted troop movement, ERA would be a hazard. The added weight of ERA could affect swim capability. Thus, passive armor is more likely and ERA application is doubtful. For amphibious use, additional armor application is unlikely.

Other options are spall liners, air conditioning, and a more powerful engine.

Other thermal sights are available for the ATGM launcher. The Russian Trakt/1PN65 thermal imaging ATGM night sight is optional. Acquisition range is 2,500 m (NFI). For the ATGM launcher in dismount configuration, the Russian Mulat/1PN86 lightweight thermal ATGM night sight has 3,600 m detection range and 2,000 m identification range.

Indian Flame-V adapter kit permits BMD-3 to launch Milan, Milan-2 and Milan-3 ATGMs.

Russian Infantry Fighting Vehicle/Infantry Fire Support Vehicle BMP-3 UAE _____

BMP-3 UAE with Namut thermal sight at turret rear

Weapons & Ammunition Types	Typical Combat Load
100-mm rifled gun	**48**
Frag-HE	Mix varies
HEF (electronic fuse)	based on role
AT-10b/Arkan ATGM	(see next pg)
30-mm automatic gun	**500**
HEI-T, Frag-HE	340
APDS-T/ APFSDS-T	160
7.62-mm coax MG	**2,000**
2 x 7.62-mm bow MG	**4,000**

SYSTEM
Alternative Designations: "Desert BMP-3". See NOTES on roles.
Date of Introduction: 1990 original BMP-3. BMP-3 UAE upgrade fielded after 2000, is the most numerous version.
Proliferation: BMP-3 variants are in at least 9 countries
Description:
Crew: 3
Troop Capacity: 7 passengers
Combat Weight (mt): 18.70
Chassis Length Overall (m): 6.73
Height Overall (m): 2.45 most common. Hydro-pneumatic suspension permits adjustable ground clearance (and height). Normal ground clearance is 400 mm, but varies from 190 to 510.
Width Overall (m): 3.15
Ground Pressure (kg/cm^2): 0.62

Automotive Performance:
Engine Type: 500-hp UTD-29 Diesel
Cruising Range (km): 600
Speed (km/h):
Max Road: 70
Max Off-Road: 45
Average Cross-Country: 35
Max Swim: 10
Fording Depth (m): Amphibious

Radio: R-173, R-173P

Protection:
Armor, Turret Front (mm): 30-35 front glacis
Appliqué Armor (mm): Yes on turret
Explosive Reactive Armor (mm): Available, see NOTES
Active Protection System: N/A
Mineclearing Equipment: KMT-8 plow available
Self-Entrenching Blade: Yes
NBC Protection System: Collective
Smoke Equipment: 6 smoke grenade launchers, VEESS

ARMAMENT
Main Armaments:
Caliber, Type, Name: 100-mm rifled gun 2A70
Rate of Fire (rd/min): 8-10
Loader Type: Autoloader 30-mm rounds; manual 100 mm, ATGMs
Ready/Stowed Rounds: 22/18 for rounds, 3/5 for ATGMs
Elevation (°): -5 to +60
Fire on Move: Yes

Caliber, Type, Name: 30-mm automatic gun 2A72
Rate of Fire: 350 rd/min (cyclic) in bursts
Loader Type: Dual-belt feed
Ready/Stowed Rounds: 500/ 0
Elevation (°): -5 to +60
Fire on Move: Yes

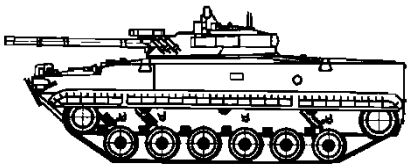
Auxiliary Weapon:
Caliber, Type, Name: 7.62-mm (7.62x 54R) machinegun, PKT
Mount Type: Turret coax
Maximum Aimed Range (m): 2,000
Max Effective Range (m):
Day: 2,000
Night: 2,000
Fire on Move: Yes
Rate of Fire (rd/min): 250 practical / 650 cyclic, in 2-10 round bursts

Caliber, Type, Name: 7.62-mm (7.62x 54R) machinegun, PKT
Mount Type: Bow left and right
Maximum Aimed Range (m): 1,000
Max Effective Range (m):
Day: 1,000/400-500 on the move
Night: 800/400-500 on the move
Fire on Move: Yes
Rate of Fire (rd/min): 250 practical / 650 cyclic, in 2-10 round bursts

ATGM Launcher:
Name: 2A70 100-mm gun
Launch Method: Gun-launched
Guidance: SACLOS, laser-beam rider
Command Link: Encoded infrared laser-beam
Launcher Dismountable: No
Rate of Launch (missiles/min): 2-3, depending on range
Firing Ports: 2 on each side, 1 in left rear door

FIRE CONTROL
FCS Name: INA
Main Gun Stabilization: 2-plane
Rangefinder: Laser
Infrared Searchlight: Yes
Sights w/Magnification:
Gunner:
Day: 1K13-2, 8x; 1P3-10 antiaircraft, 2.6x; PPD-1 stand-by
Acquisition Range (m): 5,500
PPB-2: High angle of fire (and AA) day sight
Night: Namut thermal sight 3x/10x channels "Desert BMP-3"
Acquisition Range (m): 3000+ for Desert BMP-3 (UAE)
Commander Fire Main Gun: Yes

VARIANTS
BMP-3: The original vehicle had fire control with 1K13-2 II night sight instead of improved FCS with thermal sight.



Original BMP-3 design

Russian Infantry Fighting Vehicle/Infantry FSV BMP-3 UAE continued _____

BMP-3 UAE: This is the most common version of BMP-3, and is described on these two pages. Features include improved fire control and air conditioning. A Russian firm will modernize these vehicles to the BMP-3M protection standard with ERA (see next page).

BMMP: Amphibious IFV with the BMP-3 chassis and the BMP-2 unified fighting compartment (easier to use than the BMP-3 turret).

BMP-3K: Command variant, with electronic HEF round fuse system for 100-mm gun. Bow MGs are removed. Added radios are R-159, R-143 and R-174.

BMP-3F: Amphibious IFV prototype for Naval Infantry. Advertised version has the BMP-3M turret (pg 3-47). Another version has the **Kliver** turret (pg 3-49). An export contract has been signed for both. Russian Naval Infantry selected the BMMP noted above.

9P157-2: ATGM launcher vehicle (pg 6-65) with Krizantema/AT-15 ATGM autoloader, MMW and thermal fire control system.

9P162: ATGM launcher vehicle (pg 6-64) with Kornet (AT-14) launcher and autoloader, and thermal sights.

BREhM-L: Armored recovery vehicle (ARV).

BRM-3K: Combat recon vehicle with radar and 30-mm gun.

MAIN ARMAMENT AMMUNITION
Ammunition Mix: Varies based on role

IFV/Heavy IFV:	Combat Load	48
Frag-HE (3UOF17)		22
Frag-HE (3UOF19, electronic fuse)		22
AT-10/Arkan ATGM		4
Infantry FSV/Tank FSV/HACV/Amphibious forces IFV:		48
Frag-HE (3UOF17)		22
HEF (3UOF19, electronic fuse)		18
AT-10/Arkan ATGM		8

Caliber, Type, Name:
100-mm Frag-HE 3UOF17/3OF32
Maximum Aimed Range (m): 4,000
Max Effective Range (m):
Day: 4,000
Night: 2,600+
Tactical AA Range: 4,000
Armor Penetration (mm): INA

100-mm HE-Shapnel (HEF MOD.96, 3UOF19) Focused-fragmentation, electronically-fused
Maximum Aimed Range (m): 7,000
Max Effective Range (m):
Day: 5,200
7,000 electronic fused on BMP-3K/-3M upgrades
Night: 5,000
Tactical AA Range: 5,200/7,000
Armor Penetration (mm): Due to combined HE/fragmentation effects, this round can defeat an IFV or APC on impact. A near miss would damage those vehicles.

30-mm APFSDS-T M929
Maximum Aimed Range (m): 2,500+
Max Effective Range (m):
Day: 2,500+
Night: 2,500+
Tactical AA Range: 2,500
Armor penetration (mm KE): 55 (RHA) at 1,000 m, 45 at 2,000 m

30-mm APDS
Maximum Aimed Range (m): 2,500
Max Effective Range (m):
Day: 2,000
Night: 2,000
Tactical AA Range: 2,000
Armor Penetration (mm KE): 25 (RHA) at 60° 1,500 m

Other Ammunition Types: 100-mm HE-I, 30-mm HEI-T

Antitank Guided Missiles
Name: AT-10b/Arkan
Warhead Type: Tandem shaped charge
Armor Penetration (mm CE): 750 (RHA), 700 behind ERA
Range (m): 5,500 day, 2600+ night
Launcher Dismountable: No

Range increase is a function of missile improvements coupled with a simple upgrade to the launcher system (replacing laser timer with a longer dwell timer). This replacement is assessed on BMP-3.

Name: Basnya/AT-10
Warhead Type: Shaped charge
Command Link: Encoded laser-beam
Warhead Type: Shaped charge (HEAT)
Armor Penetration (mm CE): 650 (RHA), 150 behind ERA
Range (m): 4,000 day, 2600+ night

NOTES
The vehicle may be used as a standard IFV for mechanized forces. However, its cost and other considerations may suit it better for more specialized uses. With additional armor, it can be used against enemy IFVs as a *Heavy IFV*. For rapid movement on threatened terrain, its protection is superior to most IFVs. With the modern need for LAV protection against HEAT warheads, if ERA is not added, grill armor and/or more plate armor is needed on sides and other areas of the vehicle (see BMP-3M, next page). Its protection and firepower can be used well in urban areas, where infantry dismount and move ahead of the vehicle, but require covering fires. In that use, its fire support capabilities make it effective as a Heavy IFV. The BMP-3 unified fighting compartment is being fitted to a variety of vehicles, even on vessels.

With its superior swim capabilities and superior firepower to support amphibious operations (while under threat of enemy fires during that vulnerable phase) some forces use the vehicle as an ***Amphibious IFV*** (see pg 3-40). Variants noted above may be better suited.

The 100-mm cannon is not very useful or responsive for slewing quickly against vehicles or aircraft. Therefore, it is less effective as a first option in close terrain against these targets. However, when IFVs with those capabilities are moving in the lead of a formation, their cannon and ATGM range and velocity make them valuable *infantry fire support vehicles,* or *heavy armament combat vehicles.*

French SNPE ERA kit and others are available for use on the BMP-3. Other options are spall liners and air conditioning. Russian AG-17 30-mm automatic grenade launcher modification is available for use on BMP-3.

Russian Infantry Fighting Vehicle/Infantry Fire Support Vehicle BMP-3M

BMP-3M with Box Explosive Reactive Armor

Weapons & Ammunition Types	Typical Combat Load
100-mm rifled gun	**48**
Frag-HE 3UOF17	Mix varies
Frag-HE 3UOF19	based on role
AT-10b/Arkan ATGM	(see pg 6-58)
30-mm automatic gun	**500**
HEI-T, Frag-HE	340
APFSDS-T	160
7.62-mm coax MG	**2,000**
2 x 7.62-mm bow MG	**4,000**

SYSTEM
Alternative Designations: None. Similar to "BMP-3 (UAE)". The BMP-3M with "box ERA" or other supplemental armor protection could fit it in the category of ***Heavy Infantry Fighting Vehicle (HIFV)***, with the U.S. M2A2/Bradley Fighting Vehicle. For explanation of ***Infantry FSV*** role, see pg 3-52.

Date of Introduction: 1998
Proliferation: Improved version with some of the features in at least three countries. The turret is exported to at least 2 countries.
Description:
Crew: 3
Troop Capacity: 7 passengers
Combat Weight (mt): 18.70
Chassis Length Overall (m): 6.73
Height Overall (m): 2.45 most common. Hydro-pneumatic suspension permits adjusting ground clearance (and height). Normal ground clearance is 400 mm; but variance is 190-510.
Width Overall (m): 3.15
Ground Pressure (kg/cm^2): 0.62

Automotive Performance:
Engine Type: 660-hp UTD-32 Diesel
Cruising Range (km): 500+
Speed (km/h):
Max Road: 70
Max Off-Road: 45
Average Cross-Country: 35
Max Swim: 10
Fording Depth (m): Amphibious

Radio: R-173, R-173P

Protection:
Armor, Turret Front (mm): 30-100 KE/500 HEAT with ERA
Appliqué Armor (mm): Yes on turret, additional stand-off plate
Explosive Reactive Armor (mm): See above
Active Protection System: Available. See VARIANTS
Mineclearing Equipment: KMT-8 plow available
Self-Entrenching Blade: Yes
NBC Protection System: Collective
Smoke Equipment: 6 smoke grenade launchers, VEESS

ARMAMENT
Main Armaments:
Caliber, Type, Name: 100-mm rifled gun 2A70
Rate of Fire (rd/min): 8-10
Loader Type: Autoloader for all gun rounds and ATGMs
Ready/Stowed Rounds: 34/18 for rounds (4/4 for ATGMs)
Elevation (°): -15 to +60
Fire on Move: Yes, gun rounds and ATGMs
Caliber, Type, Name: 30-mm automatic gun 2A72
Rate of Fire: 350 rd/min (cyclic) in bursts
Loader Type: Dual-belt feed
Ready/Stowed Rounds: 500/ 0
Elevation (°): -5 to +60
Fire on Move: Yes

Auxiliary Weapon:
Caliber, Type, Name: 7.62-mm (7.62x 54R) machinegun, PKT
Mount Type: Turret coax
Maximum Aimed Range (m): 2,000
Max Effective Range (m):
Day: 1,000-2,000
Night: INA
Fire on Move: Yes
Rate of Fire (rd/min): 250 practical / 650 cyclic, in 2-10 round bursts

Caliber, Type, Name: 7.62-mm (7.62x 54R) machinegun, PKT
Mount Type: Bow left and right
Maximum Aimed Range (m): 1,000
Max Effective Range (m):
Day: 1,000/400-500 on the move
Night: N/A
Fire on Move: Yes
Rate of Fire (rd/min): 250 practical / 650 cyclic, in 2-10 round bursts

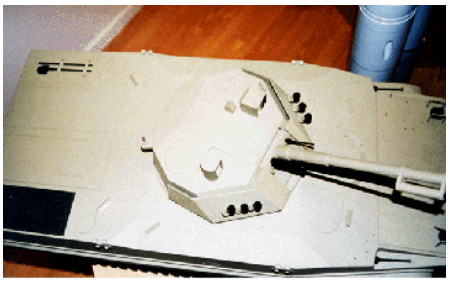
ATGM Launcher:
Name: 2A70 100-mm gun
Launch Method: Gun-launched
Guidance: SACLOS, laser-beam rider
Command Link: Encoded infrared laser-beam
Rate of Launch (missiles/min): 2-3, depending on range
Launcher Dismountable: No
Fire on the Move: Yes

Firing Ports: 2 on each side, 1 in left rear door

FIRE CONTROL
FCS Name: Vesna-K
Main Gun Stabilization: improved 2-plane
Rangefinder: Laser, 10,000 m
Infrared Searchlight: Yes, but not needed for thermal sight
Sights w/Magnification:
Gunner: Stabilized sights with AST-B infrared auto-tracker
Day: Sohz 14x, 8x, 1x
Field of View (°): 6, 12, 20 x 5
Acquisition Range (m): 6,500 point/7,000 area targets
PPB-2: High angle of fire (and AA) day sight
Night: SAGEM 2nd gen thermal sight, 5.5
Field of View (°): 6.7
Acquisition Range (m): 5,000 (7,000 detection)
Commander Fire Main Gun: Yes, with laser illuminator sight (LADAR - 1,200 m range), TV/thermal sight, and hunter-killer fire control. A LADAR sight detects retro-reflection of weapons optics, for rapid detection of those weapons, and to prompt a fast response.

Russian Infantry Fighting Vehicle/Infantry FSV BMP-3M continued

VARIANTS
The BMP-3M incorporates some changes found in other BMP-3 variants. The most distinct changes are: new angular turret, new fire control system with improved thermal sights, autoloader, stabilization, air conditioning, engine, and a mix of upgrade options.



Top View Model of BMP-3M

Desert BMP-3/BMP-3 (UAE): The most direct predecessor to BMP-3 M and the most proliferated version of BMP-3 (pg 3-45). They are in the process of being upgraded with ERA.

BMP-3M with Arena-E Active Protection System: Upgrade is offered as shown below. However, increased cost is a consideration. Therefore, it is more likely as a future upgrade with limited fielding.

BMP-3M with ERA: Several ERA versions have been seen. The best is "box ERA" which fits within the weight budget of the IFV. The boxes provide stand-off armor over road wheels and vehicle sides to detonate and disrupt warhead effects of grenades, HEAT rounds, and ATGMs. But unlike grill or slat armor cages which perform a similar function, box ERA also gives protection against KE rounds. An improved box ERA may now permit the BMP-3 and its variants to have both improved protection and swim capability.

Bakcha-U/BMP-3M Unifield Fighting Compartment: This is a drop-in turret, as used in BMP-3M IFV. Turret includes improved stabilized gun/ATGM FCS, with 2nd gen thermal sight, all of the weapons on the IFV, and improved munitions. The turret has been fitted to the BMD-3, the BTR-90, BMP-2, and other vehicles. The BMP-2 upgrade has been called BMP-2M and BMP-4. BTR-90 with turret is BTR-90M.

BMD-4 and -4M: Amphibious/airborne IFVs with compact hulls and Bakcha-U turret. BMD-4M is now in production (pg. 2-42).

Type 97 IFV: Chinese counterpart (aka **2G**) to BMP-3M, with the BMP-3M unified fighting compartment, and an indigenous amphibious tracked chassis.

MAIN ARMAMENT AMMUNITION
Ammunition Mix: Varies with role (see NOTES, pg 2-42).

IFV/Heavy IFV: Combat Load	48
Frag-HE (3UOF17)	22
Frag-HE (3UOF19, electronic fuse)	22
AT-10/Arkan ATGM	4
Infantry FSV/Tank FSV/HACV/Amphibious forces IFV:	48
Frag-HE (3UOF17)	22
HEF (3UOF19, electronic fuse)	18
AT-10/Arkan ATGM	8

Caliber, Type, Name:
100-mm HE-Shapnel (HEF MOD.96, 3UOF19) Focused-fragmentation, electronically-fused
Maximum Aimed Range (m): 7,000
Max Effective Range (m):
Day: 7,000 electronic fused
Night: 5,000
Tactical AA Range: 7,000
Armor Penetration (mm): Due to combined HE/fragmentation effects, this round can defeat an IFV or APC on impact. A near miss would damage those vehicles.

30-mm Frag-HE 3UOF17/3OF32
Maximum Aimed Range (m): 4,000
Max Effective Range (m):
Day: 4,000
Night: 2,600+
Tactical AA Range: 4,000
Armor Penetration (mm): INA

30-mm APFSDS-T M929
Maximum Aimed Range (m): 2,500+
Max Effective Range (m):
Day: 2,500+
Night: 2,500+
Tactical AA Range: 4,000
Armor penetration (mm KE): 55 (RHA) at 1,000 m
45 at 2,000 m

Other Ammunition Types: 100-mm HE-I, 30-mm HEI-T. Note: The 30-mm gun can also fire earlier types of 30 x 165 ammunition Newer ammunition includes frangible rounds.

Antitank Guided Missile
Name: Arkan/AT-10b
Warhead Type: Tandem shaped charge
Armor Penetration (mm CE): 750 (RHA), 700 behind ERA
800+ conventional armor
Range (m): 5,500 day, 5,000 night
Launcher Dismountable: No

NOTES
The vehicle has seen limited use as standard IFV for mechanized forces. Cost and other considerations may suit it better for specialized uses. Not the discussion of roles for the vehicle at NOTES, pg 2-44. A hybrid role would be as a Heavy IFSV, to provide heavy gun fire, AD fire, and ATGM launches while on the move. The chassis is also suited for mounting other weapons: see Kornet/Krizantema AT launchers at pgs 6-64 and 65, the 2S31120-mm combination gun at pg. 7-63, Hermes-A missile launcher, pg 6-75, and Pantsir-S1-0 AD system at Vol 2, pg 6-59.

Russian AG-17 30-mm automatic grenade launcher is available for BMP-3. The Shtora IR ATGM jammer countermeasure system is available.

Russian IFV/APC/Infantry Fire Support Vehicle Turret Kliver

BMP-1 with Kliver turret

Weapons & Ammunition Types	Typical Combat Load
30-mm automatic gun HEI-T, Frag-HE Frangible, APFSDS-T	**300**
7.62-mm coax MG	**2,000**
ATGM Kornet-LR and LR HE	**2-8** (See Notes)
MANPADS (optional) SA-18, or SA-18S/ Super Igla	**0 - 8** (see Notes)

SYSTEM
Alternative Designations: TKB-799 as IFV, or as infantry fire support vehicle (ATGM, SAM launch vehicle, or ADAT vehicle)
Date of Introduction: Displayed first time in 1996
Proliferation: Prototypes displayed on BTR-80, BMP-1 and -3 chassis. The BMP version is fielded in at least one country. This represents upper tier (higher cost) turret upgrades.
Description:
Turret crew: 1, gunner in 1-manned turret. Vehicle crew is 3.
Combat Weight (mt): 1.5-2.5
Fording Depths (m): Amphibious vehicle capability retained

Automotive Performance: See BMP-1 for data

Protection:
Armor, Turret Front (mm): INA
Smoke Equipment: Not on prototypes, but could be added

ARMAMENT
Main Armaments:
Caliber, Type, Name: 30-mm automatic gun 2A72
Rate of Fire: 350 rd/min (cyclic) in bursts
Loader Type: Belt feed
Ready/Stowed Rounds: 300/ 0
Elevation (°): -10 to +60
Fire on Move: Yes

Auxiliary Weapon:
Caliber, Type, Name: 7.62-mm (7.62x 54R) machinegun, PKT
Mount Type: Turret coax
Maximum Aimed Range (m): 2,000
Max Effective Range (m):
Day: 1,500
Night: INA
Fire on Move: Yes
Rate of Fire (rd/min): 250 practical / 650 cyclic, in 2-10 rd bursts

ATGM/MANPADS Launcher:
Name: INA
Launch Method: Turret mount launcher, with free-slew elevation
Guidance: Laser-beam rider
Command Link: Encoded infrared laser-beam
Launch Method: 4x tube-launched missiles
Launcher Dismountable: No, however Kornet-E spare possible
Elevation (°): INA
Rate of Launch: (missiles/min): 3-4, depending on range
Reaction Time (sec): 1-2
Ready/Stowed Missiles: 4 ATGMs or MANPADS for IFV
8 ATGMs for ATGM launcher vehicle
For ADAT see mix at the right

FIRE CONTROL
FCS Name:
Main Gun Stabilization: 2-plane for fire on move
Rangefinder: Laser built into sight
Infrared Searchlight: No
Sights w/Magnification:
Gunner: 1K13-2 12x independent 2-plane stabilized sight
Day: TV
Field of View (°): INA
Acquisition Range (m): 5,500
Night: Thermal sight
Field of View (°): INA
Acquisition Range (m): 3,500
Commander Fire Main Gun: No

VARIANTS
Prototypes include BTR-80 and BMP-3 chassis. It can be installed on any vehicle with 1.5-2.5 ton turret capacity. Hull opening rework for the turret ring would be required.

BMP-1M: IFV with Kliver upgrade. The turret was designed for the BMP-1 turret ring. See BMP-1 for automotive data. Name in OPFOR organizations is **BMP/Kliver**.

Other Kliver-based IFVs: Once the turret is added to an APC or IFV, the vehicle is considered to be an APC in simulations. This turret has been fitted to BMP-3F IFVs and exported to one country. Other applications are the BMD-3 (**BMD/Kliver**), and BTR-80 (**BTR/Kliver**). Vehicle automotive capabilities do not change with this turret. See the vehicle data sheet for automotive data. Foreign developers are considering Kliver, e.g., Jordan on its Temsah IFV.

Infantry Fire Support Vehicle (IFSV) or (Air Defense/Antitank - AD/AT) variant: The most flexible Kliver applications are vehicles with both ATGMs and MANPADS launch capability, which also carry two dismount teams. The vehicle can be specialized for the role (launchers with mostly MANPADS in air defense role, mostly ATGMs in AT role). The vehicle can be characterized to have a mix of ATGMs and MANPADS; with dismount teams for the assigned role.

Thus a BMP/KLIVER IFSV will have the following:
- Standard Kliver turret weapons (30-mm gun, and 7.62-mm MG)
- 8 missiles, SA-18S MANPADs or Kornet ATGMs, or mixed, based on the unit supported and assigned mission.

The two dismount teams will also have a total of either:
- 10 Kornet ATGMs, or
- 10 SA-18 MANPADS

Since most dismount team reloads (4-6) will stay in the vehicle during dismount, those are available for vehicle use as needed.

Russian IFV/APC/Infantry Fire Support Vehicle Turret Kliver continued

MAIN ARMAMENT AMMUNITION
Caliber, Type, Name:
30-mm APFSDS-T M929
Maximum Aimed Range (m): 2,500+
Max Effective Range (m):
Day: 2,500+
Night: 2,500+
Tactical AA Range: 2,500+
Armor penetration (mm KE): 55 (RHA) at 1,000 m
45 at 2,000 m

30-mm Frag-HE
Maximum Aimed Range (m): 4,000
Max Effective Range (m):
Day: 4,000
Night: 3,500
Tactical AA Range: 4,000
Armor Penetration (mm): INA

Other Ammunition Types: 100-mm HE-I, 30-mm HEI-T

Antitank Guided Missiles
Name: Kornet-LR
Alternative Designation: 9M133
Missile Weight (kg): 27
Warhead Type: Tandem Shaped Charge (HEAT)
Armor Penetration (mm CE): 1,100
Min/Max Range (m): 100/5,500 day, 3,500 night
Probability of Hit (%): 90
Average Velocity (m/s): 550
Time of Flight to Max Range (sec): 22

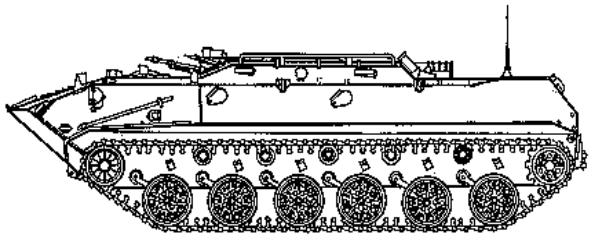
Other Missiles: Kornet-LR HE (thermobaric, 9M133F)

NOTES
This turret is one of the better one-man drop-in turret packages, which permit countries lacking in production technologies to substantially upgrade their IFVs and APCs. However, like all one-man turrets, Kliver lacks the advantage of two-man turrets in integrating commander and gunner into coordinated effort for simultaneous surveillance, acquisition, and engagement across the battlefield. The limitation can be mitigated with use of remote sights and remote weapons for the commander's station and passengers' stations in the hull.
+
Turret installation would not interfere with NBC system, commander's station, or with onboard ammunition stowage.

KBP (manufacturer) says that a 2-man turret version is available.

The turret is an excellent one for upgrading IFVs or APCs into *Infantry fire support vehicles* (see pg 3-53). Kliver is a fairly expensive turret package. But the cost is less than conversion of all vehicles, with a significant lethality improvement against armored vehicles (tanks and IFVs) as well as against aircraft. An infantry force could use a partial maneuver unit upgrade, such as one per platoon, or 3-4 per company, to serve the direct-fire support role in an APC or IFV-based mechanized infantry unit. As pure ATGM or SAM launcher vehicle, the FSV can add 8 more ATGMs and MANPADS reload missiles and a loader, to replace the dismount teams. Stowed rounds and ATGMs can be stowed in the passenger compartment. However, as an air defense/antitank (ADAT) vehicle, a more practical use would be to have the vehicle launcher as well as dismount AT or AD dismount teams. The most numerous infantry FSV configuration will probably be as BMP or BTR/Kliver ADAT.

Russian Airborne Armored Personnel Carrier BTR-D



Weapons & Ammunition Types	Typical Combat Load
2x 7.62-mm hatch MG Lt Ball, Ball-T, API, API-T, Incendiary	**2,000**

SYSTEM
Alternative Designations: BMD M1979
Date of Introduction: 1974
Proliferation: At least 1 country
Description:
Crew: 1
Troop Capacity: 12 passengers
Combat Weight (mt): 6.7
Chassis Length Overall (m): 5.88
Height Overall (m): 1.67
Width Overall (m): 2.63
Ground Pressure (kg/cm^2): 0.5

Automotive Performance:
Engine Type: 240-hp Diesel
Cruising Range (km): 500
Speed (km/h):
- Max Road: 61
- Max Off-Road: 35
- Average Cross-Country: INA
- Max Swim: 10

Fording Depth (m): Amphibious

Radio: R-123

Protection:
Armor, Turret Front (mm): "Antibullet" (7.62-mm)
Applique Armor (mm): N/A
Explosive Reactive Armor (mm): N/A
Mineclearing Equipment: N/A
Self-Entrenching Blade: N/A
Active Protection System: No
NBC Protection System: Yes
Smoke Equipment: 2x2 forward firing smoke grenade launchers
Vehicle engine exhaust smoke system (VEESS)

ARMAMENT
Main Armament:
Caliber, Type, Name: 7.62-mm (7.62 x 54R) machinegun, PKT
Rate of Fire (rd/min): 250 practical / 650 cyclic, in 2-10 round bursts
Loader Type: Belt-fed
Ready/Stowed Rounds: INA
Elevation (°): INA
Fire on Move: Yes
Auxiliary Weapon: N/A
ATGM Launcher: N/A
Firing Ports: 2 on each side, 1 in left rear door, permit two 5.45-mm RPK-74 light machineguns to be used.

FIRE CONTROL
FCS Name: N/A
Sights w/Magnification: Open, 1x
Commander Fire Main Gun: No

VARIANTS
This vehicle is an extended version of the BMD-1 chassis, with an added road wheel, and hydro-pneumatic suspension. This vehicle is therefore longer, with more room for crew and passengers.

1V119 Spektr: Artillery command and Reconnaissance Vehicle for amphibious and airborne forces.

2S9-1: 120-mm self-propelled combination gun, with a turreted breech-loaded mortar/howitzer system.

BMD-KShM: Former Soviet regiment or division command and staff variant, with AGS-17 AGL and large Clothes Line antenna.

BREM-D: Armored repair and recovery variant.

BTR-RD/Robot: An ATGM variant (AT-4/-5) with 2 launchers, dismounted or mounted on pintles for vehicle launch.

BTR-ZD: Air defense variant with ported or towed ZU-23 twin 23-mm air defense gun. Vehicle also carries 2 MANPADS launchers. The vehicle has also been wrongly designated as a BTR-3D. An early version of BTR-ZD had 6 man-portable SAM launchers, with no gun.

Sterkh (Malakit/Shmel): UAV transporter and launcher vehicle.

A variant recently seen in air assault units mounts a swiveling 12-tube Aviaagragat launcher on the center hull. It appears to launch 80-mm S-8 air-to-surface rockets, which also can be used as artillery rockets. These can be especially effective when fitted with S-Cor semi-active laser homing fuses for Frag-HE precision attack to 6-9 km. Rockets can be used direct fire; and warhead options include tandem HEAT (600+ mm penetration), HEAT-Frag, AP-HE, and flechette.

MAIN ARMAMENT AMMUNITION
Caliber, Type, Name:
7.62-mm API
- Maximum Aimed Range (m): 1,500
- Max Effective Range (m):
  - Day: 1,000 m / 400-500 on the move
  - Night: INA
- Tactical AA Range: INA
- Armor Penetration (mm): 8 (RHA) at 500 m

Other Ammunition Types: 7.62-mm Light Ball, Ball-T, Heavy Ball, API, API-T, Incendiary

NOTES
BTR-D is a variant of the BMD-1, with an additional road wheel, with the turret removed, and with a raised hatch area. The vehicle can be parachute landed with airborne troops. The BTR-Ds in grenade launcher units will carry one AGS-17 30-mm AGL in the rear.
Options include the Kliver turret with a 30-mm gun, 7.62-mm coax MG, thermal sights, superior day sights, and (four) Kornet ATGM launchers.

Fire Support Vehicles for Maneuver Forces

Military vehicle developers have sought to field IFVs and APCs that can be protected against all threats. Nevertheless, modern anti-armor weapons can defeat even the best of these. Among priorities, ability to transport troops must remain the highest. Units must rely on firepower of combined arms weapons and integrated fires to protect against various threats from all aspects. Infantry battalions must supplement squad fires with other fire support weapons and fire support vehicles (FSVs), usually infantry FSVs (IFSVs). Primary threats to vehicles are aircraft, dismounted infantry, controlled (and remotely-delivered) mines and IEDs, guns and missiles, vehicles, precision indirect fires from artillery, and recent remote weapons (such as attack UAVs and UGVs). Fire support requirements and FSVs for them include the following:

-- Infantry FSVs have MGs, medium auto-cannons, ATGMs, Man portable air defense system (MANPADS), and AGLs.

-- Tanks, assault guns, and HACVs have direct fire heavy guns, MGs, and ATGMs (Ch 6).

-- SP recoilless weapons have direct-fire AT rounds and Frag-HE rounds.

-- Flamethrower vehicles can hurl flame or dismount RPO launcher teams.

-- ATGM launcher vehicles include BLOS/NLOS capability (FOG-M and semi-active laser-homing (SAL-H), and multi-role KE AD/anti-armor Starstreak missiles.

--SP mortars and combination guns have sights for short halts, HEAT rounds, and sights for direct fires and BLOS indirect fires (with semi-active laser-homing rounds).

-- Remote mine launcher vehicles and vehicle-borne IEDs (VBIEDs) can be used in coordination with other FSVs. Mines can be launched on top of a formation to fix, isolate, and destroy it in a kill zone. The VBIEDs can attack an enemy whether stationary or moving.

-- HCSVs, SP AD guns and AD/AT vehicles have AD guns and/or missiles.

-- Vehicles for indirect fires and NLOS (artillery, combination guns, and missile launch), can operate autonomously against planned deliver deep targets and newly detected priority targets.

-- Combat recon vehicles (Ch 4) usually have weapons similar to IFVs, APCs, and IFSVs. The CRVs use them mostly for self-defense, but may be used in unit fires. As an OP they can use laser target designators (LTDs) to designate for SAL-H rounds, missiles, bombs, and rockets.

-- Light FSVs based on CSVs armored scout cars or variants (Ch 3), and truck conversions ("technicals"), with guns, MGs, AGLs, and missiles, can support infantry units.

-- Armed and LTD robot vehicles and attack-UAV launch vehicles can be used.

Units like dismounted and motorized infantry, rapid-deployment forces, and paramilitary units often use FSVs based on CSVs and trucks. They are more vulnerable (with little or no armor) but mean more prolific FSVs to maneuver, deliver AD/AT teams, and support with fires.

Infantry Fire Support Vehicles (FSVs)

Any infantry vehicle offers advantages and has limitations in mobility, survivability, and lethality, while performing its assigned role. Vehicles that carry infantry or mechanized infantry are vulnerable to a variety of threats, especially aircraft, infantry AT weapons, mines, IEDs, UXO, medium weapons on vehicles, and infantry weapons. To support moving vehicles, most forces will support them with weapons assigned to deliver AD, AT, and area fires. Those weapons and crews are carried in infantry vehicles which may be conventional infantry vehicles, or which can be modified to fit those roles. Vehicles may have partial passenger loads to hold more ammunition, or more weapons. Modification varies from none to significant.

This section focuses on infantry battalion vehicles offering flexibility, plus dismount transportability to support the infantry fight. The FSV vehicle is adapted for that role. It is part of the unit and supplements infantry unit fires. Usually an FSV uses the supported unit's vehicle chassis. For mechanized units, dismount fire support assets can be used to create ambushes against attackers when the units are stationary. There is a significant advantage to mounting infantry fire support weapons on vehicles, even more if they can be operated from the vehicles. A vehicle may provide protection; it can also reduce employment and displace time for a tripod weapon launcher to 10 seconds or less, compared to 60+ when dismounted. Many infantry vehicles for these roles include APCs or IFVs which will carry two or three dismount teams. With a vehicle pintle mount, weapons can be used while moving, and dismounted when stopped.

There are specialized vehicles designed for AD (e.g., French Albi), for AT fires (2S25 and M901), and for Frag-HE area fires (2S23 and AU-F1). They may be assigned to infantry battalions; but they are usually not organic to infantry, and may not be available. A few forces use HACVs in infantry battalions, due to their flexibility for various fire support roles. These vehicles designed for specialized roles are covered in their respective chapters.

Combat support vehicles and reconnaissance vehicles are well suited for infantry fire support vehicle roles. Smaller vehicles mean room for only one dismount team; but their lower cost affords more vehicles, which can be dispersed for better battlefield coverage. Most infantry FSVs are on tactical utility vehicle chassis. These vehicles are ubiquitous, easy to conceal, highly mobile across uneven terrain, and well suited to carrying a single team with its munitions. A towed trailer can add needed capacity. Most countries have expertise to mount a pintle on a UAZ-469 or a Jeep, for an AT-5B or HOT-3 ATGM launcher, for a Starstreak or Mistral 2 SAM launcher, or for an AGL or 12.7-mm MG. The TUV can also tow an 82-mm Type 99 mortar. The Chinese recently displayed a 23-mm chain gun mounted on a light strike vehicle.

Other vehicles can be adapted for use in infantry fire support roles. As noted, motorcycles and ATVs have been used. Others include civilian vehicles such as dump trucks, flatbed trucks, vans, dune buggies, and SUVs. These include ***technicals***, vehicles with crew weapons mounted on the back. Since most of these weapons are ground versions with attached fire control, their capabilities reflect dismount systems, versus vehicle stabilized turret FCS.

The tank threat has long compelled forces to have infantry FSVs with vehicle-borne and dismount ATGMs. In an APC unit AT Squad, FSVs can hold three two-man teams of medium-range ATGMs, with three launchers and twelve missiles. These vehicles can carry two teams (three men each) of long-range ATGMs, with ten missiles. Each infantry FSV vehicle also has its

complement of weapons (e.g., 30-mm cannon, five ATGMs, etc., in a BMP-2M IFV). Reduced passenger requirement frees more room for additional missiles and ammunition.

Air defense infantry FSVs may have only guns, only missiles, or guns and missiles. Main guns on most APCs and IFVs were selected as much or more for their anti-aircraft capability than for ground fire capability. The OPFOR IFV and APC battalions in US Army training have a MANPADS platoon with infantry FSVs (two MANPADS teams each). As we have noted in some forces, vehicles are modified with racks to hold two man-portable surface-to-air missile (SAM) launchers, and up to 18 missiles for vehicle and MANPADS launchers.

Special purpose forces and light units use FSVs to offset fire limitations. For instance, Russian airborne units include BTR-D APCs, some with MANPADS teams, and some number of BTR-3Ds, BTR-Ds with 23-mm AA guns mounted on top. Similarly, the BTR-RD/Robot is a BTR-D chassis modified with several pintles for ATGM launchers. Conventional infantry units usually uses trucks modified into *gun trucks*, or TUV-based FSVs to provide fire support.

Mechanized infantry FSV applications include light mortar or AGL teams for area fire support. Vehicle variants can include one or more 107-mm MRL modules, SP mortars, etc, for fire support roles. Many newer APCs or IFVs have turret AGLs for area fires. The 100-mm cannon on BMP-3 and other IFVs can fire Frag-HE rounds 7 km for area fires.

Proliferation of drop-in turrets and remote weapon sights has expanded force capabilities to adapt vehicles for infantry fire support roles. Turrets for ATGM launcher conversions include the ATM HOT/gun turret, the Kvartet Kornet ATGM turret, and the MCT MILAN turret. Air defense turrets include the Sosna gun/missile turret, Ukrainian BAU turret top mount (with ZSU-23-2 gun), Djigit mount (for *technicals* and LAV hulls), Russian Fenix IR turret, Strelets SAM launch modules, Albi Mistral mount, and Chinese TY-90. Many other turrets and RWS conversions can be used.

Many examples of turrets for rapid conversion of infantry vehicles into mortar or AGL infantry fire support vehicles can be found. Russian airborne and amphibious mechanized forces needed equally mobile, armored, and lethal area fire support. The answer was a 120-mm combination gun turret on the existing BTR-D airborne APC chassis, known as 2S9-1. A combination gun (gun-mortar) system can fire both cannon and mortar rounds, including direct-fire, to fit a light armored chassis. Similar systems have been designed for Russian IFV, APC, and towed chassis (pg 6-51). Other forces have also developed mortar or combination gun turrets for light chassis. These include mortar turrets such as 120-mm Rarden turrets and the French 120 2R2M. Thompson-Brandt fielded a 60-mm combination gun on the Panhard ERC, and developed a turreted 81-mm gun mortar for use on vehicle designs such as the TMC-81. A currently popular turret is the Hagglunds Advanced Mortar System (AMOS) for use on boats and vehicles, and direct-fire as well as indirect-fire lethality. Many infantry vehicles have been converted for mortar mounts, including the MT-LB, U.S M113 and Stryker, and Type 85. The Russian 82-mm Vasilek mortar can deliver automatic direct and indirect-fire, and has been carried portee style, mounted for operation on the BTR-D APC, and mounted on *technicals*.

The Russian BMP-3M Unified Fighting Compartment (drop-in turret) has been fitted to several vehicles and has been exported. This turret features the 100-mm cannon, which also launches the Arkan ATGM, and the 2A72 30-mm auto-cannon. These weapons can engage aircraft, vehicles and all other ground or seaborne targets. The 100-mm gun and auxiliary 30-AGL can also fire HE rounds and missiles to targets beyond line-of-sight, using observers.

Infantry Air Defense/Antitank (AD/AT) vehicles

A growing recent capability in infantry fire support vehicles is the *infantry AD/AT vehicle*. Because infantry fire support systems are distributed within infantry units in limited numbers and may dispersed throughout the battlefield, the vehicles are more valuable if they can provide equally effective and responsive fires against threats encountered as the dismount teams that ride in them. The vehicles may still carry dismount teams, with weapons corresponding to the particular subunit support mission. An AD/AT vehicle, however, has dual capability.

Desired capabilities for an *infantry AD/AT vehicle* include protection and firepower to engage infantry and other threats which it might encounter. In the past, the closest counterpart to such a vehicle was an IFV or APC with dismount crew weapons onboard (ATGM launchers or MANPADS). An IFV with ATGM launcher and MANPADS teams is sufficient for most missions. These vehicles only support the AD role to a limited extent, with assets such as:

- Radio or digital command links (and link to the AD net, mounting an azimuth plotting board). The vehicle can use its local radio sets to alert the dismounted teams,
- Vehicle sights, ground radar from stowage, or an RF DF system to assist surveillance,
- Weapons for supporting fires against incoming aircraft with guns and missiles.

An early version of an AD/AT system was a variant of the North Korean VTT-323 APC. In mechanized infantry units, the North Korean Army employs a mix of VTT-323 APCs (see pg 2-24) and FSV variants. The APC has two 14.5-mm MGs, rather than one main gun, which supports the anti-aircraft role. The FSVs add an AT-3 ATGM launcher and racks for two man portable SAM launchers, for use by passengers.

Now there are drop-in turrets for use on infantry vehicles which include AD/AT missile capabilities. These AD/AT systems can upgrade IFVs and APCs carrying AD and AT dismount teams. Because some of these turrets and RWS can fit on lighter and less expensive combat support vehicles (such as TUVs) or existing chassis, they can be fielded in greater numbers than newer, more specialized, and sophisticated ATGM and AD launcher vehicles, and IFVs.

The Russian Kliver turret can launch 4 x Kornet ATGMs or 4 x SA-18 SAMs. The launcher must change out pods for the different missions. However, warning time permits the changeover. A likely future upgrade will be interchangeability of the missiles on the launchers. The turret also features a 30-mm auto-cannon, coaxial MG, and modern fire control system.

One system well-suited for AD/AT applications is Starstreak. This high-velocity missile, with 3 laser-beam riding darts, can destroy aircraft as well as most armored vehicles. It cannot defeat frontal armor on most main battle tanks. However, the missile can easily out-fly missiles from aircraft and LAFVs (<6 sec flight time to 7 km), and penetrate their armor. It can be shoulder-launched, or use a three-missile launcher which can be mounted on a vehicle. There is also an eight-launcher turret, which can fit on the hulls of a variety of vehicles.

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Upgrade options permit the infantry to modify various vehicles, with the combination of AT and AD weapons, into AD/AT vehicles. Pintle mounts and RWS for ATGMs can fit onto TUVs, trucks, light strike vehicles, motorcycles, ATVs, and others. Many of those weapons can be quickly brought to bear from the move (with short halt), then be dismounted to ambush

positions as the vehicles go to hides. Man portable SAM launcher mounts such as Djigit, Strelets, Starstreak Lightweight Multiple Launcher, Mistral Albi and Atlas, and others can fit a variety of vehicles. The Starstreak can engage aircraft and LAVs, for quick conversion of AD/AT vehicles.

Some of these AD/AT vehicles were designed from the beginning to fulfill the multi-role requirement. Most were modified from existing systems with replacement subsystems, or simply added capabilities. Add-on upgrades, e.g., Strelets remotely operated MANPADS launcher, or the Israeli RWS with the Spike ATGM launcher can enable vehicles to perform multiple missions at a fraction of the cost of special-built designs, and with comparable capability. For instance, the BTR-80 APC features a higher angle-of-fire gun to address aircraft and other higher-angle targets. The Ukrainian firm KMDB has developed a twin 23-mm cannon which can replace turrets or mount on top of existing turrets to address a variety of fast-moving targets which other vehicle guns may not be able to engage. The 23-mm round is also affective against light armored vehicles, materiel, and personnel such as snipers firing from high angles.

Most ATGMs can be employed against helicopters. The faster missiles, such as gun-launch missiles, and those from the Russian 9P149/Shturm-S ATGM launcher vehicle (Vol 1, pg 6-76), are more effective in intercepting a fast-flying helicopter. The 9P149 now features an Ataka missile AD variant with a segmented rod designed for use against helicopters. The Spike-ER ATGM, with fiber-optic guidance and IIR-homing option, is advertised as an effective missile for use against tanks and helicopters. Vehicle remote weapon stations include launchers for this missile, with range out to 8+ km. Modern RF threat warning systems can warn of attacks from aircraft and ground vehicles, and differentiate the threats. Some of those systems designate direction of threat approach, with azimuth warning systems such as the 1L15-1.

The AD/AT requirement has also driven improvements in ammunition and sensors. Modern Russian tanks can remotely fire the anti-aircraft MG, using special air defense sights. The Russian FARA-1E radar can be attached to various weapons (including the NSV 12.7-mm MG), as a fire control radar for use against ground and aerial targets. Longer range sensors such as 3rd gen FLIR on the MPCV greatly increase night use of EO-based systems.

New ammunition natures include sabot rounds for existing calibers (12.7-mm, 20-mm, 23-mm, 30-mm, etc.). Rounds suited for aerial as well as ground targets include proximity-fused, frangible, and AHEAD (Advanced Hit Efficiency and Destruction, electronically fused) for infantry vehicles, tanks, and air defense systems as well.

Numbers of missiles and weapons which can be used in AD/AT vehicles are limited by vehicle size, weight, and space considerations. For APCs and IFVs, placing more launchers outside (e.g., four on the Kliver turret), and reducing passengers to four or five means more room for missile racks. Thus an AD/AT vehicle with the Kliver turret can have up to 14-18 missiles onboard (ATGMs and MANPADS combined). The mix will favor the vehicle support role. For instance, a BMP/Kliver AD/AT in an air defense unit would probably have 14 MANPADS, and 4 ATGMs. The number of 4 MANPADS for the vehicle may seem low; but it can use stowed rounds for the dismount launchers. The numbers would reverse for an ATGM launcher vehicle.

Breakthroughs in ammunition and vehicle drive stabilization offer more responsive

precision fires day and night, stationary or moving. Current trends indicate that recent subsystem technology improvements (e.g., gimbaled and gyro-stabilized RWS and OWS, better recoil compensation systems, auto-trackers and stabilized fire control, computer-based integration, radars, EO, acoustics, laser systems, and GPS-based digital C^2) will supplement air and ground observation to offer a greater variety of infantry AD/AT vehicles.

With these assets the OPFOR can supplement the infantry vehicles to fight dispersed throughout the battlefield. The AD/AT systems will also assure that infantry units will also be prepared to engage against any threats which they encounter, with minimum warning. In the Near Term, we can expect to see these capabilities become prevalent, so that forces will increasingly be organized economically to fight dispersed, with the ability to engage air and land force threats with equal deadly effect.

Heavy Combat Support Vehicles

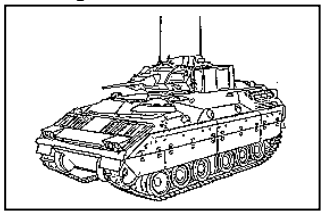
The modern lethal battlefield requires vehicles that can move quickly, survive contact, and provide lethal response. For mechanized infantry forces, a key method is task organization by adding tanks to the formation. Tank units have similar needs. Because of their lack of perspective when buttoned up, as well as their limited ammunition load to serve non-tank targets, they need eyes that can traverse 360° and at all aspects. As with infantry units, the best response is to task organize by adding mechanized infantry to battalion, company, or platoon formations. there are limitations, however, in using this TTP against the array of modern threats.

Some heavy IFVs or APCs (HIFV/HAPC), or HACVs have been up-armored sufficiently to approach the protection needed for these missions. Russian BMP-3M (right) and U.S. M2A2 can be called HIFVs. Others will be fielded. However, HIFVs, HAPCs, or HACVs often may not be available for accompaniment missions.

Another response for support is to add an organic ***heavy combat support vehicle (HCSV)***. This "accompanying vehicle" should have a tank's mobility, and much more armor protection than most light armored vehicles. Thus one approach is to use a tank chassis for this vehicle. It must also have a mix of various weapons (guns, machineguns, grenade launchers, ATGMs, and perhaps surface-to-air missiles) and sensors to rapidly service any threats and targets at all aspects, including light armor, aircraft, AT weapons, dismounted personnel. A vehicle with such an array of mobility, protection, weapons, and sensors, offers capability for a variety of roles, not just one of accompanying tanks. They can be used to accompany mechanized infantry for direct fire support, as combat reconnaissance vehicles, or as indirect fire support vehicles.

The Russians have displayed a vehicle called Combat Vehicle for Tank Support (BMPT). As an accompanying vehicle, it would move with tanks and engage targets less suitable for the tank main gun. It can also quickly engage AT threats. The BMPT can also accompany infantry units for fire support in close environments, such as urban areas. It features a T-90 based chassis with added armor and ERA, two 30-mm auto-cannons, ATGM launcher, automatic grenade launcher, and 7.62-mm MG. The 5-man crew does not dismount, rather crews the vehicle and operates weapons.

There are advantages to having some infantry carrying capability. An HCSV may be used to carry dismount teams for special purpose missions (recon, AT, weapons team carriers, MANPADS, etc.). None will carry an infantry squad. A few may carry a 2-5 man team to provide an initial infantry presence on seized terrain. A U.S. M3A2 Bradley Cavalry Fighting Vehicle can carry two men for a dismount OP. The Russian BTR-T, made from a T-55 tank chassis, carries 5. Although characterized as a HAPC, it cannot carry a squad and has limitations against use in that role. When used as a HCSV (e.g., recon variant), it may prove more effective. Tanks such as Israeli Merkava and Ukrainian BTMP-84 (modified T-84) can also carry troops.



Russian BMPT concept

Russian Heavy APC/Heavy Combat Support Vehicle BTR-T

Weapons & Ammunition Types	Typical Combat Load
30-mm automatic gun	**200**
HEI-T, Frag-HE	100
APFSDS-T	100
ATGM Launcher	**3**
30-mm auto grenade lchr (Optional addition)	**400**

SYSTEM
Alternative Designations: None. Although the vehicle is called an APC, its limited troop capacity makes it better suited for other missions, e.g., accompanying tanks, combat reconnaissance, and carrying combat support teams (AD, AT, etc.). See Notes

Date of Introduction: 1997
Proliferation: Developed, marketed for export

Description:
Crew: 2
Troop Capacity: 5 passengers, including dismounting vehicle cdr
Combat Weight (mt): 38.5
Vehicle Chassis Used: T-55 tank hull with overhead weapons station
Chassis Length Overall (m): 6.2
Height Overall (m):
Width Overall (m): 3.27
Ground Pressure (kg/cm^2): INA

Automotive Performance:
Engine Type: 580-hp Diesel
Cruising Range (km): 500
Speed (km/h):
- Max Road: 50
- Max Off-Road: INA
- Average Cross-Country: INA
- Max Swim: N/A

Fording Depth (m): 1.4, 5.0 with snorkel

Radio: R-173, R-173P

Protection:
Armor, Turret Front (mm): No turret. Hull 200 (KE)/600 (CE)
Appliqué Armor (mm): No. Grill armor in hull.
Explosive Reactive Armor (mm): Yes
Active Protection System: N/A
Mineclearing Equipment: KMT-8 plow available
Self-Entrenching Blade: No
NBC Protection System: Collective
Smoke Equipment: 12 smoke grenade launchers, VEESS

Main Armament:
Caliber, Type, Name: 30-mm automatic gun, 2A42
Rate of Fire (rd/min): 550 cyclic in bursts/200-300 practical
Loader Type: Belt feed
Ready/Stowed Rounds: 200/ 0
Elevation (°): -5 to +75
Fire on Move: Yes
Elevation (°): INA
Fire on Move: Yes

Auxiliary Weapon: Upgrade Option (See notes)
Caliber, Type, Name: 30-mm automatic grenade launcher, AG-17
Mount Type: Bow left side
Maximum Aimed Range (m): 1,700
Max Effective Range (m):
- Day: 1,200
- Night: N/A

Fire on Move: Yes
Rate of Fire (rd/min): 60-100 practical in short (≤ 5 rds) or long (6-10 rd) bursts.

ATGM Launcher:
Name: 9P135M2 - option add Flame-G adaptor for MILAN/Trigan
Launch Method: Tube-launched
Guidance: SACLOS
Command Link: Wire
Rate of Launch (missiles/min): 2-3 depending on range
Launcher Dismountable: Yes

Firing Ports: None

FIRE CONTROL Similar to BMP-2 unimproved
FCS Name: N/A
Main Gun Stabilization: 2-plane
Rangefinder: Laser
Infrared Searchlight: Yes
Sights w/Magnification:
Gunner:
- Day: INA
  - Field of View (°): INA
  - Acquisition Range (m): 4,000 (est)
- Night: II/IR for gun
  - Field of View (°): INA
  - Acquisition Range (m): 800-1,300 (est)

ATGM launcher: Day sight 9Sh119M1 range 4,000 m
Night sight 1PN86 range 2,500 m

Commander Fire Main Gun: No

VARIANTS
Producer offers different OWS versions, with 12.7-mm MG (single, with AGL, or with ATGM launchers), or with 30-mm gun (twin 30-mm, 30-mm and ATGM, and 30-mm gun with AGL).

DPM or **Scout-Patrol Vehicle**: Recon variant with a 12.7-mm MG.

MAIN ARMAMENT AMMUNITION
Caliber, Type, Name: HAPC Configuration
30-mm APFSDS-T M929
- Maximum Aimed Range (m): 2,500
- Max Effective Range (m):
  - Day: 2,500
  - Night: 800-1,300
- Tactical AA Range: 2,500
- Armor penetration (mm KE): 55 at 1,000 m, 45 at 2,000 m

Russian Heavy APC/Heavy Combat Support Vehicle BTR-T

30-mm Frag-HE
- Maximum Aimed Range (m): 4,000
- Max Effective Range (m):
  - Day: 4,000
  - Night: 800-1,300
- Tactical AA Range: 4,000
- Armor Penetration (mm): INA

Antitank Guided Missiles

Name: AT-5B/Konkurs-M (Without Flame-G)
- Warhead Type: Tandem shaped charge (HEAT)
- Armor Penetration (mm CE): 925 (RHA)
- Range (m): 4,000 day
  2,500 night

Name: Trigan (With Flame-G)
- Warhead Type: Tandem Shaped Charge with precursor charge
- Armor Penetration (mm CE): 1,300 (RHA)
- Range (m): 2,500 day and night

Name: MILAN 3 (With Flame-G)
- Warhead Type: Tandem Shaped Charge with precursor charge
- Armor Penetration (mm CE): 880 (RHA)
- Range (m): 1,920 day and night

Other ATGMs: AT-4/4b, AT-5 HE without Flame-G
AT-5B/Konkurs-M Thermobaric

NOTES
There are several notable limitations with this vehicle as an APC:

(1) Dismount capability is less than a full squad.
(2) Soldiers other than the crew must exit via two hatches on the hull top at the rear, exposing them to gunfire.
(3) The initial configuration (30-mm cannon and ATGM) lacks antipersonnel weapons and remote weapons for 360° protection.
(4) Mobility is inferior to most modern tanks, except in narrow areas such as forest trails, where the smaller vehicle easily fits.

This vehicle appears to be a response to Chechen losses, and would be a special role APC for battalion tactical groups and subunits accompanying tanks and infantry in urban conflicts. The dismount team would have to dismount out of the line of fire, and accompany the vehicle to provide protection.

The vehicle could be used as a **heavy combat support vehicle**, to accompany tanks and mechanized infantry IFVs and APCs. However, like most vehicles, it is vulnerable to fires from flanks and rear when used in defilade areas and urban terrain. It currently lacks the remote weapons and viewers needed to provide security in those circumstances.

Among the overhead weapon system (OWS) versions noted, the most versatile and useful would be the 30-mm gun, with a 30-mm AG-17 automatic grenade launcher. The grenade launcher adds antipersonnel firepower to the mix. The AGL is not advertised with this package, but is part of another package option for the system. That upgrade has been advertised for addition to a variety of LAFVs and is compatible.

A pintle mount ATGM launcher as described above could then be added. The archetype launcher is 9P135, which fits AT-4 (Fagot) and AT-5 (Konkurs). However, more robust ATGM penetration capabilities can be gained with the Flame-G adaptor and Milan variants. The most lethal ATGM (in terms of penetration) is Trigan, which mounts onto the Milan launcher adaptor. For ATGM launcher FCS, see AT-4/AT-5, pg 6-30. For night sight, use 1P86-1/Mulat, range 3,600 m.

Combat Support Vehicles

Infantry and mechanized units employ other military vehicles besides APCs and IFVs for tactical missions. Combat support vehicles supplement infantry carriers for support missions where mobility, reduced profile, and flexibility are required, but with a lesser requirement for infantry and combat power. These vehicles include armored and unarmored systems, and wheeled and tracked chassis. They are found in infantry, mechanized, tank, reconnaissance, anti-tank, artillery, air defense, and security units, and in most other military units. In the modern era with a widened spectrum of missions and restricted military budgets, most forces will increasingly turn to these vehicles to supplement or replace specialized and expensive chassis, such as APCs and IFVs. They are also more easily deployable than APCs and IFVs. The following types of vehicles fit in this class of tactical systems:

- Tactical utility vehicles
- Light armored multi-purpose vehicles
- All-terrain tracked carriers
- Light strike vehicles
- Motorcycles and bicycles
- All-terrain vehicles
- Heavy combat support vehicles

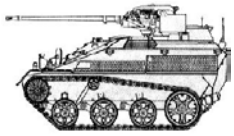
The most ubiquitous type of tactical vehicle worldwide is neither APC nor IFV; it is the ***tactical utility vehicle*** (or TUV, sometimes called light utility vehicle). Since inception of the model for these vehicles (the U.S. Jeep), other countries have developed a wide variety of indigenous designs, with improvements and variants. These include the British Land Rover, U.S.HMMWV, Russian UAZ-469, and Chinese BJ-212. Some are amphibious. The Russian LUAZ-967M TUV offers support with amphibious capability. Civilian applications of the utility vehicle as more sophisticated sport utility vehicles have fed significant improvements in mobility and flexibility for military applications. Most TUVs are multi-purpose vehicles used primarily as personnel carriers; but secondarily for other roles. They have cargo-carrying capability, and can pull a trailer. One of the favorite uses for these vehicles is for command and staff within tactical units. Many were intended for use in peacetime, but would also be part of the transformation into wartime units. With improved flexibility and mobility, they have found favor with tactical units. Organizations such as the military police, special purpose forces, reconnaissance forces, security, and patrol units use them. These vehicles are effective in antitank units with a pintle mount for an ATGM launcher, or for a recoilless gun. A number of air defense units have fitted them with MANPADS launchers and AA guns. With space and carrying capacity, they can be fitted with radios, fire control systems, and computer systems. Some serve as cost-efficient reconnaissance vehicles with radars or thermal viewers, or even with mast-mounted multi-mode sensor units and long-range data transmission systems. Variants of these vehicles can be found in information warfare/EW units, logistical units, and in artillery units. Combat service support variants include utility trucks, ambulances, and fire fighter variants. Although less mobile than most tracked vehicles, TUVs are considerably more mobile than most armored wheeled vehicles.

UAZ-469

Mobility upgrades include conversion from 4x4 to 6x6, central tire inflation, run-flat tires, fording kits, and hoists for self-extraction when stuck. Survivability upgrades include mine-resistant designs and armor protection against 7.62-mm rounds. Lethality upgrades include weapons mounts for a machinegun, automatic grenade launcher, or remote weapon and sensors. Some mount heavier weapons. The recent Chinese SAC TUV can mount a 20-mm cannon.

Multipurpose vehicles include conversions of truck or TUV chassis, like the British S-55, or are unarmored "gun trucks". Civilian trucks for this use with some type of weapon are often called "technicals". Gun trucks and technicals may add armor (at least Kevlar blankets and plate) in selected areas to survive IEDs, mines, and small arms fire, and enable the vehicles to exit the area of contact. Others are well-armored (e.g., Russian BTR-152).

The modern lethal battlefield requires that more support vehicles are armored and protected against mines and IEDs. Thus, many military CSVs are special-designed ***light armored multi-purpose vehicles.*** Because of the need for mobility and reduced signature, most of these are smaller vehicles which cannot carry a whole squad, rather 3-4 men for tactical support missions. Many smaller vehicles are initially labeled as reconnaissance vehicles, e.g., armored scout cars (ASCs), or armored cars, but are used for a variety of support roles. Vehicles include the French VBL, British Spartan, German Wiesel 2, the Russian BRDM-2 and Kombat armored car, U.S. V-150, and Hungarian FUG/OT-65. Larger examples are sometimes called APCs, like S55, BTR-152, and MT-LB. The recent Russian GAZ-39371 4x4 security van (with MG turret) and Turkish Cobra (have APC versions. An increasing priority for these vehicles is mine protection, as noted in recent contingency operations. With the increased use of Heavy IFVs and APCs as well as Heavy Combat Support Vehicles we can expect to see more CSVs with increased armor protection.


Wiesel

GAZ-39371

Many forces today use ***light strike vehicles*** (LSVs) for tactical units, special purpose forces, security forces, and other units which must move rapidly off-road with minimum danger of rollovers. In the past they were known as "fast-attack vehicles". At first most were similar to the U.S. Chenowith FAV, resembling recreational "dune buggies" and seating 1-4 with few or no body panels to interfere with weapons. Two examples are the Israeli 6x6 Desert Raider and U.S. Navy 4x4 Desert Patrol Vehicle. More recent designs hark back to WWII, resembling the classic Jeep or a cross between it and FAV. Examples include the Jordanian 4x2 AB3/Black Iris, Singaporean Flyer, and Chinese FAV. Today most are based on utility vehicles with roll bars or cages and stripped of body panels above waist level. Examples are Jordanian 4x4 Land Rover Defender AB5, South African Wasp, Army Ranger 4x4 RSOV, and 4x4 Adcam H2A. Some vehicles feature thin armor over the paneled areas. They are highly mobile with fast access and small arms fire accessibility.

Chenowith LSV

Land Rover Variant

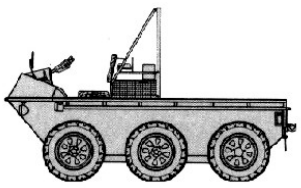
Some combat support vehicles are designed to meet the requirement for higher mobility combat under special conditions. They can be armored or unarmored. For instance, the Swedish Bv206 is an unarmored ***all-terrain tracked carrier*** (ATTC), with two articulated and connected compartments. Originally designed for use in heavy snow, it has proved equally superior to other vehicles in swampy terrain and for amphibious use. An armored counterpart is BvS210 (British Viking). Several countries have similar ATTC systems, e.g., Russian DT-10P and Singapore Bronco. The Russian MT-LB is widely used for over-snow APC and transport.

Bv206

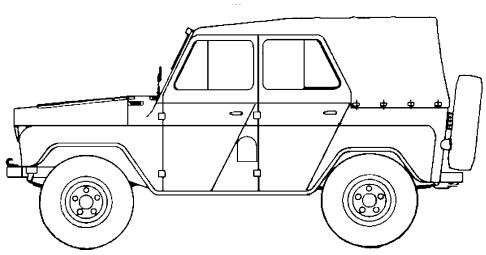
Motorcycles continue to enjoy a niche in military forces. These systems offer some risk to operators, especially in difficult weather. Nevertheless, their flexibility means that a force designer with available manpower can use 2-3 motorcycles to economically replace a TUV, and 4-9 to replace an armored vehicle. Sidecars greatly expand the variety of missions available to motorcycles. Improvements in civilian versions and more compact accessories (such as radios, GPS and weapons) permit motorcycles to maintain a place in modern forces. Missions include: courier, scout, special operations and sniper missions, and air defense and anti-armor ambush. Motorcycle mobility improvements include diesel engine, two-wheel drive, wide studded tires, more agile suspensions and brakes, and improved sidecar arrangement with drive wheels. Vehicle motorcycle racks and low-bed motorcycle trailers enable motorcycle carry in reconnaissance and other tactical units, for easy use within patrol areas. Their compact size and ruggedness facilitates insertion by vessel or helicopter, and airdrop. Fitted with battery-powered air pumps and inflatable pontoons, or simply lashed to logs, motorcycles can be floated across waterways. The Russian Gear-up) has a pintle mount for a MG and/or AGL/ATGM launcher. A 2-man team can move rapidly with very little signature. Jordanian special operations units include 2-man teams on two high-mobility AB23 Desert Ranger bikes. Light forces such as airborne units are also looking at air-droppable ***bicycles*** and mountain bikes to aid mobility. Robots will also be used to extend the eyes and carry capacity of these light forces. These include amphibious robots and micro-UAVs, with weapons and other supporting loads.

Rokon

Some forces have turned to smaller 4x2, 4x4, or 6x6 ***all-terrain vehicles*** (ATVs). These vehicles offer the same advantages as motorcycles, with somewhat more utility in difficult terrain and densely wooded areas. The British Army is trialing a 4x4 Diablo for 2-man Trigat ATGM launcher teams. Dutch RDM Group has demonstrated the 4-wheeled Light Airmobile Vehicle, with a TOW ATGM launcher mount. The U.S. Army employed the Gator ATV in Afghanistan. The British 6x6 Supacat) is in wide use and trialed in Malaysia. This amphibious vehicle is an expanded ATV that bridges the gap between LSVs and ATVs, and has many variants. That type of ATV offers high speed, mobility in all terrains, and sufficient carry capacity and stability for weapons carrier missions. Tactical improvements include 10-inch wide tires, folding frames, and racks to hold gear. The ATVs can substitute for vehicles in the same manner as motorcycles - with a ratio of 2-9:1 (depending on crewing) to replace armored vehicles. For littoral and river-crossing operations with difficult off-road conditions, amphibious ATVs offer an unmatched balance of mobility and carry capability.


Supacat

Russian Tactical Utility Vehicle UAZ-469



SYSTEM
Alternative Designations: UAZ-3151 upgrade
Date of Introduction: 1985 for upgrade
Proliferation: Widespread

Description:
Troop Capacity: 2 in front, up to 5 in rear
Weight (mt):
Gross Vehicle Weight: 2.35
Curb: 1.59
Length Overall (m): 4.025
Height Overall (m): 1.99
Width Overall (m): 1.785
Payload on/off Highway (kg): 600
Number of Axles: 2
Drive Formula: 4x4
Ground Clearance (mm): 300
Turning Radius (m): 6.5
Wheels:
Size (in): 8.40x15
Central Tire Pressure Regulation System: No
Run Flat: No

AUTOMOTIVE

Engine: 92 hp gasoline
Cooling: Water
Cruising Range (road) (km): 482
Speed (km/h): 110

Fuel Capacity (liters):
Left Tank: 39
Right Tank: 39
Towing Capability (kg):
Off Highway: 850
On Highway: 850
Gradient (loaded) (°): 60
Fording Depths (m): .8
Trench Crossing Width (mm): INA
Winch: Optional, yes for vehicles in tactical units and roles

CARGO SPACE

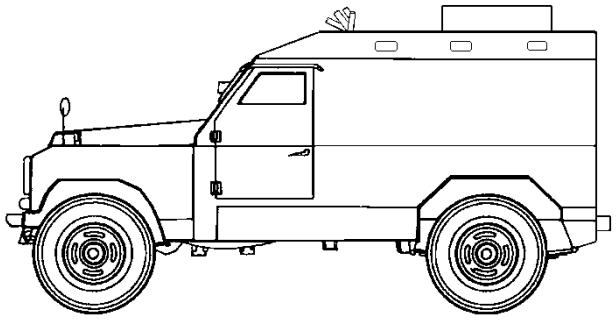
Height (mm): 400
Width (mm): 1,400
Length (mm): 1,000
Cargo Bed Area (m^2): 1.6

ARMAMENT
For use in tactical units and in tactical support roles, the vehicle will have a pintle mount with a 7.62 or 12.7-mm MG, or a W-87 automatic grenade launcher (see organization guide). Air defense or anti-tank units may have other role-specific weapons.

VARIANTS
UAZ-469: Initial model fielded in 1973, with 70-hp engine, and inferior off-road performance and crew features.
UAZ-469B: Export; lower off-road performance
Ambulance: 1 stretcher patient and 1 attendant
BJ-212: Chinese TUV variant.

NOTES
The UAZ-469 replaces the earlier UAZ-69. The vehicle will generally tow a utility trailer or other towed item; but it may disconnect the load to move across more difficult cross-country terrain.

British Personnel Carrier S55



S55 without machinegun turret

Weapons & Ammunition Types	Typical Combat Load
7.62-mm Turret MG	**1,500**
Ball	
Ball-T	
API	
API-T	

SYSTEM Unless otherwise stated, data is for Mk 5 upgrade.
Alternative Designations: FV18061, S5 Shorland
Date of Introduction: 1963 original, 1990s for Mk 5
Proliferation: At least 21 countries

Description:
Crew: 3
Troop Capacity: 0, 8 passengers in raised roof personnel carrier
Combat Weight (mt): 3.6
Chassis Length Overall (m): 4.51
Height Overall (m): 1.85, 2.29 for turret
Width Overall (m): 1.80
Drive Formula: 4 x 4, with run-flat tires

Automotive Performance:
Engine Type: 114-hp Gasoline
Cruising Range (km): 514
Speed (km/h):
- Max Road: 105 Mk 5
- Max Off-Road: INA
- Average Cross-Country: 48
- Max Swim: N/A

Fording Depth (m): 0.5
Radio: INA

Protection:
Armor, Turret Front (mm): 11.0, can defeat 7.62-mm ball at 26 m
Appliqué Armor (mm): Grass-reinforced plastic flooring
NBC Protection System: No
Smoke Equipment: 2 x 4 smoke grenade launchers + roof mount

ARMAMENT
Main Armament:
Caliber, Type, Name: 7.62-mm (7.62x 51) GP Machinegun, L7A2
Mount Type: Turret
Rate of Fire: 80-100 (practical)
Loader Type: Belt feed
Ready/Stowed Rounds: INA
Elevation (°): -4 to +82
Fire on Move: Yes
Rate of Fire (rd/min): INA

ATGM: N/A
Firing Ports: 3 each side, 2 in the rear doors for personnel carrier

FIRE CONTROL
Infrared Searchlight: None, visual searchlight only
Sights w/Magnification:
Gunner:
- Day: Periscope sight on turret roof
- Night: N/A

Commander Fire Main Gun: No

VARIANTS
The vehicle is produced in several versions, including armored car (with notchback cab and room for 3), personnel carrier van version.

Upgrades:
Mk 1: Initial version, with 7.25-mm armor and 67-hp engine.
Mk 2: Variant with 8.25-mm armor and 77-hp engine.
Mk 3: Upgrade with 91-hp engine.
Mk 4: Variant with 11-mm armor and 114-hp engine.
Mk 5: Upgrade with improved suspension, wider wheelbase.

Special-Purpose Vehicles:
S53 Mobile Air Defense Vehicle: Vehicle with lightweight multiple launcher (3 ready, 6 stowed).

S54 Anti-Hijack Vehicle: Version has special rifle marksman turret.

MAIN GUN AMMUNITION
Caliber, Type, Name:
Maximum Aimed Range (m): 2,000 (est)
Max Effective Range (m):
- Day: 800
- Night: INA

Armor Penetration (mm RHA):

Other Ammunition Types: Ball, Ball-T, API, API-T

NOTES
Vehicle is based on British Land Rover chassis. Primary use for the vehicle is for military site security, and internal security vehicle for police and border forces.

Air conditioning is available.

French Armored Carriers VBL and VBR

Weapons & Ammunition Types	Typical Combat Load
.50 cal MG	**1,200**
Other Options:	
7.62-mm MG	**3,000**
or	
Auto Grenade Launcher	**(est) 300**
ATGMs (See Variants)	**9**

SYSTEM
Alternative Designations: Vehicule Blinde Leger, Ultrav, M11
Date of Introduction: 1984
Proliferation: At least 16 countries
Description:
Crew: 3
Troop Capacity: None, up to 3 with expanded version
Combat Weight (mt): 3.55
Chassis Length Overall (m): 3.70
Height Overall (m): 1.7
Width Overall (m): 2.02
Drive Formula: 4x4
Tires: 9.00 x 16 inch run-flat, with central tire inflation system

Automotive Performance:
Engine Type: 98-hp Diesel
Cruising Range (km): 600, 800 max fuel
Speed (km/h): Max Road: 95, Off-Road and Cross-Country: INA
Max Swim: 4.5

Radio: INA
Protection:
Armor, Turret Front (mm): 5-11.5
Appliqué Armor (mm): VBR has increased mine protection.
Kevlar blankets are used for VBL/VBR to add more protection.
Explosive Reactive Armor (mm): No
Active Protection System, Mineclearing Equipment, and Self-Entrenching Blade: No
NBC Protection System: Collective
Smoke Equipment: No

ARMAMENT
Main Armament:
Caliber, Type, Name: .50 cal (12.7 x 99) heavy MG, M2HB
Rate of Fire (rd/min): 450-550 cyclic
Loader Type: Belt-fed
Ready/Stowed Rounds: 250 /750
Elevation (°): -10 to +50
Fire on Move: Yes
Firing Ports: None

FIRE CONTROL
None, except MG day/night sights. Crew will employ viewers, LRF, and navigation gear.
Commander Fire Main Gun: No

VARIANTS
The vehicle was initially fielded in two configurations: armored recon vehicle and MILAN/HOT ATGM launch vehicle. The variety of configurations now includes AD, C^2, and others.
EW system, internal security, etc. For recon versions, see pg 4-14.

VBL with MILAN launcher

Albi/ air defense forces use a VBL modified with the Albi turret to launch Mistral and Mistral 2 missiles (see Vol 2, pg 6-57).

Russian KPB has displayed a VBL with the **Kvartet/**9P163-2
o
Wasp MILAN ER: The remote weapon station fits the top, with a 7.62-mm MG and 1-tube launcher for the new ATGM (pg 6-26). The superior EO sensors can also be used for observation in recon units.

VBR: Stretch variant which can carry a total of 5. Vehicle weighs 7.5 mt, has smoke grenade launchers, and a remote weapon station with an M2HB MG, smoke grenade launchers, and thermal sights. Overhead weapons module to mount on a variety of vehicles, and launches the Kornet-LR ATGM. It has a dual twin (4-tube) launcher and central module with TV/FLIR sights. The ATGM launcher vehicle seats two, with room for an additional five missiles

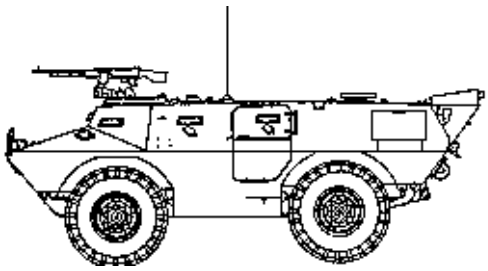
VBL/Ingwe: South African Armed Long Range Reconnaissance Turret (ALRRT - with 4 Ingwe ATGM launchers) on a VBL.

MPCV (Multipurpose Combat Vehicle): VBR chassis with a 4 x missile launcher turret and 12.7-mm MG. Missiles are Advanced Short-Range Air Defense (ASRAD) SAM or MILAN-ER ATGMs. The FCS is CCD/3rd gen FLIR and LRF. Load is 8 missiles.

MAIN ARMAMENT AMMUNITION
Caliber, Type, Name:
.50 cal SLAP or API
Maximum Aimed Range (m): 2,000
Max Effective Range (m):
Day: 2,000
Night: INA
Other Ammunition Types: Ball-T, frangible

NOTES:
Vehicle will mount a winch, and can also tow a utility trailer. The VBR can be used as a multi-role vehicle in the same way as VBL, but with more carry capacity, including crew/passenger capacity. For instance, Kvartet and HOT multi-ATGM launchers can be mounted on VBR.

U.S. Armored Vehicle V-150



Weapons & Ammunition Types	Typical Combat Load
7.62-mm cupola MG Ball-T, Match API, API-T	**3,200**

SYSTEM
Alternative Designations: Commando
Date of Introduction: 1971
Proliferation: At least 20 countries
Description:
Crew: 3
Troop Capacity: 2
Combat Weight (mt): 9.89
Chassis Length Overall (m): 5.69
Height Overall (m): 1.98
Width Overall (m): 2.26
Ground Pressure (kg/cm^2): INA
Drive Formula: 4 x 4

Automotive Performance:
Engine Type: 202-hp Diesel
Cruising Range (km): 643
Speed (km/h):
- Max Road: 89
- Max Off-Road: INA
- Average Cross-Country: INA
- Max Swim: 5

Fording Depth (m): Amphibious

Radio: INA

Protection:
Armor, Turret Front (mm): Against 7.62-mm ball
Applique Armor (mm): N/A
Explosive Reactive Armor (mm): N/A
Mineclearing Equipment: N/A
Self-Entrenching Blade: N/A
Active Protection System: N/A
NBC Protection System: N/A
Smoke Equipment: Optional

ARMAMENT
Main Armament:
Caliber, Type, Name: 7.62-mm (7.62 x 51) MG, FN-MAG (example)
Rate of Fire (rd/min): 650-1000 cyclic
Loader Type: Belt feed, box magazines
Ready/Stowed Rounds: INA
Elevation (°): INA
Fire on Move: Yes

Auxiliary Weapon: N/A

ATGM Launcher: N/A
Firing Ports: None

FIRE CONTROL
FCS Name: N/A
Main Gun Stabilization: N/A
Rangefinder: N/A
Infrared Searchlight: N/A
Sights w/Magnification:
Gunner:
- Day: Open ladder sight
  - Field of View (°): INA
  - Acquisition Range (m): 2,000
- Night: N/A

Commander Fire Main Gun: No

VARIANTS
Armament options vary widely and include: a turret with 7.62-mm or 12.7-mm MG or turrets with 20-mm, 25-mm, 30-mm, 76-mm, or 90-mm gun. Another turret offers a 12.7-mm MG and 40-mm grenade launcher. An 81-mm self-propelled mortar launcher variant and a TOW ATGM launcher variant are available. Variants include a cargo carrier, police and security vehicles, and an air defense variant with 20-mm Vulcan cannon.

V-100: This earlier 4x4 APC has a gasoline engine.

V-150S: This slightly larger 4x4 variant has improved drive train and the above variety of turret and gun options. A Commando command variant includes a raised compartment area with external-mount 7.62-mm MG. Taiwan has versions with an open-mount 12.7-mm MG and a 107-mm (4.2 inch) mortar.

V-200: Variant sold to Singapore with 20-mm turret, 90-mm turret, air defense variant with RBS-70 surface-to-air missile and a recovery variant. Another variant has a 120-mm mortar.

MAIN ARMAMENT AMMUNITION
Caliber, Type, Name: 7.62-mm Ball, NATO
- Maximum Aimed Range (m): 2,000 (est)
- Max Effective Range (m):
  - Day: 1,500
  - Night: INA
- Tactical AA Range: INA
- Armor Penetration (mm): INA

Other Ammunition Types: Ball-T, API, API-T, Match

NOTES
The baseline V-150 is equipped with a variety of pintle-mounted 7.62-mm machineguns. Many MGs are installed by user countries from their inventories. The Belgian FN-MAG general purpose MG is a widely used MG that represents a common capability.

Ukrainian/Russian Light Armored Multi-purpose Vehicle MT-LB

Weapons & Ammunition Types	Typical Combat Load
7.62-mm Turret MG Lt Ball, Ball-T, API, API-T, Incendiary	**2,000**

SYSTEM
Alternative Designations: MT-LB-T when used as prime mover.
Date of Introduction: 1970, and produced in the Ukraine. After the USSR breakup, they are produced in Ukraine and Russia.
Proliferation: At least 16 countries
Description:
Crew: 2
Troop Capacity: 11 passengers
Combat Weight (mt): 11.9
Chassis Length Overall (m): 6.35
Height Overall (m): 1.87
Width Overall (m): 2.85
Ground Pressure (kg/cm^2): 0.46 standard track / 0.28 wide track
With wide tracks and low ground pressure, it is among the world's best LAVs for all terrains (e.g., ice, snow, marshes, sand, and sea).

Automotive Performance:
Engine Type: 290-hp Diesel
Cruising Range (km): 500
Speed (km/h):
Max Road: 61.5/70 modernized
Max Off-Road: 30/45 modernized
Average Cross-Country: INA
Max Swim: 5-6
Fording Depth (m): Amphibious

Radio: R-123 or upgrade to -123M/-173
Protection:
Armor, Turret Front (mm): 7-14
Self-Entrenching Blade: Yes
NBC Protection System: Collective
Smoke Equipment: No

ARMAMENT
Main Armament(s):
Caliber, Type, Name: 7.62-mm (7.62x 54R) machinegun, PKT
Rate of Fire (rd/min): 250 practical / 650 cyclic, 2-10 round bursts
Loader Type: Belt-feed
Elevation (°): -5/ +35
Fire on Move: Yes
Firing Ports: 1 on each side and 1 in each rear door.
Many guns, grenade launchers, missile launchers, and turrets (such as the Russian Kliver, pg 3-49) are available for the MT-LB.

FIRE CONTROL
Sights w/Magnification:
Gunner:
Day: PP-61AM, 2.6x
Field of View (°): 23
Acquisition Range (m): 1,500 (est)
Night: N/A on base version
Commander Fire Main Gun: No

MAIN ARMAMENT AMMUNITION
7.62-mm API, API-T (See BTR-D, pg 3-51)

VARIANTS
Many versions and upgrades from Russia, Ukraine, Bulgaria, and other countries are currently marketed for this vehicle. Although MT-LBs can be used as APCs or modified as IFVs, most are used for support, or are reconfigured into specialized support vehicles.

MT-LB "blade": Dozer version with a blade attached to vehicle.
MT-LBu: Variant has a raised hull area for more carry capacity.
The MT-LBu version (1974) is used for 50+ of 60+ MT-LB variants. Applications include artillery command and reconnaissance vehicles (ACRVs), air defense mobile CPs (Sborka, Vol 2, p. 5-64), etc.
2S1: 122-mm self-propelled howitzer, on MT-LBu chassis.
BMP-23: Bulgarian IFV with MT-LB chassis and 23-mm auto-cannon on a BMP-2 type design, but inferior lethality and protection.
MTP-LB: Technical support vehicle.
MT-SON: Ground radar vehicle with Pork Trough/ SNAR-2 radar.
RKhM: Chemical reconnaissance vehicle.
SA-13: Regimental surface-to-air missile launcher vehicle.
SNAR-10: Ground surveillance radar vehicle with Big Fred radar.
9P149/Shturm-S: ATGM launcher vehicle with AT-6 autoloader.

The Ukraine continues the offer MT-LB, and an MT-LBu variant called **MT-LBV. MT-LBVM** is modernized with a 12.7-mm MG.
A Ukrainian APC upgrade package cited as **MT-LB** has a suite of improvements, including a 30-mm auto-cannon and night sights.

In 1995 a Russian plant began upgrading MT-LBs, with improved steering and a new engine. This plant now produces MT-LBu, and other variants, including the MT-LBM (6MA and 6MB) series.
MT-LB6MA: Upgrade with 14.5/twin 14.5-mm and 7.62-mm MGs
MT-LB6MB: Upgrade APC/multi-purpose vehicle fitted with Modular Weapon Station. Weapons include a 30-mm cannon, 30-mm AGL, and 7.62-mm MG. See BTR-80A (pg 3-19, also fitted with MWS) for weapons, fire control system, and ammunition data.
MT-LB6MB3: Infantry FSV/APC (below) with aircraft 23-mm GSh-23L twin cannon, 30-mm AGL, and 7.62-mm MG.

MT-LB6MB5: APC/IFSV optimized AD version has a Gsh-30K twin 30-mm aircraft gun, 12.7-mm MG, 30-mm AGL, and space for a squad. It also has a Strelets module with 2 x SA-18/18S SAMs.

NOTES

Turkish Light Armored Vehicle Cobra

Cobra armored personnel carrier open turret vehicle

Weapons & Ammunition Types	Typical Combat Load
12.7mm MG, M2HB SLAP, API, API-T, Ball, Ball-T, Incendiary, I-T	**1,000**

SYSTEM
Alternative Designations: The version featured is a light armored personnel carrier (< 8 mt) version. Other APC versions are offered.
Date of Introduction: 1998
Proliferation: At least 8 countries
Description:
Crew: 2
Troop Capacity: 10 passengers
Combat Weight (mt): 6.2
Chassis Length Overall (m): 5.23 with winch
Height Overall (m): 2.10
Width Overall (m): 2.20
Drive Formula: 4 x 4
Central tire inflation system: Yes

Automotive Performance:
Engine Type: 190-hp GM Diesel
Cruising Range (km): 725
Speed (km/h):
Max Road: 115

Max Swim: 8
Fording Depth (m): Amphibious
The vehicle is C-130 transportable.

Radio: INA, man-portable /vehicle, as needed by the customer.

Protection:
Armor, Turret Front (mm): 7.62-mm protection, all-welded steel
Self-Entrenching Blade: No
Mine protection: Yes
NBC Protection System: Yes
Smoke Equipment: Yes

ARMAMENT
Main Armament(s):
Armament varies with the configuration. Below is for APC.
Caliber, Type, Name: .50 cal (12.7 x 99) heavy MG, M2HB
Rate of Fire (rd/min): 450-550 cyclic
Loader Type: Belt-fed
Ready/Stowed Rounds: 250 /750
Elevation (°): -15 to +50
Fire on Move: Yes
Firing Ports: 3 on each side and 1 in the rear door.

FIRE CONTROL
Sights w/Magnification: Open turret model APC
Gunner (m):
Day: INA
Acquisition Range (m): 1,500 (est)
Night: 1,200 II sight (est)
Commander Fire Main Gun: No

VARIANTS
The factory lists many different vehicle configurations. These include APCs with MG on an open turret, a closed turret, or a RWS. Closed turret and RWS offer improved day/night FCS range out to 2,000.

Other variants are: fire support vehicle (FSV, with a 40-mm AGL and a 12.7-mm MG, or with a 20-mm cannon), a reconnaissance/ surveillance vehicle, EOD vehicle, no-prep amphibious vehicle, ambulance, command and control vehicle, and communications vehicle. Other country versions are designed for specific applications. For instance, one version has a turret with a 12.7-mm MG and two Spike ATGM launchers. Sources claim that 25-mm or 30-mm auto-cannon mounts are available. Selected turrets for other AT and AD missiles could also fit on this vehicle.

MAIN ARMAMENT AMMUNITION
Caliber, Type, Name:
.50 cal AP
Maximum Aimed Range (m): 1,500
Max Effective Range (m):
Day: 1,500 (est)
Night: 1,200 (est)
Armor Penetration (mm): 11@30° at 1,500 m

.50 cal Ball
Maximum Aimed Range (m): 1,500
Max Effective Range (m):
Day: 1,500
Night: 1,200 (est)
Armor Penetration (mm): 20 at 100 m

Other Ammunition Types: Ball-T, API, API-T, Incendiary, I-T

NOTES
The vehicle uses mechanical components from the U.S. HMMWV.

Singapore Light Strike Vehicle Spider

Spider LSV

Spider with Spike ATGM launcher

Weapons & Ammunition Types	Typical Combat Load
CIS-50 .50-cal MG	**1,200**
API, API-T, Incendiary, I-T	est
Other Options:	
7.62-mm MG	**3,000**
or	
Auto Grenade Launcher	**(est) 300**
Spike-LR ATGMs	**6**

SYSTEM
Alternative Designations: None
Date of Introduction: 2008
Proliferation: At least 1 country, currently marketed. Similar to vehicles in forces of 9 or more countries. Other forces use LSVs of front engine design similar to Jeep and Land Rover (see pg. 3-62)
Description:
Crew and passengers: 2-6
Combat Weight (mt): 1.6
Payload Weight (mt): 1.2
Chassis Length (m): 4.5
Height Overall (m): 1.9
Width Overall (m): 2.0
Drive Formula: 4 x 4
Central tire inflation system: No

Automotive Performance:
Engine Type: 130-hp Peugeot Diesel. An option is Mogen hybrid drive with diesel-electric engine for quiet movement, or power assist.
Cruising Range (km): 700
Speed (km/h):
Max Road: 130
Max Off-road: 80
Max Swim: No
Fording Depth (m): 0.6
The vehicle is C-130 transportable 6/aircraft.

Radio: INA, man-portable /vehicle, as needed by the customer.

Protection:
Self-entrenching blade, mine protection, NBC Protection System, and smoke equipment are not used. LSVs rely on off-route mobility, speed, 360° crew fire, and quick dismount capability for protection.

ARMAMENT
Main Armament(s):
Armament varies with the configuration. Below is common one
Caliber, Type, Name: .50 cal (12.7 x 99) heavy MG,CIS-50
Rate of Fire (rd/min): 400-600 cyclic
Loader Type: Belt-fed
Ready/Stowed Rounds: 1,200 /0
Elevation (°): -15 to +80
Fire on Move: Yes

FIRE CONTROL
Sights w/Magnification: EO on the weapon
Gunner (m):
Day: 1,500 (est)
Night: 1,200 II sight (est)
Commander Fire Main Gun: No

Other Weapons: As with other LSVs, open sides mean that crew and passengers can fire personal weapons in all directions.

VARIANTS
The factory lists many different vehicle configurations. These include weapon mounts for MGs, automatic grenade launchers, Spike ATGM launchers (see above photo), and others. MG versions include 5.56 mm and 7.62-mm calibers.

A currently fielded variant is a mortar carrier for 120 mm **SRAMS** Super Rapid Advanced Mortar System, with auto-load and recoil damping. Only 6 rounds are carried onboard; but a Spider ammo carrier accompanies the mortar. The team has a crew of 3 (two drivers, and 60 rounds (est). The SRAMS has a GPS-based navigation and positioning system, and automatic fire control. Fire rate is10 rounds/minute. The weapon can be remote fired. Frame handles recoil loads up to 25 tons.

Other uses include use with weapons teams, or as a fire support vehicle with AT weapons and man-portable SAMs, or as a vehicle for RISTA or security teams. This is an excellent chassis for a UAV team vehicle. SOF currently uses LSVs in many modern forces.

An expected future refinement will be hydro-pneumatic suspension to raise or lower vehicle for off-road use and provide stiffer suspension damping when firing.

MAIN ARMAMENT AMMUNITION
Caliber, Type, Name:
.50 cal AP
Maximum Aimed Range (m): 1,500
Max Effective Range (m):
Day: 1,500 (est)
Night: 1,200 (est)
Armor Penetration (mm): 11@30° at 1,500 m

.50 cal Ball
Maximum Aimed Range (m): 1,500
Max Effective Range (m):
Day: 1,500
Night: 1,200 (est)
Armor Penetration (mm): 20 at 100 m

Other Ammunition Types: Ball-T, API, API-T, Incendiary, I-T

NOTES
The roll cage and windshield can be removed as needed in the field. Photo above at right has been edited for clarity.

Russian Motorcycle, Gear-Up

SYSTEM
Alternative Designations: IMZ-8.107, IMZ-8.103
Date of Introduction: By 1999
Proliferation: At least 3 countries, this and similar models
Description:
Troop Capacity: 2 w/sidecar, 3 with added rear seat passenger
Weight (kg): Weight (kg): 315 gross vehicle weight
Length Overall (m): 2.56
Height Overall (m): 1.1
Width Overall (m): 1.7
Number of Axles: 2
Ground Clearance (mm): At least 700
Wheelbase (m): 1.5
Wheels:
Drive Formula: 3x2
Size (in): 4.00 x 19"
Central Tire Pressure Regulation System: No
Run Flat: No
Brakes: 2 drums

AUTOMOTIVE
Engine: 2-cylinder, 4-cycle, 45-hp gasoline
Cooling: Air-cooled

Performance:
Cruising Range (road) (km): 240, 365 with additional tank
Speed (km/h): 105
Obstacle Height (m): .7 using "flying chair" driving style
Fording Depth (m): INA, float capability with air pump available for inflation of pontoons, or attachment of wood floats
Protection: Same as LSVs at pg 3-70

TRANSPORT CAPABILITY
Cargo (kg): 25
Weapons and Support (kg): 100
Trailer: Available, remove for cross-country

ARMAMENT
Weapons: Pintle mount for 7.62-mm MG. Other options: 12.7-mm MG, AGS-17 automatic grenade launcher, man portable or portable ATGM launcher. Air defense teams can carry MANPADS. Current ATGM version highlighted is AT-5b/ Konkurs-M.

Sensors: Optional searchlight. When used with observer teams, other sensors can be added. Air defense teams may have the 1L15 or similar azimuth warning system. Lower tier recon and AT teams may have goniometric-based observation equipment (LRF, II night sight, GPS, radio, and lap-top computer. Higher tier recon, artillery and AT teams may have laser target designator-based observation equipment. Also included for recon, AT, and AD units could be the FARA-1 ground surveillance radar.

VARIANTS
This system is derived from a German BMW design of World War II. Other applications include reconnaissance, air defense, and artillery observer or sniper teams.

Civilian versions are **Sportsma**n (with sidecar), and **Solo** and **Tourist** (without sidecar)

NM3-8.107: Earlier fielded version.

Chang Jiang 750: Chinese variant, with sidecar capability.

NOTES
Motorcycles will be used for airborne infantry, snipers, security, reconnaissance, antitank, command liaison, signal, and other units.
Sidecar can be removed.

British All-Terrain Vehicle Supacat

Supacats Swimming

ATV with 12.7 mm MG and 40-mm AGL

Weapons & Ammunition Types	Typical Combat Load
7.62-mm Machinegun	**1,000**
Other options: 12.7-mm MG	
and/or	
30/35/40-mm Automatic Grenade launcher	
(See Photo left)	
ATGM Launcher Optional	
Note: Above MG is the most common weapon configuration. However, pintle mounts on roll bar can fit other weapons.	

SYSTEM
Alternative Designations: aka Cats. Classed as an All-Terrain Mobile Platform (ATMP). Current configuration is Mk III.
Date of Introduction: By 1982
Proliferation: Used in 43 countries
Description:
Troop Capacity: Two in front. One or two or cargo in rear.
Gross Vehicle Weight (mt): 2.7 max payload, 3.5 for Mk III
Length Overall (m): 3.44 with hitch
Height Overall (m): 1.9
Width Overall (m): 1.87 chassis, 2.0 wheels
Ground Clearance (mm): 215
Drive Formula: 6 x 6
Tires: 13.00 x 15"

Automotive Performance:
Engine**:** 4-cylinder, 78-hp diesel
Cruising Range (road) (km): INA
Speed (km/h):
Max Road: 54
Max Swim: <5
Fording Depth (m): 0.86 heavy load, amphibious normal load
Protection: Same as LSVs at pg 3-70
Radio: Vehicle/manpack radio

TRANSPORT CAPABILITY
Cargo (mt): 1.0
Towing Load (mt): 2.0. Two towing eyes on front and rear
Trailer: Generally employed when terrain permits
Trailer Load (mt): 0.28
Winch: Yes, mounted front or center or rear
Air mobility: Yes, helicopter sling and brackets for parachute frame or platform mount. Stackable for aircraft transport.

ARMAMENT
Main Armament:
Caliber, Type, Name: 7.62-mm (7.62x 54R) machinegun, PKT
Rate of Fire (rd/min): 250 practical / 650 cyclic, 2-10 round bursts
Loader Type: Belt-feed
Ready/Stowed Rounds: 200 rounds at the gun, 3 more boxes ready (estimate). Load varies with mission.
Elevation (°): -5/ +35
Fire on Move: Yes

Fire Control:
Sights are on weapons. The pintle mount can also hold a FARA-1 ground surveillance radar when stationary.

VARIANTS
It comes in various configurations, including Milan ATGM launcher, or 81-mm mortar with ammunition. Another version can tow a 105-mm howitzer and a trailer of ammunition. Trailers include the Forklift Pallet Trailer. Supacats are also used for hauling, for laying land lines, for evacuating wounded personnel. There is also an engineer version

MAIN ARMAMENT AMMUNITION
Caliber, Type, Name:
7.62-mm API, API-T
Maximum Aimed Range (m): 1,500
Max Effective Range (m):
Day: 1,000/400-500 on the move
Night: INA
Tactical AA Range: INA
Armor Penetration (mm): 8 (RHA) at 500 m

Other Ammunition Types: Light Ball, Ball-T, Heavy Ball, Incendiary

NOTES
A number of similar amphibious ATVs have been fielded, as well as dozens of variations and applications from this design.

Chapter 4
Reconnaissance

Reconnaissance represents all measures associated with organizing, collecting, and studying information on the enemy, terrain, and weather in the area of upcoming battles. Aggressive, continuous reconnaissance allows the timely accomplishment of combat missions with minimum losses. Poor reconnaissance can lead directly to failure.

The OPFOR term which addresses the totality of reconnaissance activities is RISTA (reconnaissance, intelligence, surveillance, and target acquisition). Thus RISTA does not equal the U.S. term C4ISR (command, control, communications, intelligence, surveillance, and reconnaissance). For information on OPFOR command and control (C^2), see Chapter 9.

The OPFOR commits significant resources to any reconnaissance mission. Prior to the beginning of hostilities, the OPFOR will already have developed an intelligence picture and expected military courses of actions. Similar intelligence and reconnaissance disciplines (HUMINT, SIGINT, IMINT, etc.) available to U.S. forces are also available to the OPFOR, albeit with different assets, focuses, and methodologies.

Reconnaissance embraces all spheres of operation, including ground, surface and below surface, air, space, naval, and littoral areas. Therefore, reconnaissance platforms must be able to operate in all of these spheres. There are reconnaissance assets at all echelons. Intelligence products derived from these assets are processed into actionable intelligence.

This chapter describes reconnaissance assets used by ground maneuver forces and specialized ground reconnaissance troops such as special purpose forces. The most basic sensors are lasers/optics/electro-optics used in infantry units (see Chapter 2), which are ubiquitous throughout the force. When linked with a radio, they can be used for unit reporting and other HUMINT reports. There are also dedicated reconnaissance assets in specialized combat support areas (see reconnaissance system data sheets and trend discussions in the following chapters):

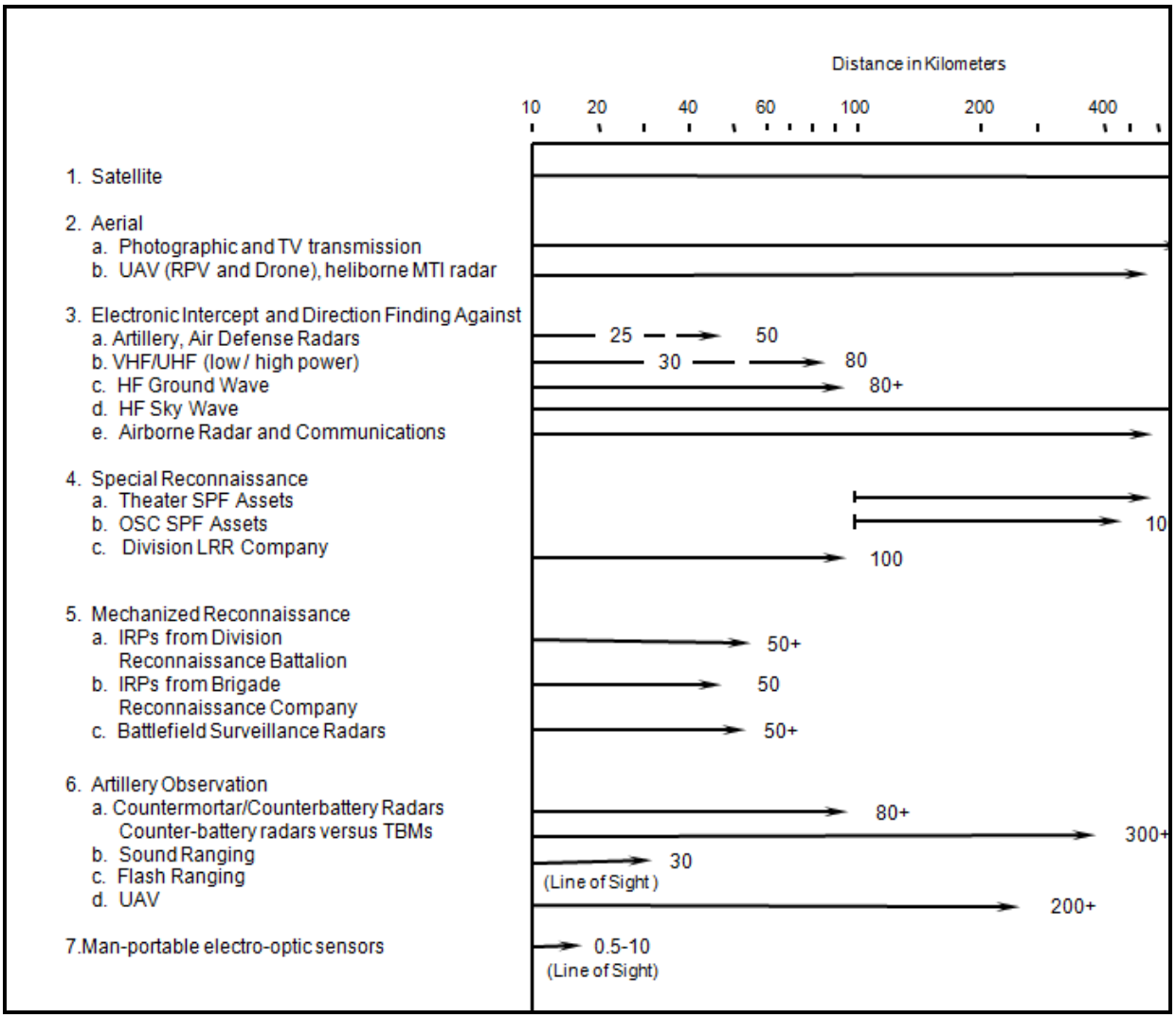
- Artillery target acquisition (Artillery chapter)
- Engineer reconnaissance (Engineer chapter)
- Signals reconnaissance (Information Warfare chapter)
- NBC reconnaissance (Chemical chapter)
- Aerial reconnaissance (Rotary-Wing and Fixed-Wing aviation chapters in Volume 2)
- Unmanned aerial vehicles (UAV chapter in Volume 2)
- Air defense reconnaissance, early warning, and target acquisition (Vol 2 AD chapter).

An array of sensors have extended surveillance and acquisition capabilities far beyond human eyes and ears. The primary sensors used by all military forces are human senses. The second most prolific category of sensors is sights for weapons, which are employed throughout the force for aiming, and which can be used for surveillance. Discussions of day and night sights for the infantry can be found in the Infantry Chapter (2). In the last 20 years, we have seen an explosion of new sensor technologies, and applications of technologies to explore the electro-magnetic (EM) spectrum for detection and surveillance. Much of it was initiated in the civilian sector, but it has applications for military forces.

Timely reporting enables the military commander to exploit temporary enemy vulnerabilities and windows of opportunity. Using increased data automation, he can adjust plans to fit a dynamic battlefield. The OPFOR achieves timeliness through increased automation for C^2 and processing of information; real-time or near real-time aerial downlinks; and satellite downlinks.

The reconnaissance effort depends upon sensor technologies for location, surveillance and acquisition. This chapter focuses on sensors in the ground force. Most units will employ a mix of older and newer systems, with recon vehicles, portable sensors, and man-portable sensors. The most prolific sensor on the battlefield is the human eye. Range is a critical factor. The table below gives general range capabilities of reconnaissance assets supporting tactical forces.

Effective Ranges of Selected Reconnaissance Assets



The most prolific reconnaissance discipline is HUMINT (human intelligence) reports generated by units on the ground. Much of the reconnaissance effort consists of tactical recon executed by maneuver units in their area of operations. Tactical reconnaissance is often a combined arms mission. Therefore any unit or individual can generate reports for recon units. The OPFOR will exploit civilian information and acquisition assets for reconnaissance purposes.

As the modern battlefield becomes increasingly mobile and lethal, the challenge is to design and deploy reconnaissance systems which can acquire the enemy, transmit intelligence, and survive for the next mission. The struggle for "information dominance" complements other technological struggles (e.g., armor/anti-armor and mobility/counter-mobility) that characterize the modern battlefield. Some man-portable sensor devices are distributed throughout the force to support security and day/night operations. Maneuver and reconnaissance units, including troops in reconnaissance vehicles, will have assets available to set up dismounted observation posts.

These OPs will supplement the vehicle OPs or replace the vehicles while those vehicles may be concealed out of view. Thus, dismounted recon assets must be robust on a level that approaches that of the sensors on the supported vehicle. A newly added section, *Sensor Technologies for Tactical Ground Forces*, discusses trends within that area.

Most forces employ a mix of vehicles for reconnaissance, including tanks and infantry vehicles, engineers, and reconnaissance vehicles. The following section *Reconnaissance Vehicles* discusses the array of vehicles used by ground forces for conducting reconnaissance.

Tactical-level units conducting reconnaissance missions may need specialized mission specific equipment other than sensors for support. These can include motorcycles or all-terrain vehicles, multi-spectral concealment materials, navigation equipment, light-weight laptop computers, and long-range communications/digital transmission systems. Other reconnaissance units which may have specialized and technology intensive equipment are information warfare (INFOWAR) units, UAV units, special purpose operational level units such as reconnaissance brigades, commandos, and naval or airborne or amphibious reconnaissance units. Recent developments include assets for special operations forces, varying from lightweight man-portable precision location and laser designators to radio repeaters and satellite communications systems, and semi-submersible infiltration landing craft (SILC) for naval special operations forces (see Volume 2).

Questions and comments on reconnaissance for specific BOSs should be addressed to the respective chapter POC. Questions concerning data in this chapter should be addressed to:

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Reconnaissance, Intelligence, Surveillance, and Target Acquisition (RISTA) Systems: Key Technology Trends

Military forces worldwide continue to field new RISTA and upgrade legacy systems. These assets are found in reconnaissance units, as well as in tactical units, and in fire support units. They include RISTA vehicles, crew-served assets, and hand-held systems found on the modern battlefield. Other assets use stationary ground mounts, or aerial platforms such as aircraft, UAVs, or airships.

System Category	Technology Trend	Reference Vol/Page	System Example	Ref Page
Ubiquitous Handheld RISTA Systems	Remote EO/3rd gen thermals, 30x, precise loc, video link, graphic net	4-17	Sophie MF	4-32
	EO bionics with FLIR, LRF, and goniometer for precise target location	4-19	ADAD	4-23
	LADAR optical augmentation scans and detects enemy weapon sights	4-21	Mirage 1200	4-21
	Robotic hand-thrown camera with PDA display, and robot/ball mount	4-25	Macroswiss	4-18
	Camera grenade (rifle, RPG, AGL) remotes in-flight image to display	4-25	SPARCS	V2/4-8
RISTA Dismount Team Assets	Man-portable II cameras net to display monitor and alert system	4-17	Nighthawk	4-18
	Site spy cameras with remote-display images on monitor display	4-18	NG-30	4-17
	EO Laser target designator guides laser homing rounds to 10+ km	4-20	DHY-307	4-20
	Man-portable radar with 24 km range and LPI frequency	4-22	Squire	4-22
	Multi-sensor unattended ground sensors with remote monitor display	4-24	CLASSIC 2000	4-24
	Hand-launch UAVs/micro-UAVs for infantry, SPF, RISTA, AT, etc.	4-26	Zala 421-08	V2/4-6
RISTA Vehicles	Masted 50+ x EO, 3rd gen thermals and other sensors for real-time nets	4-6	ATM	4-9
	Mast-mounted motorized LPI radars and real-time digital transmission	4-7	HJ-62C	4-13
	Remote add-on turrets and radar modules for vehicle conversions	4-7	Stalker	4-7
	Integrated weapons with sensor pods for combat recon vehicles	4-6	BRM-3K	4-11
Aerial RISTA Systems	Helicopters and FW with real-time MTI and synthetic aperture radars	V2/2-21	Horizon	V2/2-21
	Powered airship or aerostat with video camera or other sensor arrays	4-23	TAOS/Sky Media Pro	V2/7-2
	Helicopter/weapon-launch UAV munitions for real time intel/targeting	4-26	R-90	V2/4-8
Other RISTA Assets	Artillery/aerial-delivered and hand-emplaced UGS display in intel net	4-24	BSA	4-24
	Handheld and embedded GNSS receivers for in-view displays	4-14	Magellan GPS	4-14
	Laptop display data transmission systems, encryption, and SATCOM	4-30	Kredo-M1	4-30
	EO laser RF weapon sights with 3rd gen day and night capability	4-14	IS-2000	2-30
	Weapon launched sensor munitions for aircraft and artillery	4-26	R-90	V2/4-7
	Trip-wire charges, mines or sensor-fuzed grenade launchers	4-23	AJAX	4-23
	Acoustic sensors quickly detect vehicles, weapons, and aircraft	4-21	HALO	4-21
	Infowar, UAV, aerial, and HUMINT assets tactically linked and fused	4-7	HJ-62C	4-13

Reconnaissance Vehicles

The OPFOR conducts continuous and pervasive reconnaissance activity throughout the battlefield prior to and during all phases of military operations. To accomplish that, ground forces employ a mix of vehicles in areas that vary based on types of threat, and on mobility requirement. The spectrum of reconnaissance vehicles currently ranges from older systems ill-suited for modern requirements, to survivable, mobile, and lethal systems, equipped with complex sensor arrays and communications suites. Some of the vehicles must act as independent reconnaissance patrols, combat reconnaissance patrols, security patrols, and combat outposts against high threat forces. Many reconnaissance missions will be executed by maneuver units using organic vehicles, such as APCs, IFVs, tanks, and combat support vehicles (see Chapter 3).

The most varied and most widely fielded type of vehicle which can be improvised for use as a reconnaissance vehicle is the unarmored 4x4 *tactical utility vehicle* (see the Infantry Chapter section *Combat Support Vehicles*). It is worth remembering that the original U.S. Army Jeep was designed as a reconnaissance vehicle. Most forces still use small Jeep-type chassis, because of their mobility. In the last decade, some countries have developed a requirement for larger multi-role chassis similar to the U.S. HMMWV, which are better suited for roads, but less for close-in and high-defilade terrain. The two vehicle chassis most often used as models for TUVs continue to be the Jeep and the British Land Rover. Most countries can produce their own chassis, or can modify imports as improvised recon vehicles.

Land Rover Defender

Improvised reconnaissance vehicle designs vary to fit the recon role, force requirements, terrain, and local limitations. For site security and other missions, such as MP patrol, *light patrol vehicles* may be fashioned with weapons protection, minimum sensors, and troop carrying capacity. Most forces deal with the vulnerability of these unarmored vehicles to small arms by adding armor and/or increasing firepower. A widely used approach is to add pintle mount guns or grenade launchers, sophisticated manned weapons stations and guns up to 30-mm, or adding remote weapons stations. An affordable and widely used trend in the last few years is using light strike vehicles (LSV -see section referenced above) with roll bars and struts, open sides for rapid use of small arms and rapid egress, and pintle mount vehicle weapons. Another survivability trend is addition of light armor. However, most TUV chassis are poorly suited to the stresses of structural and weight increases with true all-over armor protection, or even for real protection against the most likely weapons from any aspect. Also, wheels are generally vulnerable to all weapons. Added armor on TUVs remains a compromise at best.

Troller LSV

A class of vehicles widely proliferated and better suited than TUVs for reconnaissance duties is the *armored scout car*. These wheeled vehicles offer good road mobility, and better all-terrain off-road mobility than any other type of vehicle. They can be based on a truck, armored personnel carrier, or indigenous chassis to handle the armor and mobility requirements for the role. Many look like 4x4 sport utility vehicles or TUVs, but are designed from the ground up for recon missions. The armor protection is still light armor; but it can include all-over protection, with roof armor and mine protection. As noted above, wheels are vulnerable to all weapons. The increased

mobility can include amphibious capability, as with the French VBL and VBR. With guns of 7.62 - 30 mm and automatic grenade launchers of 30 - 40 mm, they are being fitted with sensors from minimal to sophisticated, and offer lower cost than specialized combat reconnaissance or sensor vehicles. Examples include the British Fox, Hungarian FUG-66, and Russian BRDM-2. General use *armored cars* may also be used or adapted as improvised armored scout cars.

Luchs ASC

The OPFOR forces recognize that in areas where contact with the enemy is imminent, they need to conduct reconnaissance with better armored vehicles, or mechanized vehicles with the capacity to carry a squad of infantry. Therefore, most forces use mechanized infantry units with IFVs or APCs to augment or substitute for reconnaissance units.

Most forces have some specialized *combat reconnaissance vehicles* (CRVs) designed for operations at or beyond the FLOT, not to initiate combat but to survive if engaged. These vehicles sacrifice some infantry carrying capability to gain increased mobility, sensor equipment, and command and control. Vehicle protection remains a priority to assure that this high value asset can fulfill the mission, and survive to continue the mission. They may operate in combat recon patrols with heavily armed vehicles such as tanks and IFVs. Most of these vehicles are tracked, for cross-country mobility; but that mobility may limit their effectiveness for high-speed long-range missions using roads. Recent 6-wheeled or 8-wheeled vehicles have been developed. Swim capability is a valuable asset. Some offer sensors no better or only marginally better than those on APCs or IFVs, and can be used for a variety of combat support missions, such as fire support. A growing trend is fielding of CRVs with sophisticated sensors (such as the Russian BRM-3K). It is a versatile vehicle configured for maneuver reconnaissance with thermal sights, a laser radar system, and a 30-mm gun; but it can also deploy into a stationary surveillance position with its mast-mounted TALL MIKE or Credo-1E LPI radar. As a command (-K) vehicle, its mix of radios transmits reports across various nets throughout the force. Often these vehicles are assigned IFVs or APCs, and are then used as the reconnaissance platoon command vehicle.

Scimitar CRV

A technological innovation which expands acquisition capabilities of recon vehicles while aiding survivability is the *multi-sensor suite.* The suite permits the vehicle to integrate all of its sensors for rapid day/night reconnaissance at the longest possible range. Although sensors can be mounted separately, they feed acquisitions to a common viewer screen with compatible digital reporting and display formats, permitting data to then be digitally transmitted. Common sensor suites incorporate day/night cameras and laser rangefinder/ designators. More sophisticated suites can include radars and "laser radars". Coincidental to development of the integrated suite is use of a telescoping or crane-mount elevating mast (1-3 m) for operating behind terrain to minimize exposure. Recent CRVs may use turret mount sensors or short masts for rapid employment and deployment. The Russian BRM-3K is an effective compromise with turret-mount sensors, and a radar on a short telescoping mast at the vehicle rear. The vehicles must briefly halt to use their radars or mast-mounted sensor suites; but most can use turret or pod-mounted sensors (e.g., TV/thermal sights) while on the move.

Pandur RECCE

Snezka Sensors

The next application of mast mounts and the multi-sensor suite is a more sophisticated reconnaissance vehicle - the *sensor reconnaissance vehicle*. These vehicles are not designed to operate in areas where contact is imminent, rather at or behind the FLOT and using cover while providing continuous data to ground forces. They feature powerful multi-sensor arrays erected on 5-10 m masts, which provide longer- range continuous surveillance, with less vulnerability to enemy fires. Most have armored APC or IFV chassis, which provide room for 3-5 workstations. Thus, the vehicle can be used not only as a reconnaissance vehicle, but also as a recon and intelligence coordination and analysis center. Given their reduced vulnerability, longer emplace and displace times, and longer duration acquisition and C^2 requirements, these vehicles are likely to move less often than CRVs. Examples of these vehicles include the Czech Snezka and Chinese Type 85 with HJ-62C radar. Older sensor vehicles may not have masted sensors or totally integrated sensor suites, but have a mix of sensors which can provide data for posting and transmission to another location where the data can be integrated. Examples include the Russian BRM-1K and PRP-3. Sensor vehicles designed for specific branches are included with those branches, such as PRP-3/PRP-4M for artillery, and Sborka for air defense.

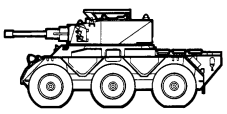
Snezka

Many modernized forces are shifting their recon budget to the sensors rather than to expensive vehicle designs. Forces are fitting mast or turret mounts with sensor suites on light tactical utility vehicles (Rafael Stalker) or armored scout cars (VBL and Fennek), to afford a greater proliferation of highly mobile reconnaissance sensor vehicles. Motorcycles and all-terrain vehicles are also being used with radars and LRF-based FCS, combining mobility and flexibility for rapidly placing dismounted observation posts on any terrain. For further discussion of these systems, see the section *Combat Support Vehicles* in Chapter 3.

Stalker

Specialized capabilities to support route reconnaissance on a complex battlefield include NBC and engineer recon vehicles. They should have comparable mobility and survivability with accompanied vehicles. Engineer vehicles must clear obstacles, and may be required to conduct underwater reconnaissance for prospective water crossings. For information on engineer reconnaissance vehicles, see the Engineer chapter.

Reconnaissance elements may range far from their supported forces. Many forces have developed vehicles designed to provide fire support for reconnaissance elements, and have similar mobility for reconnaissance missions. Examples include the British Saladin Armored Car and Austrian Pandur Fire Support Vehicle. Main guns on these vehicles can range from 57 mm to 105 mm (South African Rooikat). With firepower similar to antitank guns, these vehicles are often co-opted for other missions, such as assault, fire support, and antitank ambushes. Therefore they are included in the category of heavy armored combat vehicles (HACVs), which can be used for a variety of roles (see Antitank Chapter - 6).


Saladin

Polish BRDM-2M-98 and BRDM-2M-97 Armored Scout Cars

BRDM-2M-97/Zbik-B Armored Scout Car

Weapons & Ammunition Types	Typical Combat load
BRDM-2M M98	est 1,000
12.7mm MG	
API (B-32)	
API-T (BZT-44) HEI	
	est 4
HOT-3 ATGM	

SYSTEM:
Alternative Designations: BRDM-2A, Zbik-A as presented.
Date of Introduction: 2004
Proliferation: Fielded in at least 1 country, and offered for export.

Description:
Crew: 4 (2 dismountable for separate OP, short periods)
Platform: BRDM-2, with an added turret
Combat Weight (mt): INA (close to BRDM-2, pg 3-7)
Chassis Length Overall (m): 5.78
Height Overall (m): 2.57
Width Overall (m): 2.78

Automotive Performance:
The engine was replaced with a diesel engine. For other automotive data, see BRDM-2.
Radio: See BRM-3K
Protection: See BRDM-2

ARMAMENT
Main Armament:
Caliber, Type, Name: 12.7-mm (12.7 x 108), NSV-T
Rate of Fire (rd/min): 100 practical/680-800 air, in bursts/4-15
Operation: Gas
Loader Type: Belt feed
Elevation (°): -5 to +75
Fire on Move: Yes

FIRE CONTROL
FCS Name: BAA electro-optical system for BRDM-2M-98
Sights w/Magnification:
Day TV range (km): 20 for a helicopter
Night thermal range (m): 5,000 est, for Ophelious 2nd gen thermal
Rangefinder: Molem Laser rangefinder

Radar: MSTAR battlefield surveillance radar for BRDM-2M-98
Azimuth coverage (°): 180
Mount: Elevating mast
Transceiver: Pulse Doppler, with adaptive threshold for slow-moving personnel detection
Signal: J-band (10-20 GHz)
Power (W): 36-56 consumption, 0.7-1 output
Weight (kg) 35

Surveillance range (km): 4.5 personnel
10.0 light vehicles
12.0 tanks
Resolution: 10 m range, 5° in azimuth
Tracking speed: 3+ km/hr
Alarms: Audio and visual
Features: Artillery fire correction, helicopter detection
Countermeasures: Low probability of intercept

VARIANTS
BRDM-2 upgrade variants include versions with or without radar, and guns from 7.62-mm MG to 20-mm cannon. Upgrade turrets include a variety of weapons such as 30-mm auto-cannon and AGL. Sensors include no radar, and TALL MIKE/Credo radars.

Polish (WZM) modernized variants are offered in five versions, with upgrades such as: 12.7-mm MG, improved PKT MG mount, roof-mounted AT-4 ATGM, surveillance radar, improved fire control, etc.

BRDM-2-M98/Zbik-A/BRDM-2A: Upgrade with new turret, 12.7-mm MG, BAA EO sighting system, and MSTAR battlefield surveillance radar. The BAA system is similar to that on the Fennek light armored reconnaissance vehicle. This is a command vehicle for recon platoons or batteries. It has modern digital communications for real-time data transmission.

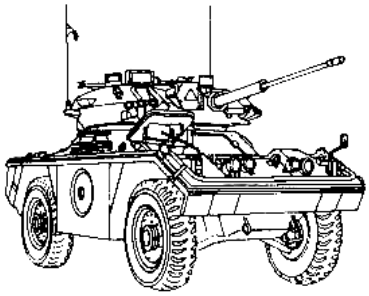
BRDM-2-M97/Zbik-B/BRDM-2B: Polish modernized BRDM-2 armored scout car version with more than 20 upgrades, such as a larger turret, 12.7-mm MG, ATGM, TV, LRF, night sensors, radar, drive train upgrade options, and space redesign.

Other countries, including Russia, the Ukraine, Belarus, Czech Republic, Serbia, and Slovakia have upgraded this vehicle.
BRDM-2A: Russian upgrade version with a higher HP engine and other mobility improvements.
BRDM-2SMD or -2D: Upgrade with 145-hp engine and other changes.
BRDM-B: Czech Upgrade with overhead turret, 12.7-mm MG, TV/thermal sight, space increases for 6, and new engine.

The ATM masted turret can be fitted to a BRDM-2 sensor vehicle, and can be used as a sensored overhead weapon station on combat recon and AT variants of the BRDM-2 (see pg 6-68).

NOTES
These systems represent a variety of recon vehicles, including BRDM-B, BRDM-2 M96i, BRDM-2/99, BRDM-2SMD, Fennek, Eagle II, VBL sensor recon version, and other contemporary designs.

British Armored Scout Car Fox



Weapons & Ammunition Types	Typical Combat Load
30-mm auto-cannon	99
HEI-T,	(est) 66
APDS-T, APSE-T	33
7.62-mm coax MG	2,600

SYSTEM
Alternative Designations: FV721
Date of Introduction: 1973
Proliferation: At least 3 countries

Description:
Crew: 3
Troop Capacity: 0
Combat Weight (mt): 6.12
Chassis Length Overall (m): 4.17
Height Overall (m): 2.20
Width Overall (m): 2.13
Ground Pressure (kg/cm^2): INA
Drive Formula: 4 x 4

Automotive Performance:
Engine Type: 190-hp Gasoline
Cruising Range (km): 434
Speed (km/h):
- Max Road: 104
- Max Off-Road: INA
- Average Cross-Country: INA
- Max Swim: 5.23

Fording Depth (m): 1.0 Unprepared

Radio: INA

Protection:
Armor, Turret Front (mm): Resistant to heavy MG (NFI)
Applique Armor (mm): N/A
Explosive Reactive Armor (mm): N/A
Active Protective System: N/A
Mineclearing Equipment: N/A
Self-Entrenching Blade: N/A
NBC Protection System: N/A
Smoke Equipment: 2 x 4-barrel smoke grenade launchers

ARMAMENT
Main Armament:
Caliber, Type, Name: 30-mm auto-cannon, Rarden L21
Rate of Fire (rd/min): 80-90 cyclic (1-6 round bursts)
Loader Type: Feed tray, manual clip-fed (3-round clips)
Ready/Stowed Rounds: INA
Elevation (°): -14/+40
Fire on Move: INA

Auxiliary Weapon:
Caliber, Type, Name: 7.62-mm machinegun L7A2
Mount Type: Coax
Maximum Aimed Range (m): INA
Max Effective Range (m): INA
Fire on Move: Yes
Rate of Fire (rd/min): INA

ATGM Launcher: N/A
Firing Ports: None

FIRE CONTROL
FCS Name: INA
Main Gun Stabilization: N/A
Rangefinder: N/A
Infrared Searchlight: N/A
Sights w/Magnification:
Gunner:
- Day: SPAV L2A1, 5.8/1.6 x
  - Field of View (°): 8/28
  - Acquisition Range (m): INA
- Night: L2A1, II sight
  - Field of View (°): INA
  - Acquisition Range (m): INA

Commander Fire Main Gun: No

VARIANTS
None of the variants have been fielded.

MAIN ARMAMENT AMMUNITION
Caliber, Type, Name:
30-mm APDS-T, L14A2
- Maximum Aimed Range (m): 1,500
- Max Effective Range (m):
  - Day: 1,000
  - Night: INA
- Tactical AA Range: INA
- Armor Penetration (mm KE): 40 (RHA, 45°) at 1,500 meters

Caliber, Type, Name: 30-mm HE-T, L13A1
- Maximum Aimed Range (m): 2,000
- Max Effective Range (m): INA
- Tactical AA Range: INA
- Armor Penetration (mm): N/A

Other Ammunition Types: APSE-T (AP Secondary Effects-T L5A2). The gun can fire the KCB (Oerlikon) family of munitions.

NOTES
These vehicles have been phased out of British service.

Russian Armored Scout Car BRDM-2

BRDM-2 with auxiliary wheels lowered

Weapons & Ammunition Types	Typical Combat Load
14.5-mm machinegun	500
API, API-T, I-T	160
HE-T	340
7.62-mm coax MG	2,000
Heavy ball, I-T, Light ball, Ball-T, API-T	

SYSTEM
Alternative Designations: GAZ 41-08
Date of Introduction: 1963
Proliferation: At least 45 countries
Description:
Crew: 4
Troop Capacity: 0 (for this configuration)
Combat Weight (mt): 7.0
Chassis Length Overall (m): 5.75
Height Overall (m): 2.31
Width Overall (m): 2.35
Ground Pressure (kg/cm^2): INA
Drive Formula: 4 x 4 (+ 4 auxiliary wheels)

Automotive Performance:
Engine Type: 140-hp Gasoline
Cruising Range (km): 750
Speed (km/h):Max Road: 95
Max Off-Road: INA
Average Cross-Country: INA
Max Swim: 10
Fording Depths (m): Amphibious

Radio: R-123

Protection:
Armor, Turret Front (mm): 10
Applique Armor or Explosive Reactive Armor (mm): N/A
Mineclearing Equipment or Self-Entrenching Blade: N/A
Active Protective System: N/A
NBC Protection System: Collective
Smoke Equipment: N/A

ARMAMENT
Main Armament:
Caliber, Type, Name: 14.5-mm Machinegun KPVT
Rate of Fire (rd/min): 150 practical/600 cyclic
Loader Type: Belt feed
Ready/Stowed Rounds: 500/0
Elevation (°): -5 / +30
Fire on Move: Yes

Auxiliary Weapon:
Caliber, Type, Name: 7.62-mm (7.62x 54R) Machinegun PKT
Mount Type: Coax
Maximum Aimed Range (m): 1,500
Max Effective Range (m):
Day: 1,000m / 400-500 on the move
Night: N/A
Fire on Move: Yes
Rate of Fire (rd/min): 250 practical / 650 cyclic in 2-10 round bursts

ATGM Launcher: Some BRDMs may include an AT-4 launcher and ATGMs for dismounted self-defense.
Firing Ports: INA

FIRE CONTROL
FCS Name: N/A. There is no gun stabilization or rangefinder.
Infrared Searchlight: INA
Sights w/Magnification:
Gunner:
Day: PP-61AM
Field of View (°): 23
Acquisition Range (m): 2,000
Night: N/A
Commander Fire Main Gun: No

VARIANTS
BRDM-2 has been used as the base chassis for a variety of vehicles.

National War College Photo

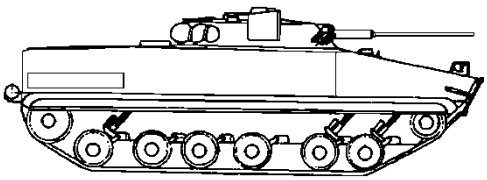
Antitank guided missile launcher vehicles:
9P122: Variant with 6-rail AT-3 ATGM launcher
9P124: Variant with 4-rail AT-2 MCLOS ATGM launcher
9P133: Variant with 6-rail AT-3C SACLOS ATGM launcher
9P137: Variant with 5-rail AT-5 ATGM launcher
9P148: Variant with 5-rail AT-4 or AT-5 ATGM launcher.
BRDM-2Rkh: NBC reconnaissance vehicle
BRDM-2U: Command variant without a turret
SA-9: SAM system transporter-erector-launcher vehicle

MAIN ARMAMENT AMMUNITION
Caliber, Type, Name:
14.5-mm API-T, BZT-44M
Maximum Aimed Range (m): 2,000
Max Effective Range (m):
Day: 2,000
Night: INA
Tactical AA Range: 2,000
Armor Penetration (mm KE): 20 at 1,000 m/30 at 500 m

Other Ammunition Types: 14.5-mm API, I-T, HE-T Type MDZ

NOTES
The auxiliary wheels can retract for easier road movement, or lowered for difficult terrain. The unit may be removed for more interior space.

Russian Combat Reconnaissance Vehicle BRM-3K



BRM-3K with radar retracted in hull

Weapons & Ammunition Types	Typical Combat Load
30-mm auto gun	500
HE-I & Frag-HE-T	340
APDS, APFSDS-T	160
7.62-mm coax MG	2,000

SYSTEM
Alternative Designations: Rys (Russian for Lynx), Model 501
Date of Introduction: 1990
Proliferation: At least 1 country
Description:
Crew: 6 (2/4)
Combat Weight (mt): 19.6
Chassis Length Overall (m): 6.10
Height Overall (m): 2.65
Width Overall (m): 3.15
Ground Pressure (kg/cm^2): 0.62

Automotive Performance:
Engine Type: 500-hp Diesel
Cruising Range (km): 600
Speed (km/h):
- Max Road: 70
- Max Off-Road: 45
- Average Cross-Country: 35
- Max Swim: 10

Fording Depths (m): Amphibious

Radio: R-163-50U UHF, R-163-50K HF, R-163-10U (dismounts)
Transmission range: 100 km moving, 350 stationary

Protection:
Armor, Turret Front (mm): 30-35 mm (front glacis)
Applique Armor (mm): Yes on turret
Explosive Reactive Armor (mm): Available
Mineclearing, self-entrenching, active protective systems: N/A
NBC Protection System: Collective
Smoke Equipment: 6 Smoke grenade launchers, VEESS

ARMAMENT
Main Armament:
Caliber, Type, Name: 30-mm automatic gun, 2A72
Rate of Fire: 350 rd/min (cyclic) in bursts
Loader Type: Dual-belt feed
Ready/Stowed Rounds: 500/ 0
Elevation (°): -5 to + 60
Fire on Move: Yes

Auxiliary Weapon:
Caliber, Type, Name: 7.62-mm machinegun, PKT
Mount Type: Turret coax
Max Effective Range:
- Day: 2,000 m
- Night: 1,200-1,500 passive/2,000 active

Fire on Move: Yes
Rate of Fire (rd/min): 250 practical / 650 cyclic, in 2-10 rd bursts

Firing Ports: 1 on each side

FIRE CONTROL
FCS Name: BPK-2-42
Main Gun Stabilization: 2-plane, 2E52-1
Rangefinder (m): 1D14 laser (7.3x and 18x sights) daylight 10,000
Sights w/Magnification:
Gunner:
- Day: BPK-2-42
  - Field of View (°): 8
  - Acquisition Range (m): 4,000 (est)
- Night: 1PN71 TV linked thermal sight (3.7x/11.5x)
  - Acquisition Range (m): 5,000 recognition

Commander Fire Main Gun: INA

OTHER ONBOARD SENSORS:
1PN61: Night observation device. Using its active laser pulse illuminator (laser radar), acquisition range is 5 km (3 km identification). In passive mode the generation II (7x) sight has a night acquisition range of 1.2-1.5 km.
PSNR-5M/1RL33-2: Radar in operating band J, and detection ranges: 3.0 km against personnel, 12.0 against moving vehicles. A simple upgrade to the Kredo-M1 modernized version (pg 4-30) extends range to 32 km.
Navigation: TNA-4 navigation system, 1G50 gyrocompass

VARIANT
BRM-3K is a variant of BMP-3 with a steel hull.

BRM-3K/Kredo 1: A version of the CRV has been seen with a 2-3 m mast and Kredo-1 radar (pg 4-30). The Catherine 2 gen thermal sight extends night range to 5-7 km. A 1D22 laser target designator ranges 7 km. TV sight and digital transmission system integrates remote sensor nets to recon command vehicles and HJ-62 long-range sensor vehicle.

MAIN ARMAMENT AMMUNITION
Caliber, Type, Name:
30-mm APDS
- Maximum Aimed Range (m): 4,000 (est)
- Max Effective Range (m):
  - Day: 2,500
  - Night: 1,200-1,500 passive/ 2,500 active
- Tactical AA Range: 4,000
- Armor Penetration (mm KE): 25 (RHA) at 60° 1,500 m

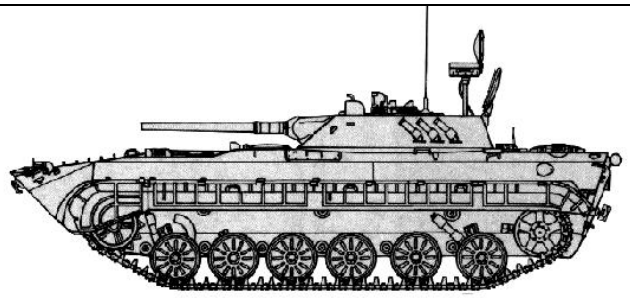
30-mm APFSDS-T M929
- Maximum Aimed Range (m): 4,000 (est)
- Max Effective Range (m):
  - Day: 2,500+
  - Night: 1,200-1,500 passive/2,500+ active
- Tactical AA Range: 4,000
- Armor penetration (mm KE): 55 (RHA) at 1,000 m
  45 at 2,000 m

30-mm Frag-HE
- Maximum Aimed Range (m): 4,000
- Max Effective Range (m):
  - Day: 4,000
  - Night: 1,200-1,500 passive/ 3,000+ active
- Tactical AA Range: 4,000
- Armor Penetration (mm): INA

Other Ammunition Types: 30-mm HEI-T, AP-T

NOTES
A vehicle with Kredo M1/Kredo-1 radar upgrade represents modern combat recon vehicles, such as 2T/Stalker, Fennek, TRACER, etc.

Russian Combat Reconnaissance Command Vehicle BRM-1K



Weapons & Ammunition Types	Typical Combat Load
73-mm gun	20
HEAT	(est) 10
HE	10
7.62-mm coax MG	2,000

SYSTEM
Alternative Designations: BMP M1976/2
Date of Introduction: 1976
Proliferation: At least 3 countries
Description:
Crew: 4 (with addition of a navigator)
Troop Capacity: 2 passengers
Combat Weight (mt): 13.3
Chassis Length Overall (m): 6.74
Height Overall (m): 2.15
Width Overall (m): 2.94
Ground Pressure (kg/cm^2): 0.57

Automotive Performance:
Engine Type: 300-hp diesel
Cruising Range (km): 600
Speed (km/h):
Max Road: 65
Max Off-Road: 40-45
Average Cross-Country: INA
Max Swim: 7
Fording Depth (m): Amphibious
Radio: R-173, R-130, 2x R-148 man-portable, R-014D telegraph

Protection:
Armor, Turret Front (mm): 19-23
Applique Armor (mm): Available
Explosive Reactive Armor (mm): Available
Active Protective System: N/A
Mineclearing Equipment: N/A
Self-Entrenching Blade: N/A
NBC Protection System: Yes
Smoke Equipment: VEESS

ARMAMENT
Main Armament:
Caliber, Type, Name: 73-mm smoothbore gun, 2A28/Grom
Rate of Fire (rd/min): 7-8
Loader Type: Autoloader
Ready/Stowed Rounds: 20 / 0
Elevation (°) : -4/+33
Fire on Move: Yes, but only 10 km/h or less (est)

Auxiliary Weapon:
Caliber, Type, Name: 7.62-mm (7.62x 54R) machinegun PKT
Mount Type: Coaxial
Maximum Aimed Range (m): 1,300
Max Effective Range (m):
Day: 1,000 / 400-500 on the move
Night: 800
Fire on Move: Yes
Rate of Fire (rd/min): 250 practical / 650 cyclic, in 2-10 round bursts
Firing Ports: 1 on each side, 1 in left rear door
Other Weapons: Two man-portable SAM launchers may be included.

FIRE CONTROL
FCS Name: INA
Main Gun Stabilization: No
Rangefinder: Laser
Infrared Searchlight: Yes
Sights w/Magnification:
Gunner:
Day: 1PN22M2, 8x
Field of View (°): 15 (est)
Acquisition Range (m): INA
Night: 1PN22M2 II channel, 6x
Field of View (°): 6 (est)
Acquisition Range (m): 800-1,000, based on light

SENSORS/COMPONENTS
Onboard Sensors BRM-1K:
Navigation: 1G25 gyrocompass and 1G13 gyro course indicator Fire Sight: 1PN22M2 above is also used for reconnaissance.
The Russian Alis or Sanoet thermal gunner's sight can be installed.
Laser rangefinder : 1D8
Radar: PSNR-5M battlefield surveillance radar (pg 4-30)
Operating Band: I
Detection Range (km): 10-15 vehicles
3-5 personnel

Dismount Sensors:
Passengers may dismount from BRM-1K and will dismount from BRM-1 to form an alternate reconnaissance post. Dismount sensors include laser rangefinder FCS and thermal binoculars.

VARIANTS
BRM-1: Baseline armored reconnaissance vehicle (BMP M1976/1).
BRM-1K: Added smoke grenade launchers, comms (R-130, R-014D telegraph), and PSNR-K radar (pg 4-30). Virtually all BRM-1s were upgraded to the BRM-1K standard, with PSNR-5M radar.

MAIN ARMAMENT AMMUNITION
Caliber, Type, Name: 73-mm HEAT-FS, PG-9
Max Aimed Range (m): 1,300
Max Effective Range (m):
Day: 800, but 600 or less on the move in 2-4 rd bursts
Night: 800
Tactical AA Range: INA
Armor Penetration (mm CE): 335 (RHA)

Other Ammunition Types: OG-9, OG-9M and PG-15VNT HEAT-FS, (Tandem HEAT). See BMP-1 (pg 4-28)

NOTES
Derived from BMP-1, vehicle has a 2-man turret and additional sensors. BMP-1 options (pgs 3-27 and 28) fit BRM-1 and -1K.

Chinese HJ-62C Sensor Reconnaissance Vehicle

HJ-62C with mast in raised position

Weapons & Ammunition Types	Typical Combat Load
12.7-mm Machinegun	1,120
APDS, API, API-T,	500
HE-T, HEI	620

SYSTEM
Alternative Designations: Type 89 reconnaissance vehicle
Date of Introduction: 1990
Proliferation: At least 1 country. Represents Czech Snezka, Canadian LAV-RECCE, Russian Credo-S, and other reconnaissance vehicles with elevated sensor pods
Description:
Crew: 4 est
Platform: Chinese Type 89 APC. Vehicle data is for APC
Combat Weight (mt): 13.60
Chassis Length Overall (m): 6.13
Height Overall (m): 2.59
Width Overall (m): 3.06

Automotive Performance:
Engine Type: 320-hp Diesel
Cruising Range (km): 500
Speed (km/h):
Max Road: 66
Max Off-Road: 40
Average Cross-Country: INA
Max Swim: 6.0
Fording Depths (m): Amphibious

Radio: HF/VHF, digital, SATCOM, encryption (est)

Protection:
Armor, Turret Front (mm): 14, front glacis
NBC Protection System: Yes
Smoke Equipment: No. Smoke grenade launchers 2x4 available

ARMAMENT
Main Armament: INA, 12.7-mm MG available as noted.
Caliber, Type, Name: 12.7-mm (12.7 x 108), heavy MG, Type 54
Rate of Fire (rd/min): 80-100 practical/600 air targets in bursts
Loader Type: Belt feed
Ready/Stowed Rounds: INA
Elevation (°): -5 to +85
Fire on Move: Yes

FIRE CONTROL
FCS Name: N/A
Sights w/Magnification:
Gunner:
Day: Open ladder sight, optical sight, NFI
Field of View (°): INA
Acquisition Range (m): 2,000
Night: N/A
Commander Fire Main Gun: No

SENSORS: The following represent capabilities of state-of-the-art specialized sensor systems with elevated sensor pods.
Radar: Acquisition and tracking radar similar to current western radars (such as Dutch Signaal GB-Scout or the Israeli EL/M-2140).
Detection range (km): 8-12 man, 17-25 LAV, or 25-30 tank/helicopter
EO sensors: 24-32x with optical and digital zoom (est)
Day: TV, range 5 km/12 km detection with digital zoom (est)
Night: Imp 1st Gen FLIR 5 km recognition range/7 detection est
Other ISR: LTD designation range 7 km/LRF range 15-20 km, digital data transmission with multicolor graphic displays (inc GPS) on digital terrain map overlay. ISR net capability will include links to UAVs, UGSs, and other remote sensors for integration and transmission of common picture.

VARIANTS None

MAIN ARMAMENT AMMUNITION
Caliber, Type, Name:
12.7-mm, APDS (Tungsten Core), Type 54
Max Aimed Range (m): 2,000 (est)
Max Effective Range (m):
Day: 1,500 vehicles, 1,600 aircraft
Night: INA
Tactical AA Range: 1,600
Armor Penetration (mm): INA

Other Ammunition Types: Type 54 API, API-T, Russian Duplex/Duplex-T, Incendiary-T, HE-T Type MDZ, HEI Type ZP

NOTES
An upgrade capability currently available for selected reconnaissance vehicles is an auto-tracker for the EO system. Examples of auto-trackers are in the Crotale, Russian Sosna, Stalker and BMP-3M IFV, Japanese Type 90 tank, and the Israeli Merkava 4 tank.

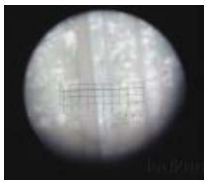
Sensor Technologies for Tactical Ground Forces

Reconnaissance units use a mix of high and low technologies. As noted in FM 7-100.2, Opposing Force Tactics, forces may perform tactical reconnaissance using troops with specially designed reconnaissance assets, as well as infantry soldiers assigned from maneuver units. Sensors today are spanning wider segments of the electromagnetic spectrum while integrating C2, navigation systems, data processing, and fusing technologies. Developers offer more compact packages, platforms, sensor integration, and mobility systems for greater situational awareness, better operational security, and shorter response time at all force echelons.

Reconnaissance starts with *location and navigation*. These include survey instruments (e.g., Bulgarian PAB-2A theodolite), aiming circles or goniometers, global position system (GPS) receivers, maps, compasses, terrain data, and inertial guidance systems. Commercial units such as Magellan hand-held GPS units are sufficient for most forces. In-viewer navigation data for laser rangefinders (such as the Azimuth LIGHT add-on GPS module) expand the utility of graphic displays. Improved communications with digital interface aid coordination for precise navigation.

Handheld GPS II

The primary single sensor on the battlefield is still the human eye; but it is getting more help. Second most proliferated of all sensors are sights for weapons, employed throughout the force for aiming and surveillance. See Chapter 1 (Infantry) for discussions of day and night weapon sights. All recon forces use *optics* (sights, binoculars, and telescopes). These operate in the visual light (0.4-0.75μm) band of the electro-magnetic (EM) spectrum - see below. Binoculars vary in features and magnification. Most models, e.g., Zeiss or Leupold, zoom to 7-12 power). For long-range day acquisition, the OPFOR uses spotting telescopes ("spotter scopes" such as Celestron and Swarovski models), with zoom to 60+ power. Features include anti-fogging lens coatings, camouflage netting, and tripods for stable long-range viewing. Soldiers can use binocular periscopes like the German RWDL for covert viewing.


Scope View

Celestron Scope

Night time observation systems which operate in the visual band light spectrum are all daylight observation systems, such as the human eye. Therefore they require visual light illumination to see in that band. As noted in Chapter 2 section *Infantry Weapon Night Sights*, presence of ambient light such as starlight, moonlight, or street lights enables the average soldier to see some distance (average resolution ranges from 50m in close terrain to 200m or more in open, dependent on lighting, background, terrain, enemy activity, etc.). Illumination support equipment includes spotlights, flashlights, and pyrotechnics, such as grenades, illumination rounds, etc. Specialized tactical devices are available, such as the Universal Tactical Light, which can be mounted on weapons and is triggered near the weapon trigger. Fires or other improvised lighting offer illumination support. Generally, the OPFOR will not use artificial illumination in a combat zone until a fire fight is underway, to ensure operational security.

UTL

In recent years optical viewers are being supplemented or supplanted by *electro-optical* (EO) systems. This technology has seen the most growth and proliferation among reconnaissance sensors. These use a camera to convert an image into a digital electronic signal, which is sent to a display circuit (e.g., photocathode tube or micro-channel plate) for viewing. Optical zoom lens units are still critical. But the EO cameras require almost no focal length or mirrors, reducing length and bulk. Polymers and composites provide light and ruggedized housings, ergonomic units that are easier to hold, and image processing/transmission capabilities for rapid exploitation and dissemination. Features such as electronic zoom can link with zoom lenses to yield overall magnification of 84 X or more and rapid detection at 10+ km for selected targets (line-of-sight permitting). Day and night use EO technologies include television (TV) cameras, which transform video imagery into an RF signal, and transmit it to a receiver and display unit. Applications include tripod surveillance cameras and aircraft sensor pods which can acquire targets at 10-30+ km. Larger mounts such as vehicles and aircraft can fit more powerful sensors with longer range, better resolution, and longer transmission ranges.

ITT Night quest

ELECTRO-MAGNETIC SPECTRUM AND SENSOR TECHNOLOGIES			
LIGHT BAND	ALSO CALLED	MICRONS	TECHNOLOGY
Ultraviolet	UV, Black light	0.01 - 0.4	Mercury arc
Visible Light	Daylight	0.4 - 0.75	Eye, Optics, TV, CCD
Near Infrared	NIR	0.75 - 1.3	CCD, II, Active IR
	Short-Wavelength IR	1.3 - 3	Active IR
Mid-Infrared	Mid-Wavelength IR	3 - 6	Thermal
Far Infrared	Long-Wavelength IR	6 - 15	Thermal/FLIR

All night-time observation systems which operate outside of the visual spectrum are EO systems. Band parameters appear to vary widely in publications, but are as noted above. Technologies include CCD (as noted below), which offers some capability during dawn and dusk and periods of adverse weather (aka. low light level). Other technologies are active infrared (IR), image intensifiers (II), and thermal imagers (TI). Fusion of a variety of sub-component improvements offer night vision devices that are clearer, more compact, more resistant to glare and blooming, require less power and longer service, with new features such as laser pointers, better zoom and magnification, and electronic zoom. Commercial grade viewers offer affordable alternatives to military grade systems. Many features come from civilian systems such as video camcorders. *Electronic zoom* (EZ) can expand images to multiply the optical zoom by a factor of 3-8, resulting in magnification of 60-100+ x in affordable systems, and doubling or tripling acquisition range. Although image clarity in highest EZ mode may suffer, EZ's expanded pixel

size facilitates earlier detection at greater range for reconnaissance units, providing increased range and time budget for cueing other sensors, assessing, and responding to alerts.

Night Hawk

An inexpensive digital technology is *charged-coupled device* (CCD), used in most video camcorders and some cameras, and operating in the near IR (0.75-1.3μm+) band. They generally lack ability to see in absolute darkness. But most (e.g., Bushnell Night-hawk) offer superior day vision, video capability (short videos in cameras), and use in "low-light-level" (LLL) conditions. One set of 20-80x CCD binoculars is claimed to have a day range of 10 km (8 for man-sized targets).

The following table notes the evolution and variety of viewing sensors which meld EO and other technologies, and which are used by reconnaissance as well as other ground force units.

EVOLUTION OF OPTICS AND EO SENSORS: GROUND FORCE APPLICATIONS

Surveillance and Observation	Add Technology	Weapons Target Acquisition
	Optics (Lenses and Reticles)	
Binoculars, theodolites, telescopes	← →	Day sights (telescopes, collimators)
	Electro-optics	
Day/night viewers Digital cameras and Video recorders	← →	Day and night sights
	Laser Technology	
Laser rangefinders Laser illuminators or "radars"	← →	Laser aim sights and pointers Optical augmentation for FCS
	Navigation/Location Unit (GPS, computer, LRF, goniometer)	
Digital survey sets	← →	LRF fire control systems
	Rocket Motor/Airframe	
UAV (drone, RPV)	← →	Fiber-optic Guided Missiles Attack UAVs Laser-homing missiles
	Artillery/Grenade/Canister Launcher	
Micro-UAV Canister launch UAV Artillery/rocket launch UAV TV recon grenades, projectiles, rounds	← →	Attack UAVs Laser-homing munitions, rockets Laser target designators
	Remote Cameras/Acoustics (motor drive actuator-controls)	
Unattended ground sensors (cameras) Multi-sensor pods (vehicles/UGS) Passive IR (autotracker) alerters	← →	Sensor units for side-attack mines Sensors on unattended ATGLs
	Robotic Cameras (robotic chassis)	
Unmanned ground vehicles (UGVs)	← →	UGVs with guns/ATGLs/ATGMs Robotic mines

Night *Infrared viewers* operating in the 0.75-2.0 μm band employ active light sources such as IR spotlights. Use of this technology has declined because active emitters are easily detectible by adversaries with night vision systems. Although many IR systems can operate without active lights, passive mode range is limited. Therefore, this technology has limited practical use.

The passive night technology known as *image intensifier (II*, or *imaging IR*) is explained in Chapter 1 section *Infantry Weapon Night Sights*. This technology is now into its 3rd generation, with some new technologies claimed to be "4th generation". An explosion of products in this EO arena is fueled by requirements from hunters, police, and military customers. Night vision goggles (NVGs - e.g., Malaysian NG-30) continue to be widely used for hands-free operations (driving, etc.) at night. Although more affordable commercial systems ($200+), such as Night Hawk, may not range as far or offer as many features as the most expensive military systems, II is sufficient for night-time needs of hunters, and tactical and support personnel, now and into the future. Products include viewers, scopes, cameras, camcorders, and night adaptors for day systems such as weapon scopes, laser rangefinder binoculars, and periscopes. Some cameras fuse II and CCD together for effective and affordable day/night use.

Gen 3 II Image

NG-30 II Binocs

Many so-called night scopes, night viewers, and NVGs, are not weapons sights; but they can be used to assist in accurate firing. They can detect targets and queue new targets for weapons. Observers, gunners, or assistant gunners with NVGs can direct weapons to the spot. A weapons gunner with NVG and visual light pointer, flashlight, etc., can illuminate or "designate" targets to direct fires for a unit that cannot afford night vision for other members. An IR laser pointer for a unit with NVGs offers massive fires with near complete surprise against a target lacking night vision.

Night Vision Binoculars

The newer night vision technology which is challenging II in popularity and surpasses it in range and resolution is *thermal imagery (TI)*. In Chapter 2 and the section noted above, TI is explained. Thermal imagers can see any object with temperature above background objects; so it can see in absolute darkness. Thermal imaging, however, has limitations:

Improved II Image

- It does not necessarily convert images into shapes which most soldiers readily recognize based on our visual frame of reference.
- At various times of day, temperature changes from solar heating and from cooling may alter shapes and render objects invisible.
- Lack of heat among selected materials means that TI may not see objects in foreground or background, which help to provide contrast and context.
- Historically, thermal imagers have generally been bulkier than their II counterparts. They also require bulky and noisy coolant bottles and power supplies.
- Thermal imaging systems are usually much more expensive than most II sensors.

The advantages of thermal imagers (TI) are significant. They are particularly sensitive to temperatures of warm-blooded animals, vehicle engines, solar-heated metal surfaces, and running gear from vehicles which had been moving. Even after vehicles stop, their heat renders a clear TI image for an hour or more. Thus thermals offer easier and faster detection than II. Most 1st generation thermals used silicon detectors. Many thermal imaging systems use cameras operating in the mid-IR band (3-6μm), with ranges to 2-3 km. Although mid-IR has some advantages, later thermal cameras in the far-IR band (6-15μm), often called *forward-looking infrared (FLIR)*, offer superior clarity and range (3-4 km) for most applications. The superior range of TI over II night systems establishes this as the preferred technology for high priority weapons and sensors. As production and competition increased, cost has declined to the point that TI is affordable for priority weapons such as ATGM launchers, tanks, and infantry fighting vehicles. In Tier 1 and Tier 2 forces, TI is commonly used in reconnaissance vehicles.

Thermal Image

Thermal imagers have seen many improvements in processing and display technologies. Like II, TI can be categorized by generation. The current proliferation of mercury-cadmium-telluride (HgCdTe), detectors, and SPRITE detector staring arrays has extended range (5+ km) and discrimination in 2nd gen thermal imagers. A recent development, uncooled thermal imager, takes away the bulky coolant bottle. Recently, 3rd generation thermal (with II and FLIR fuzed in one clear image), has begun to appear. Reductions in size for microcircuits and imagers have permitted development of portable thermal viewers. In Tier 1 and Tier 2 reconnaissance and selected other units, key sensors and key dismounted personnel will have Sophie thermal binoculars with this technology upgrade. For reconnaissance, ATGM thermal sights may be used for battlefield surveillance. Of course, smaller and less costly systems offer less range and clarity than larger systems mounted in reconnaissance and combat vehicles.

Sophie Binocular LRF

Miniaturization of *camera technologies* and the spread of commercial applications offer fertile ground for new military reconnaissance applications. A number of EO sights and viewers, such as the commercial Bushnell Nighthawk CCD Viewer and Digital Imaging System 22x60 spotter scope offer video output which feed images to digital transmission systems and computers or goniometer systems. These cameras also permit observers to position themselves out of view while monitoring the area. Military systems such as the Aselsan thermal Portable Weapon Sight offer video output for surveillance. Simpler applications of this technology include spy cams (including commercial "nanny-cams", such as the commercial XCam2 or British Spy Vision) which can monitor close in areas such as urban streets and transmit images. The breakthrough technology is CMOS (complementary metal-oxide semiconductor) transistors, for tiny cameras. The simplest tactical applications use hand thrown cameras which require only occasional attention such as Macroswiss, short range throwing camera. Other commercial products include digital cameras, camera cell phones, and binocular CCD imagers.

Macroswiss Camera

CMOS Spy Camera

Short-wave IR (1-3μm) COTS detectors used by industry may have military applications. These may be able to detect camouflage, and add background view like II sensors.

The addition of *lasers* to the battlefield has brought a new order of precision for measurement, location, and target acquisition. The fundamental laser-based instrument which has had the most effect is the *laser rangefinder (LRF)*. The most common use is to measure distances: for surveying in equipment, for self-location by measuring distances to registration points, or for measuring weapon firing distances to targets. Many fire control systems on crew weapons and combat vehicle weapons include an in-viewer LRF which feeds data into the FCS computer for target acquisition. For dismounted soldiers a common hand-held device is a binocular LRF, such as the Leica Vector or Aselsan LH-7800, which can precisely measure ranges out to 10 km. A few binocular LRFs such as the Eloptro LH-40C and Russian 1D18 can range targets as far as 20 km away; but range may be limited based on line-of-sight and size of the subject. Compact commercial units such as Bushnell Lytespeed with 1,000 m range are available for less than $300. Forces can use a LRF to map a battlefield area and all registration points, and then rely on the map and observers to quickly gauge enemy locations and call for fire.

Bushnell Lytespeed

Another benefit of lasers in EO systems is increased responsiveness. The combination of lasers with optics, EO, acoustics, radars, and other azimuth-producing sensors mean that accurate location can be achieved without the need for a second azimuth or calculating by intersection. Getting a second azimuth is usually a time-consuming process which delays or precludes precise location of fleeting targets, e.g., moving formations. With one azimuth, a laser snap, and a simple ballistic computer, targets can be precisely located and engaged. The above table, EVOLUTION OF OPTICS AND EO SENSORS: GROUND FORCE APPLICATIONS, notes some of the applications of lasers for use on the modern battlefield.

A device which exploits the capabilities of LRFs to best effect is the *goniometer*. This device is used similarly to older aiming circles, while being more compact. It is surveyed into position on a tripod base with an azimuth viewer. Most are illuminated for night use, and have a GPS mount and simple computer (or programmable calculator) to calculate self location, direction, and elevation/deflection. Some link to a digital transmission system. Others have a system built in. A binocular LRF can be mounted on top to sight and range objects, targets and registration points. Night sights can be added for day/night use. The complex can be referred to as a *goniometer system*, a fire control system (Vectronix Mortar FCS-MORFIRE), forward observer system - FOS (OIP Delft), observation station (Leica Digital), targeting system (Sure Strike) or other names. It can be used for various recon roles. A modern goniometer-based LRF FOS for the OPFOR is the SG12 with GPS, Leica 21 LRF with 12 km range, thermal night sight, computer interface, and digital data transfer. Emplace time is < 2 min.

Sure Strike

An *aiming circle* can be used to achieve similar accuracies, but only when all of the separate components (LRF, GPS, computer, and digital transmission system) are present. Often a goniometer-based system can be more responsive, more quickly moved, and more consistently accurate. Any OPFOR aiming circle should be regarded as the base for an observation system. Most dismounted forces worldwide use aiming circle or goniometer-based systems. Because the

complex can be broken down and reassembled, it is fairly easy to carry. Armed with a goniometer system or modernized aiming circle-based system, reconnaissance personnel can observe the battlefield as well as call for lethal strikes without risking integrity of their mission.

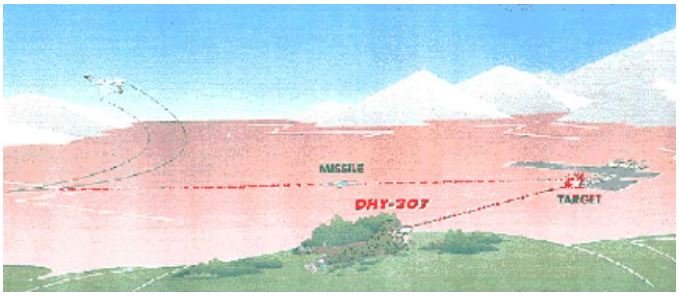
U.S. Aiming Circle

In the past reconnaissance ground units and forward observers could calculate target locations with accuracies in 100s of meters. With only optics, maps and estimated locations, errors were expected. Such a large error meant high ammunition expenditures to service targets. Part of the problem was self-location error. That error can now be almost eliminated. A dismounted observation post can locate targets with accuracy of 1-5 meters and quickly call for precise lethal fires. Observers with the U.S. Air Force used them to call in air strikes in Afghanistan. In the past reconnaissance personnel were often not used for the precise work of calling in fires. With this equipment, trained reconnaissance teams can call in precise fires on the enemy while far enough away to avoid a direct fire fight and continue their role of surveillance and reporting.

A variety of recent sensor systems can be fused into *multi-sensor suites*, which can employ sensors for day/night integrated detection, location, and target acquisition. Most suites are mounted on vehicles. However, suites can also be created by dismounted personnel in OPs linking components - cameras, radars, weapon sights, goniometers, computers, and digital data transmission systems. The Eloptro LH-40C LRF can link GPS for in-viewer digital data, and has a computer link for the viewer image with range, bearing, and elevation, permitting digital transmission and data fusion. This LRF can bypass a goniometer base for precise target location.

DHY-307 LTD

The next link in the evolution of lasers is the *laser target designator (LTD)*, or simply laser designator. The proliferation of laser-guided semi-active homing bombs, artillery and naval gun rounds, mortar projectiles, rockets, and antitank guided missiles (ATGMs) has spawned the spread of LTDs. The LTDs are coordinated to cast a laser beam at a target as a laser-homing munition approaches that target. The seeker directs the munition to "laser splash" on the target. Some LTDs, such as the Russian 1D26, can be carried by an operator. Most include a tripod mount, break down into sub-assemblies for easy carry by a team of two or three, and include a built-in LRF and built-in or added night sight. As the proliferation of laser-homing munitions extends to lower level units, smaller lightweight LTDs will be developed for carry by dismounted companies and squads. Laser-homing grenades for squad ATGLs have been developed and available for almost a decade.



Lasing a target with LTD to guide laser-homing bombs

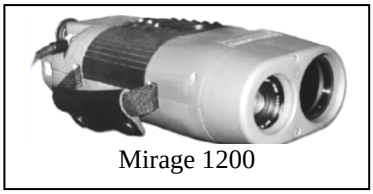
A modern trend is to use LTD-based fire control systems, such as the French DHY-307. A LTD thus replaces a goniometer as an OP base. A LTD FCS may have features such as an encoded beam for one hit per target, a signal coordinator on the firer (which times activation of the laser to avoid counter-measures), GPS, night sights and other components in goniometer FCSs. Most laser munitions can be used with most LTDs. Tiers 1 and 2 OPFOR observers in units firing laser-homing munitions have OPs with DHY-307-based FCSs (vs goniometer-based),

with a designation range of 10 km. A man-portable LTD may have a night range to 5 km, and accuracy to 1 m. Recon and AT unit observers also have LTD-based FCS to call in laser rounds.

Lasers are used in other sensor applications. As we noted in the Chapter 1 section *Infantry Weapon Day Sights*, lasers can be used in *laser aimers*. *Laser pointers* or "illuminators" are used to direct unit fires or point out features to others. Some display in the visual band. A number of night viewers include laser illuminators which provide sufficient IR ambient light to facilitate seeing even in starlight or no light conditions. Of course, laser aimers, pointers or illuminators actively emit light and offer risk of exposure to a prepared adversary. In that case they might be used only at the onset of a fire fight, and when the user unit expects to have fire superiority.

Laser Illuminator

A recent laser technology with great reconnaissance potential is the *laser locator* (also referred to as "laser radar" or LADAR, or when linked into weapons fire control systems as "optical augmentation"). This device employs a technology known as LIDAR ("light detection and ranging") to detect and measure ranges. It can operate in the active or passive mode. In the active mode, it employs a laser to scan in the observed sector, scanning in a band pattern similar to that of radar. The aligned IR viewer then looks for IR light generated by laser light reflected from optics and sights. Although the device operates in an active mode, the narrow nature of the laser beam limits beam spread beyond the scanned target. Passive use is more difficult, because it depends on use of light close to or behind the viewer in the right frequency, with sufficient brightness and the right angularity for the viewer to detect down-range reflections. Markings on target sight reticles, e.g., crosshairs generate more return ("retro-reflection") to designate location of weapons pointed toward the sensor. An example is the Mirage 1200 hand-held "lens detector", with range up to 1,200 m. Laser filters on optics can reduce the effectiveness of their detection. Reconnaissance vehicles and aircraft employ LADARs for imagery day and night use.


Mirage 1200

A long-used technique by reconnaissance units for detection of the enemy is the process of "triangulation". With two or more azimuths obtained from known locations, they can be intersected on a map to locate an object or enemy location. The process, however, has its limitations: time delay from obtaining two reports, errors in locating sensors in position to get those azimuths, and time delays in getting those azimuths. However, innovative linking of recent technologies can exploit this methodology in new ways. Precise self location with GPS, proliferation of computers, including laptops for dismounted troops, digital map displays, and digital data links permit fusing of data from different sensors across the battlefield Sensors that can exploit these technologies include acoustics and radars.

Acoustic sensors include multi-directional microphones, directional microphones, as well as sound-ranging arrays and vehicle arrays which intersect azimuths to locate sound sources (including guns, helicopters, and combat vehicles). Artillery sound-ranging systems such as Russian AZK-5 and AZK-7, Swedish Soras 6, and British HALO use microphones digitally linked to automated processors for rapid calculation of enemy fire locations. Sensitive microphones on various Israeli Helispot systems, including

HALO Microphone

autonomous acoustic vehicles, enable them to detect and locate enemy helicopters in-flight. British Pickett has been linked into air defense

MANPADS units. This technology can detect various guns, vehicles, and other systems with loud audible signatures. Improved error reduction with multiple microphones and improved signal processing algorithms facilitate responsive precision location with a relatively small acoustic array. A single microphone that cannot define sound direction can still be used to detect vehicles in an area and cue other sensors in a network to focus toward a particular road, valley, or avenue of approach. Thus acoustic sensors can trigger a wake-up signal to actuate sensor suites, permitting them to operate on much smaller power supplies for longer duration.

Radars are finding new applications. Battlefield surveillance radar mounts include tripods, carriage, weapon and vehicle mounts, and aerial platforms, even trees. Technologies such as miniaturization, millimeter-wave (MMW), improved power supplies, and links to laptop computers offer new radar applications, such as day/night FCS (see MT-12 antitank gun, MT-12R variant). Compact radars like Fara-1 offer man-portable carry, and attachment to weapons, such as automatic grenade launchers for fire direction. Slightly larger systems include the Thales Squire two-man radar system with 24-km operating range and portability in carry packs. Tripod-mounted radars such as Credo-1E can link to digital nets and be quickly emplaced or displaced.

Squire in Travel Mode

Squire Radar in Operation

One disadvantage of radars is that they actively emit. Thus electronic warfare (EW) and other systems can detect and attack them. Squire is a low probability of intercept (LPI) radar due to its extremely low peak power. Other LPI features include phased array with lower power levels for detectors, reduced side lobes, and operating frequencies outside of most radar intercept system bandwidths. The most common frequency bands for land radar systems have been I and J bands. But in recent years, new radar technologies have been fielded. Several forces use radars with LPI features to reduce intercept vulnerability. Airborne radar recon systems like Horizon use moving target indicator (MTI) and synthetic aperture radars (SAR), and Doppler processing with secure stand-off for missions. Millimeter wave (MMW) radars (30+ GHz) offer precise acquisition and fire control, compact size antennas, and lower signal detectability.

NATO Band	U.S. Band	Low-End Freq
D	L	1 GHz
E	S	2
F	S	3
G	C	4
H	C	6
I	X	8
J	Ku	10
K	K, Ka	20
L	—	40

The modern lethal battlefield, with increased lethality, mobility, day and night operations, and longer range coverage poses an increasing hazard to reconnaissance assets and personnel. Therefore, two other technology trends are on the increase - *remote sensors* and *robotic sensors*. Remote sensors are generally immobile, although they may be able to point in order to see as is required. A simple remote sensor is a *side-attack mine,* such as an antitank disposable grenade launcher placed at roadside and linked to an autonomous acoustic sensor unit, such as AJAX. Upon an adversary's approach along a road, the device will launch a grenade, thus audibly signaling the approach. Robotic sensors can relocate to perform their mission. Civilian applications have led to a wide variety of remote cameras, remote actuators on robotic systems, and use with unattended ground sensors (including acoustic, IR, seismic, tripwire-electronic, and magnetic). Key technology limitations, including detectability, power supply and battery limitations, and signal transmission inadequacies are being resolved. Use of fused sensors means more accurate, timely, and complete reports. Rechargeable batteries, acoustic/IR wake-up, miniaturization, increased sensor sensitivity, etc., make use of remote sensors and sensor suites practical and marketable.

Side-attack Mine

An expanding variety of motor-driven, operator signal or sensor-directed platforms, acoustic wake-up sensors, and longer-lasting power supplies permit use of *remote cameras* with limited operator presence to tip off a surveillance target. An example is the British Radamec 1000L system. Other applications include cameras which can be tethered from concealed vehicles and run off of vehicle power supplies. New technologies include passive *IR scanning cameras* with auto-track and alert algorithms (such as the French Sirene or British ADAD IR units) emplaced in battlefield zones to link into sensor nets and monitor sensitive avenues of approach, and unit flanks. Earliest uses are as air defense sensors, e.g., ADAD, Sirene, or Swedish IRS-700, which can use hand-carry monitor terminals.

ADAD Camera

Another sophisticated use of cameras is mounting of remote camera platforms on tethered *aerostat balloons* for beyond-line-of-sight surveillance. The Israeli TAOS system uses a gimbaled, stabilized, multi-sensor platform, which includes CCD and thermal cameras for day/night use. Radar and laser illuminator applications are optional. The ground station is a trailer.

Ground forces are adapting camera network technologies from commercial and military installation security nets to create *surveillance cameras networks*, which can monitor wide areas of the battlefield. Two candidates are Israeli CELTICS and TACS systems, which use cameras (including thermal imagers for night use), supplemented by other sensors. Other Israeli installation monitoring systems such as Israeli Gamma 2000 can be adapted for battlefield use.

Battlefield monitoring systems require the use of cable links or RF data transmission equipment, and display arrays, such as those in light armored vehicles converted as ground station modules. Digital communication and graphic display technologies support fused intelligence networks which can incorporate a wide variety of assets, such as reconnaissance vehicles and aircraft, UAVs, operational-strategic intelligence sources (such as satellite data, map data, and links to higher-level assets). Commercial data from cameras, video cameras, laptop computers, and camera phones can be used by military forces. Commercial imagery, improvised ground station terminals, TV, and internet can support real-time fused intelligence.

A form of remote sensor which dates back more than 40 years is the *unattended ground sensor (UGS)*. The U.S. employed UGS in Vietnam. These devices are dispersed in areas where enemy presence and movement are expected, in order to monitor activity in those areas. Among the earliest UGS are break-wire sensors, which would generate a signal when broken. Various UGS can monitor seismic, magnetic, and infrared and RF activity; but the most common UGS use acoustic. They can sleep to save energy, to awaken when distinctive signals such as vehicle sounds are present. Most UGS are small (a few centimeters to a few inches in size) and unsophisticated. Early improvised UGS consisted of tripwires and alarms. When tripped, modern UGS report a simple indiscriminate RF signal back to a monitoring station, such as a battlefield display in a ground station or a simple laptop computer. Relay systems may be required to forward the signal to the monitor. By analyzing the location and pattern of signals against a map, the operator is cued to initiate battlefield surveillance activities in the indicated area. Examples include the Thales Miniature Intrusion Sensor (MIS), and Rafael UGS. Current networks permit multi-sensor signal discrimination to reduce false alarms, such as from animals wandering through the area. Most UGS are manually emplaced, for best concealment and reception. Most UGS locations must be carefully selected in open areas (where they may be seen) or urban or defilade areas where the signal may be lost.

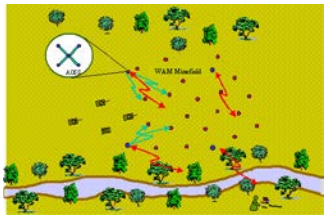
Current OPFOR use of UGS would primarily be to monitor large areas and cue surveillance networks. Cameras and other reconnaissance assets or personnel can easily be assigned for over watch of monitored areas. Larger UGS with multi-sensor processing for classifying targets may be located at key locations, such as road junctions and river crossing sites. These units may be 0.3 - 2 meters in size. Examples are ATE UGS, Steel Eagle, Gateway, and Boden-Sensor-Ausstattung (BSA). Thales CLASSIC 2000 features the complete network, with monitor, acoustic and other sensors, and cameras. It has been sold in over 39 countries for military, border control, police, and commercial applications. Roles for the system include perimeter protection, route monitoring, and area and point surveillance.

Gateway

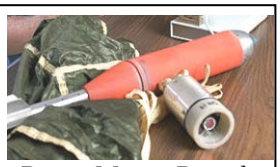
Steel Eagle

ATE UGS

Emerging UGS employments include linking to and activating mines and remote weapon systems, and autonomous cueing to precision targeting and the use of target signature data for use in target identification algorithms. A tested technology is "smart dust" or "motes", which can be disbursed from aircraft over large areas to track moving formations. Similarly, man-portable UAVs with UGS dispenser pods could seed terrain around small units and monitor activities outside of their view. The UGS will continue use as supplemental sensors in surveillance networks, rather than to replace current systems, vehicles, or personnel. Most remote sensors and sensor suites are hand-delivered.


UGS linked to Minefield

Another innovation is the *remotely-delivered sensor*. Several developers and manufacturers offer *reconnaissance rounds* which can be delivered by weapon systems. They include artillery rounds which transmit data back to monitors for acquisition, target location, and post-


Recon Mortar Round

mission battle damage assessment. The 81-mm Recon Mortar Round was successfully tested for this role. Other rounds are in development.

Camera munitions offer a low-cost way for small units and individual soldiers to obtain an immediate view "beyond line-of-sight" over the hill or behind foliage, with reduced risk of being seen. Israeli IMI recently displayed a version of the Refaim rifle grenade with a camera which can transmit pictures back to the launching unit as it descends on the target. The Israeli Firefly can be launched from a 40-mm under-barrel rifle grenade launcher. The display unit can use a digital radio and laptop terminal. Fiber-optic ATGMs use a camera and operator controls. In addition to the anti-tank role, their video footage can be used for analysis by recon units.

Robotic sensors consist of single or multiple sensors mounted on robotic or unmanned ground vehicle (UGV) chassis. Robots have been used to explore the ocean floor, other planets, and inaccessible areas of caves and volcanoes. Others have been used by police departments for surveillance in hostile situations, as well as to examine the Chernobyl nuclear plant during clean-up operations. Military versions include the tracked Matilda, with a day TV camera used in Afghanistan caves, and applications for clearing minefields, and checking for potential IEDs and NBC. The OPFOR can use them for surveillance and patrols in urban and defilade areas, or in open terrain requiring sensor movement for surveillance, but where troops are vulnerable. A simple and logical application is robots operating from reconnaissance vehicles or personnel concealed nearby. A robotic chassis has EO viewers for guidance and surveillance, such as a TV camera with an RF or cable link, GPS in-view readouts, a thermal or II night channel and LRF. A robot can carry other sensors (e.g., acoustic microphones, NBC samplers, even radar) and weapons. Other robot examples include the British tracked Wheelbarrow mine detection system, and the Giant Viper wheeled line charge launcher vehicle, which tows its line charge trailer. German Telerob produces tracked robots for industrial, police and military applications. The Russian SPC robot can employ various sensors. Robotic weapons can also be used as robotic sensors, especially as forward observers in areas covered by fire and minefields.

Robot at Chernobyl

Urbot

K100 UAV

The earliest robotic sensors on the modern battlefield were *unmanned aerial vehicles,* (see Vol 2, Ch 3). They can maneuver to perform missions using one or two modes, pre-programmed (drone), and operator control (remotely piloted vehicle - RPV). Recent UAVs may use both modes, pre-programmed en route to and from the surveilled area, and under operator control in the surveilled area. At the core of a UAV's utility are its TV camera and its ability to transmit images to a ground station. In recent years, attack UAVs and unmanned combat aerial vehicles (UCAVs) have begun to appear. But most UAVs are used for reconnaissance, or as extensions of or support to weapons system fire control. Reconnaissance has been greatly expanded with technology upgrades such as improved sensors, including day/night EO, synthetic aperture radars, in-viewer GPS for precise location, in-viewer LRF, MTI radars, and stabilized sensor pods with interchangeable sensor suites (See Volume II, UAV chapter). Other roles for UAVs

include: NBC reconnaissance, designating targets for laser-homing munitions, target acquisition, fire observation and adjustment, testing of air defense radars, and battlefield damage assessment.

Recently fielded and emerging technologies are expanding UAV battlefield applications:

- Light *man-portable UAVs* for use at battalion and below. Man portable or "backpack" UAVs (German Carolo, Russian Pustelga, French K100, etc.) enable dismounted infantry to carry their own airborne intelligence asset. Many can indeed be backpacked and launched by hand, from ground, or from fold-out ramps. Currently available on the internet is an SPI Company hand-launched E2 flying wing with a stable video image and day and night use cameras.

Carolo

- *Micro-aerial vehicles* (MAVs). These products of radio-control (RC) model plane technology permit dismounted troops to carry multiple sensors for multiple aerial recon sorties during surges. Some of these are not much larger than your hand. Most will be disposable or have a short use life.

Rotary-wing MAV

- Improvised UAVs include RC aircraft which can be used for OPFOR over-the-hill aerial recon missions. For details of RC aircraft, man-portable UAVs, and MAVs, see Vol 2, pg 4-3.

- UAVs for launch from vehicles include canister launchers mounted on combat vehicles, and versions for launch from robots (UGVs). The Israeli Skylite UAV can be hand-launched or canister launched from vehicles. French developers are looking at a canister launch UAV for the next LeClerc tank upgrade.

- UAVs launched from weapons. Examples include the Russian R-90 300-mm UAV rocket, launched by the 9A152-2 MRL prior to a fire mission against high precision targets. The rocket arrives at the strike area in seconds, and expends the UAV. The rocket can loiter for 30 minutes while transmitting imagery back to an artillery command and reconnaissance vehicle (ACRV), also used as a ground station. It can then confirm the target, correct fires, and select and locate new targets.

- A key application is the use of UAVs to direct lethal precision fires, and direct munitions to target using laser target designators (LTDs). These can substitute for soldiers or vehicles. The UAV can fly to areas inaccessible to other assets, and designate targets for the laser-homing seekers of laser-guided projectiles (including rounds from artillery, tanks, and naval weapons, rockets, bombs, and missiles, such as air-launched and ATGMs).

- The UAV field continues to expand, with new ideas from commercial applications used for industrial surveillance, inspection operations, environmental and climate research and monitoring. Ground station options for small recon UAVs include use of notebook computers and PDAs as terminals. Today, even a force limited by budget constraints and lacking a manned air force can have its own ground-based aerial reconnaissance capability. Many modern UAVs are rotary-wing designs for urban, foliated, and congested area use.

Technology limitations will continue to challenge reconnaissance operations. A critical factor for sensors is in the power supply requirement. Military force developers must balance the benefits from new technologies with increasing military budget challenges. Nevertheless, it is likely that new technologies and sensor applications based on other areas of the electromagnetic spectrum (such as the ultraviolet light band), new applications for existing sensors, and newly fused sensor technologies for military applications are imminent. Battery improvements such as lithium batteries and rechargeable batteries are matched with the use of reduced power micro-circuits with gallium arsenside and other micro-chip technologies. We are seeing increased use of solar panels to maintain battery charges and minimize down time.

Novel new commercial and military sensor applications continue to appear on the market. A sensor called the AimShot Heatseeker is offered in hunter publications. The device looks like a flashlight or a sight, and can be hand-held or mounted on a weapon. It gauges heat generated by objects such as animals or vehicles, but is not a sight. When pointed at a subject, this does not display an image, rather a reading on a bar graph. When a subject such as a person is detected, it can send an audible signal to earphones and show a high bar reading. The user can press a button for a laser pointer signal in the visual band, or in the infrared band when using NVGs. The device is less costly than most viewers or sights, and can be operated passively. Devices like AimShot, laser pointers, RC aircraft with cameras, digital cameras, etc., offer economical improvised sensors to supplement legacy military systems as reconnaissance assets for conventional military and other forces. Other sensors receiving research attention include ultra-wideband radars that can penetrate foliage, synthetic aperture radars that can be used day and night to produce three-dimensional images, tunable lasers, electrostatic sensors, and ground-penetrating radars.

Low technology forces will continue to use improvised sensor systems, such as trip-wires, remotely detonated mines, commercial hunting laser range-finders and NVGs, periscopes, mirrors for seeing around corners, RC aircraft with cameras, CCD cameras and camcorders, and weapon sensors (such as ATGM fire control) to supplement military reconnaissance systems.

Innovative military forces, even those with limited equipment budgets, can use niche technologies and aggressive manned reconnaissance units to field battlefield surveillance networks. These networks will be comprised of personnel, their variety of organic and assigned sensors, vehicles, UGS, remote sensors, UAVs, and the variety of other reconnaissance assets available. Effective equipment, sound organization and planning, commitment to the OE variables, and effective reconnaissance tactics can enable the OPFOR to gain greater situational awareness within their operational area, and to challenge enemy capabilities for tactical surprise.

France Ground Surveillance Radar RASIT / RASIT-E

SYSTEM
Alternative Designations: RASIT 3190B (Radar 'Acquisition de Surveillance Intermediare) RACIT E upgraded version, DRPT-5, Basir 110D (Iranian RASIT)
Date of Introduction: 1970s, 1990s (RASIT-E)
Proliferation: Algeria, Argentina, Australia, China, Egypt, Estonia, France, Germany, Iraq, S. Korea, Libya, Morocco, Nigeria, Norway, Pakistan, Saudi Arabia, Sudan, Thailand, Tunisia, Venezuela, Zimbabwe, (possible Iranian reversed engineer version)

Description:
Crew: 1 or 2. System can be carried by 4 Soldiers
Platform: shelter or vehicle mounted, Tripod for dismount
Combat Weight (kg): 90 total system (breaks down into three 30 kg sections for dismounted operations).
Console: Digitally operated including display.

RADAR
Mount: Motor-driven for azimuth adjustment with remote control.
Azimuth coverage (°): Operator selects 10 to 240 (200 to 4300 mils)

Antenna Type: Flat array type slotted waveguide antenna, cable link

Transceiver:
Signal: I-band (8-10 GHz)
Power (W): 3,000 consumption, 150 emitted
Width of radiation pattern lobe (°): -11 to 240
Antenna Rotation Speed: 160 mils/s
Accuracy: 90% probability of detection.
Polarization: linear and circular.
Compatible with IFF systems and has ECCM capabilities.

Operation:
Coverage sector for motor drive is 0-240° azimuth.
Travel mode: Dismount system breaks down into three 30kg units.
Remote operation: Console can be set up at least 300 m away.
Target Display: Radar automatically detects, tracks, and identifies all targets. Provides polar and Universal Transverse Mercator coordinates on TV monitor, Plotting table or mapping computer. A tone signal is also available.

Other links: The digital data can be transmitted to remote users over network via standard interface. RASIT E data can be integrated with and displayed on an integrated battle management system using TCP/IP interface.

Alternative Modes of Operation:
Magnified Mode: area focus on zones at 2.5 km long intervals up to 40km and widths in 10° intervals up to 240°. Registers only when there is movement within the zone.

FDC Mode: RASIT/ E becomes a "weapon aiming radar" when used to correct artillery fire by simultaneously tracking both target and POI sites, calculating deviations, and sending via digital link. In that mode, the radar can still be used for ground surveillance.

AD Mode: RASIT / E can be used in air defense units to locate helicopters flying at nap-of-the-earth up to 30km and up to 40 km for low flying aircraft. The digital link can send coordinates to AD units.

Vehicle mount version can be used as an alert system for early warning of enemy presence in day/night operations. Mounts tactical utility vehicles. The antenna need not be set in a stowed position for travel; so set up time would be a few seconds.

RASIT E is compatible with GPS navigation systems and can transmit relative coordinates using digital interface to battlefield management systems.

Reversed engineered RASIT [Basir-110D]

PERFORMANCE
Surveillance range (km): 20-23 personnel
32- 40 vehicles
20- 40 aircraft
Resolution: ±10 m range, ±0.6° in azimuth
Tracking speed: 00-103 km/hr
Countermeasure resistance: ECCM, and LPI capable

RASIT E- Is a digitized networked version of the RASIT with improved solid state internal circuitry and an IP based interface for use with integrated battlefield management systems.

Russian Ground Surveillance Radar Kredo-1E

Kredo-1E ground mount

Kredo-1S Ground reconnaissance vehicle

SNAR-10M Artillery reconnaissance vehicle

SYSTEM
Alternative Designations: RP-200, 1RL-133-3, Kredo-1, Credo-1, Credo-1E, and PSNR-8
Date of Introduction: 1990s
Proliferation: At least 1 country
Description:
Crew: 2 or 3
Platform: Tripod for dismount, or pintle or mast-mounted on vehicle
Combat Weight (kg): 48, plus battery and display (up to 97)

RADAR
Mount: Motor-driven for azimuth adjustment.
Azimuth coverage (°): 360, 180 in scan sector
Antenna Type: Slotted wave guide
Transceiver: Multi-mode master oscillator and klystron
Signal: Coherent pulse Doppler J-band (10-19 GHz, U.S. Ku)
Power (W): 250 consumption
Mode: Mono-pulse digital processing

Operation:
Coverage sector is 30-180° azimuth, 18° elevation
Emplace time: 5 minutes.
Travel mode: Systems breaks down into antenna, tripod, battery unit, and laptop PC or monitor unit.
Operating mode: Unit can be operated remotely 25-100 m away or operated autonomously. Operates in sector or circular scan mode.
Target Display: Radar automatically detects, tracks, and identifies targets, automatically reads coordinates, and can display acquisitions on digital map display (with different target display colors). It can also store images. Transmits Data digitally over network via standard interface.

PERFORMANCE
Surveillance range (km): up to 40 for detection, 30 for tracking
Resolution: 50 m range, 1.8° in azimuth
Mean error auto-tracking: 10 m range, 0.12° in azimuth

Tracking range (km):
Tanks: 40
Light vehicles and trucks: 20-40
Helicopters: 35
Large aircraft: 30
Ships: 12
Personnel: 15
Shell burst (155 mm): 15
Min: 0.2
Tracking speed: 3-72 km/hr

VARIANTS
This system can be used as the base for an integrated digital sensor suite, or to fuse and process data from other sensors. Credo-1 can be used to replace other ground surveillance radars, e.g., PSNR-5/5M on BRM-1K, BRM-3K (see pg 4-10), 1V118, PRP-4, PRP-4M, BMD recon vehicle, etc. The radar can also be mounted on a BRDM-2M type upgrade wheeled reconnaissance vehicle.

With a pintle mount for this radar, virtually any vehicle or ATV can be readily be modified into a reconnaissance vehicle. Tactical utility vehicles are often used with a radar top-mounted (and folded down when moving), or dismounted with the vehicle hidden. Given improvements in modern IFV or APC fire control systems (with day camera or day TV sight, thermal night sight, and laser rangefinder), many of these can be converted in the field for a reconnaissance role. A laser target designator can also be used on these systems.

Kredo-1S: Ground recon vehicle (above) with Kredo-1E radar/EO sensor pod mounted on a telescoping arm on amphibious BAZ-5921 chassis. A ground recon vehicle is in development with the same telescoping system, but on a BTR-based UNSh/K1Sh1 chassis.

SNAR-10M: Russian upgrade (above) for the SNAR-10 artillery battlefield surveillance radar vehicle (pg 7-11) replaces the BIG FRED radar with the Kredo-1E.

NOTES
Targets: Ground systems, helicopters and vessels. System can also be used to adjust artillery fire and control UAVs and runway aircraft.

Russian/Bulgarian Ground Surveillance Radars PSNR-5, -5M, and Kredo-M1_____

PSNR-5 ground mount system

PSNR-5K on PRP-4 Recon Vehicle

Kredo-M1/PSNR-5M Modernized

SYSTEM
Date of Introduction: 1974 for PSNR-5. Both C and K are used in translations of Russian radar nomenclatures.
Proliferation: At least 11 countries
Description:
Crew: 1 for vehicle mount, 2 from vehicle, 3 for dismounted carry

Radar Name: PSNR-5
Alternative Designations: Russian name is Kredo (NATO GS-12 and TALL MIKE). Portable ground mount is PSNR-5/1RL133. Vehicle mount is PSNR-5K/1RL133-1.
Drive: Motor-driven for azimuth adjustment with remote control.
Antenna Type: Parabolic dish with cable link
Azimuth coverage (°): 360, 180 in surveillance sector
Transceiver: Coherent pulse Doppler, with magnetron
Signal: I-band (9 GHz)
Power (W): 90 consumption , 12 output
Range Resolution (in m): 100
Azimuth resolution (mils): 50
Vertical coverage angle (°): ±18. Tripod can adjust for more.
Moving Target Detection Speed (km/hr): 2-60, more some targets
Target Display: Monochrome digital readouts
Travel mode: Dismount system breaks down to: tripod, antenna/ transmitter, and backpack unit (battery, scanner,), headphones
Weight (kg): 56

Radar Name: Kredo-M1. Portable ground mount is aka 1RL 133M. PSNR-8 vehicle mount is aka 1RL 133M1.
Antenna Type: Motorized parabolic dish
Transmitter: Coherent pulse Doppler, with klystron
Signal: J-band, (10-19 GHz, U.S. Ku)
Power (W): 110 consumption
Azimuth coverage (°): 360, 180 in scan sector
Range Resolution (in m): 25
Azimuth resolution (mils): 50
Moving Target Detection Speed (km/hr): 2-60, more some targets
Target Display: Color on Baget-14 notebook computer
Travel mode: Same as above, but with notebook vs scanner unit
Weight (kg): 50, including two batteries

OPERATION
Common Operation:
Platform: Tripod for ground mount, pintle or mast for vehicle mount
Mounts: Tripod mount and remote control permit use in surveillance of wide battlefield areas with limited operator exposure.

Emplacement time for ground mount versions is 5 minutes. Consoles can be set up 25 m away for concealed operators.

Vehicle mast mounts allow quick raise on stop, and are motor-driven for remote azimuth adjustment. Many vehicle radar sets can be dismounted for use in a tripod mount in a remote OP. Vehicles may use PSNR-5 on a pintle mount vs the PSNR-5K mast mount.

The vehicle mount version alerts to enemy ground/low-altitude aircraft movement and real-time locations day and night. The antenna quickly swings up, or down for travel; so set up time is less than one minute.

Radar Name: PSNR-5 (mast-mounted PSNR-5K on vehicles)
Display: The radar automatically detects, tracks, and identifies all targets. Earphones and sound signal alert the user and classify targets. A light can also be used as an alert signal.

Communications links: Data transmission uses analog systems. With hand-held laser rangefinder and GPS, data can be fused in a vehicle onboard computer with data from other sensors to locate targets within a few meters in daytime and nighttime.

PERFORMANCE
Radar Detection Range (km): Depends on target size, composition. PSNR-5/5M ranges are 3-5 personnel and 10-15 vehicles. At wind speed ± 5 m/s, range reduces 50%.. Minimum range is 0.2

VARIANTS
PSNR-5 is on a tripod. PSNR-5K has a mast mount for vehicles, e.g., Russian BRM-1K (pg 4-10), sensor vehicle PRP-4, BMD-based recon vehicle and 1V118 observation post, and the Czech BPzV. Other mounts can include ATVs, light strike vehicles, and TUVs.

PSNR-5M/Kredo-M: Updated PSNR-5K on vehicles e.g., PRP-4M, upgraded BRM-1Ks, and BRM-3K, with a computer monitor and digital display. The ground version uses a notebook computer for display, processing, and transmission, plus GPS.

Monitor-M: variant of Kredo-M which can link to up to 4 PSNR-5M radars and provide 360° simultaneous coverage or wide area battlefield coverage.

Kredo-M1/ PSNR-5M Modernized: PSNR-5M (above) further upgrade, with a new transmitter, improved range, improved digital processing, and expanded digital interfaces. It is now in production. Ranges are 5-8.5 personnel, 20 tanks, 32 trucks (12 tracking).

Display: The radar is controlled and displayed on a notebook computer. It automatically detects, tracks, and identifies all targets and displays coordinates. Targets are color coded. Maps are overlaid in the display.

Communications links: It can operate using analog or digital processing to match user interface. Digital data can be transmitted over network as digital data or graphic display. It can link to and fuse data of remote sensors, such as unattended ground sensors.

Strazh-ST: Vehicle sensor pod with Kredo-M1 and EO cameras. The PRP-4M (pg 7-10) uses the PSNR-5M system. The PRP-4MU has the option for the Kredo-M1.

NOTES
The Kredo-1E radar (next page) shares similar name; but it is a different system with a new design.

Russian/Bulgarian Man-portable Ground Surveillance Radar Fara-1E _____

SYSTEM
Alternative Designations: Fara, Fara-3, RP-100, 1RL-136, SBR-3 (Russian), SSBR-3 (Bulgarian)
Date of Introduction: 1990s
Proliferation: At least 2 countries
Description:
Crew: 1 or 2. System can be carried by one soldier
Platform: Backpack tripod for dismount
Pintle mount for vehicle
Right angle flange mount attaches to weapons, such as PKM MG and AGS-17 automatic grenade launcher
Combat Weight (kg): 14 total system (18.3 with tripod)
Patrol version is 6.

RADAR
Mount: Motor-driven for azimuth adjustment with remote control.
Azimuth coverage (°): 360, 180 in surveillance sector
Antenna Type: Flat array type slotted waveguide antenna, cable link
Transceiver: Coherent pulse Doppler, with continuous-wave klystron
Signal: J-band
Power (W): 7 consumption, 0.5 emitted
Width of radiation pattern lobe (°): 4 azimuth, 10.5 elevation
Gain (dB): 27
Sideload in azimuth (dB): 16

Operation:
Coverage sector for motor drive is 0-180° azimuth.
Travel mode: Dismount system breaks down into antenna, tripod, backpack unit (battery, scanner, transmitter), and headphones.
Remote operation: Console can be set up 15 m away.
Target Display: Radar automatically detects, tracks, and identifies all targets. Earphones and sound signal alert the user and classify targets. A light signal can also be used.
Other links: The digital data can be transmitted to remote users over network via standard interface. The data can be fused with data from other sensor systems for target location by intersection of azimuths.

Alternative Modes of Operation:
Target Acquisition for individual weapons: The radar can be mounted on the NNP-23 infrared night sight for fusing data to that device and for acquiring targets.

Target Acquisition for crew weapons: The manufacturer offers an elbow flange for mounting on crew-served weapons, such as machineguns. The mount version for the AGS-17 automatic grenade launcher is called Fara-2. The radar can slew with the weapon and signal targets in the gun line for immediate firing. Fara-1 becomes a "weapon aiming radar", a fire control radar this can deliver precision fires up to 4 km day or night. In that mode, the radar can still be used for ground surveillance.

Used with hand-held laser rangefinder and GPS, FARA-1 can fuse azimuth directional data, current location, and range data, for precise target location for day and night time reconnaissance.

Fara-1 can be used in air defense units to locate helicopters flying at nap-of-the-earth and use the elbow mount to immediately direct AD machineguns. The digital link can send reports to AD units.

Vehicle mount version can be used as an alert system for early warning of enemy presence in day/night operations. Mounts include motorcycles and tactical utility vehicles. The antenna need not be set in a stowed position for travel; so set up time would be a few seconds.

The digital interface facilitates use in surveillance of wide battlefield areas, with limited operator exposure. Radar can link with unattended ground sensors for remote surveillance.

PERFORMANCE
Surveillance range (km): 5.0 vehicles
2.5 personnel
Resolution: 20 m range, 0.9° in azimuth
Tracking speed: 2-50 km/hr
Countermeasure resistance: Good jam resistance with phase-coded modulation

VARIANTS
Use of a laptop instead of the backpack unit decreases weight considerably.

The compact modular system is ideal for use on small vessels.

NOTES
The system is light enough for the manufacturer to portray a tree mount for the antenna.

French Thermal Binoculars/Forward Observer System Sophie LR_____

Sophie binoculars using daytime CCD camera mode

SYSTEM
Alternative Designations: See Variants
Date of Introduction: 1996 original version
Proliferation: At least 45 countries with Sophie and Sophie LR
Description:
Crew: 1
Combat Weight (kg): 3.3 Sophie LR with 2 X electronic zoom (EZ)
2.4 original Sophie

COMPONENTS
Configuration: Hand-held binocular device
Power Supply: Internal rechargeable lithium battery and DC adaptor
Detector : SOFRADIR 288 x 4 element CdHgTe detector
Frequency: 8-12 microns
Thermal Technology Generation: Second generation
Optional additions: Tripod mounts for reconnaissance units. An RS 422 Remote control box for remote viewing permits tripod-mount system to be remotely controlled by a concealed observer, with a remote monitor. See VARIANTS for other applications.

Operation:
Battery Time (hrs): 4+ thermal, 6+ day use with lithium batteries
4+ thermal , up to 12 day/night on rechargeable
Cooling Bottle: None, uncooled FLIR
Detectability while surveilling: None, passive day and night
Data transmission: CCIR or RS-170 Link for digital downlink to computer, net for TV display
Operating hours: Night on thermal, day in CCD camera mode

Performance:
Field of View (°): 12.4 x 6.2 wide view, 6.2 x 3.1 narrow view
Other Sophie versions, such as CCIR have different FOVs.
Electronic zoom (EZ) has a 2 x 1.5 FOV.

Night Range (km): standard, ( ) without EZ
Fixed-wing aircraft: 22 (15) detection, 10 (6.4) recognition
Helicopters: 16 (11) detection, 7 (4.5) recognition
Vehicle: 13 (8.7) detection, 6 (3.3) recognition
Personnel: 9 (4.4) detection, 3 (1.6) recognition
Day ranges are comparable to night ranges above.

VARIANTS
The original Sophie was designed as day/night binoculars. It can be fitted to a goniometer to serve as base sight for a dismounted forward observation and fire control system.

Sophie LR (Long Range): Improved version with increased range, 2x electronic zoom (EZ), and image stabilization. For ranges see the figures for EZ at left.

Later versions have expanded applications of the system. Key is the concept of using Sophie-LR and later variants as lightweight cameras within surveillance systems and indirect weapon fire control systems. Sophie-LR is configured as a remote sensor pod for vehicle or site mount, with digital feed to a remote display. An earlier version was the BARCO Vector, with hooded Sophie, commercial LRF, and TV display panel.

A current Sophie-based RISTA system depicted at the Thales website is used in the F2000 unmanned aerial vehicle, and is mounted on ATGM launchers, helicopters and variety of vehicles. It has a telescoping mast, an RS 422 remote control box for azimuth rotation, and a vertically swiveling pintle for precision elevation. The pod uses a DC power supply and a digital data cable linked to a remote viewer or RF video transmission system (UAV).

Sophie UF2: A redesigned more compact hand-held viewer. With total weight trimmed to the original 2.4 kg standard, it meets the upgraded standards of Sophie LR (above).

The below Sophie models are used as integrated goniometer FC systems. They can include a computer and RF data link.

Sophie MF (Multi-function): Forward observer system (FOS) has all features of LR version, plus a laser rangefinder, laser pointing system, internal GPS, and internal color camera. This system can be used by forward observers to direct indirect fires 13 km, 6 with recognition. Direct fire precision ranges would be 6 km or more, depending on targets and ammunition. Range against helicopters is 7 km with EZ.

Sophie XR (Extended Range): Includes all of the features of MF, as well as a new SOFRADIR Scorpio detector with increased ranges.

NOTES
The digital data from the viewer could feed a digital battle management system with map-based target display. This system is robust enough to be used as the camera for a direct-fire weapon fire control system, with an external ballistic computer and monitor-based target sight display.

Chapter 5
Main Battle Tanks

This chapter contains a representative sampling of main battle tanks (MBT) used in various countries and regions covered by US combatant commands. This selection is not comprehensive; however, the capabilities of vintage and/or modern MBT are significant indicators of the organization and order of battle that armed forces arrayed against the United States might employ in future real-world situations and conflicts.

By using the WEG, a unit commander, scenario developer, curriculum developer, and/or other subject matter expert can determine a level of Threat capabilities in an opposing force (OPFOR) for training, professional education, and leader development purposes. The spectrum of MBT capabilities addressed in this chapter is descriptive, and facilitates creating robust, realistic, and challenging Threats for Army training and capabilities development initiatives. The annual update of this guide includes developments and trends of this weapon system—the main battle tank.

A capability can be assessed and evaluated in several ways depending on its context or intended purpose. The main battle tank is an integrated "system of systems," and any evaluation or comparison of capabilities between or among MBT must analyze efficiency and effectiveness from a holistic perspective. The WEG descriptions used in this chapter employ three categories of major subsystems (and their related functions) to gauge overall MBT capabilities:

- Mobility.
- Survivability.
- Lethality.

This guide defines a *main battle tank* as a tracked, heavily-armored vehicle with a main gun and auxiliary weapons. Many modern MBT have a four-person crew of tank commander, gunner, loader, and driver. When an autoloader is part of the main gun system, the MBT has a three-person crew of tank commander, gunner-loader, and driver. Most modern MBT mount a 105-mm to 125-mm main smoothbore gun, although limited types of MBT mount a rifled rather than smoothbore gun. Some MBT have the capability to launch antitank guided missiles. Most tanks can typically stow at least 40 main gun rounds in the tank. An autoloader allows only half of the main gun rounds for immediate automatic loading and gunnery missions. For MBT such as the current Russian–made T90S, or a T55 tank model converted to the Typhoon 2, the gun autoloader can feed both main gun rounds and missiles.

Mobility considers the relationship between improved automotive performance efficiency and the combat-load weight of a MBT. Vehicle fuel cell capacity and the type of terrain to be traversed affect expected norms for cruising range. MBT with on-board fuel cells can typically run for some distance between 450 and 600 kilometers (km). Diesel is the norm for engine fuel among modern MBT; however; some tanks such as the (U.S.) M1A1/2 and (Russian) T90S have a multi-fuel engine which can run on kerosene, diesel, and/or specific types of benzene. Auxiliary power units can be incorporated into system upgrades that economize MBT fuel use during temporary halts or while operating in stationary positions. Improved diagnostic upgrades alert the crew for corrective actions needed to sustain availability of the MBT's multiple subsystems.

Upgrading systems with modular components reduces inoperative time for repair and maintenance.

Vehicle weight for an MBT can range from 40 to 70 tons. For example, the T90S is approximately 47 tons, the (German) Leopard 2A6 is approximately 55 tons, and the M1A2 is approximately 70 tons. Improvements to suspension systems and tracks complement each other. Appliqué armor, and explosive reactive armor (ERA), now the norm for improving armored protection, substantially increases vehicle weight and therefore affect MBT mobility.

Survivability is a category that receives ever-increasing research. Functional improvements to improved composite or spaced tank hull armor include mine-protection appliqué, active-reactive and/or passive appliqué armor for the turret, glacis, flanks, and rear, and various forms of stand-off caging or mesh screens that degrade the effect of antitank rounds. All these innovations serve to enhance MBT survivability. Camouflage systems include methods for reducing detection by optical, infrared, and radar technologies. Sensors can include mine detectors and laser or radar acquisition warning receivers that automatically activate MBT defense and/or interception systems. Some MBT mount television cameras to improve crew 360-degree visual awareness of the tank's immediate surroundings, and to enhance local security.

A pressurized nuclear-chemical-biological (NBC) system provides crew protection in upgraded tanks on the modern NBC-contaminated battlefield. Air conditioning in some MBT enhances systems readiness and sustainment of crew readiness in heat-extreme climates.

Other survivability enhancements can include entrenching blades for MBT self-emplacement in defensive positions, mine-clearing plows and rollers, vehicle smoke emission systems, and smoke-obscurant grenade launcher systems. This chapter considers tank survivability in the context of a *combined arms* team. Some upgrade suites include an external intercommunication telephone on the MBT's exterior for coordinating with infantry operating alongside the MBT and crew. Armor and infantry typically operate as a team to optimize the tactical advantages that each provides the other team member.

Lethality considers more than the main gun and auxiliary weapons systems. In addition to weapon efficiency, lethality is related to the MBT's ability to acquire and track a target, its weapon system engagement range, and crew situational awareness of multiple concurrent targets available for engagement. Improved command and fire control systems can include thermal viewfinders for the tank commander and gunner, laser rangefinders, and digital communications devices. Integrated command and control is achieved through an interconnected network of sensors, imagery, navigation, and information systems that facilitate situational awareness and understanding of the tactical as well as operational environment.

Upgrades to lethality can include main gun replacement, improved stabilization and fire control systems, additional weapons such as antitank guided missile systems, and improved ammunition. Critical considerations relevant to these upgrades include linking fire-on-the-move capability to MBT stabilization systems, rate of fire, integrated sights, target acquisition ranges, and weapons ranges (to include maximum effective ranges). The *WEG* incorporates factors relevant to gun sights, gun precision, type of gun mount, and specific round caliber ballistics as components of *maximum aimed range* and *maximum effective range* (see Glossary).

Discussions of improved main gun munitions covered in the *WEG* incorporate ongoing research and development of kinetic energy (KE) rounds with a dart-like penetrator (armor-piercing, fin-stabilized, discarding sabot (APFSDS) and high-explosive antitank (HEAT) multi-purpose rounds that use a shaped-charge for penetration. The *WEG* reflects a variety of ammunition capabilities, such as electronically-fuzed rounds for use against helicopters, or canister rounds for use in close combat. HEAT-multipurpose (MP) rounds can also be used against anti-materiel and antipersonnel (AP) targets. In comparing tank-on-tank main gun round lethality, kinetic energy rounds are more lethal against composite or spaced armor than high-explosive antitank rounds gauged at the same penetration rate. Ammunition upgrades are trending toward more efficient propellants with improved effects and penetration rates.

Ready rounds are stored for easy retrieval either inside the turret or in bustle compartments, to sustain a consistent rate of main gun fire. In listing available ready-rounds in the tank turret, the number of rounds does not include the ability to add an additional round in the breach. *Stowed rounds* are rounds that are either outside the tank's autoloader, or in compartments that preclude immediate retrieval during a main gun engagement. For OPFOR MBT, the typical mix of main gun rounds on board a tank is 50% antitank and 50% for use against soft targets. However, an ammunition combat load for an OPFOR MBT may have more kinetic energy (KE) rounds than HEAT rounds. The ammunition unit basic load and ammunition combat load will vary based on operational considerations.

Heavy machinegun auxiliary weapons in or on the tank turret are trending toward a remote-controlled weapon station (RWS) configuration that provides the ability to fire the weapon while the crewman remains protected inside the turret. Weapons mountings now often allow high-angle air defense fire and similar uses helpful in built-up urban areas. Armor shielding for the loader’s machinegun, mounted on the turret, improves protection when the loader is exposed outside the turret hatch.

Summary. Current practices and trends underscore the manner in which increasing fiscal costs are constraining research and development, testing, and production of MBT systems. Many countries have decided to reduce their military budgets in favor of supporting other domestic programs. Meanwhile, MBT produced previously are in jeopardy of becoming obsolete as other nations either manufacture newer MBT or obtain systems improvements for older models. As a trend, improvements in MBT capabilities are typically upgrade packages rather than new tank models going into production. See *WEG*, chapter 15.

Although several countries have initiated or sustained new indigenous tank production programs, new tank initiatives typically involve furnishing older MBT models with systems upgrades, modular improvements, and technologies by purchasing them from nations with an established history of tank-production capability The technology-sharing and proliferation of MBT upgrade packages among vehicles can also be part of a comprehensive overarching upgrade program that includes an entire “family” of armored vehicles tailored to cover a broad range of battlefield functions.

The *WEG* addresses *heavy armament combat vehicles* (HACV) at volume 1, p. 6-40, and *heavy combat support vehicles* (HCSV) at volume 1, pp. 3-59 to 3-61.)

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Pakistani Main Battle Tank Al Khalid

Latest version of Al Khalid with new 2nd gen ERA

Weapons & Ammunition Types	Typical Combat Load
125-mm smoothbore gun	**mix est 49**
APFSDS-T	19
HEAT	6
Frag-HE	24
7.62-mm coax MG	**3,000**
12.7-mm cupola AAMG	**500**

SYSTEM
Alternative Designations: Type 90-IIM. Pakistani variant of Chinese P-90, MBT-2000 export variant (see pg 5-40 and NOTES).
Date of Introduction: 2001
Proliferation: At least 1country. Being tested in another. Currently, 5 countries have expressed interest.
Description:
Crew: 3
Combat Weight (mt): 47.0
Chassis Length Overall (m): 6.50
Height Overall (m): 2.37
Width Overall (m): 3.50
Ground Pressure (kg/cm^2): INA

Automotive Performance:
Engine Type: 1,200-hp Ukrainian 6TD-2 Diesel
Cruising Range (km): 450
Speed (km/h):
Max Road: 70
Max Off-Road: INA
Average Cross-Country: 45
Max Swim: N/A
Fording Depths (m): 1.4 Unprepared, 5.0 with snorkel

Radio: INA

Protection:
Armor, Turret Front (mm): Turret 600+ERA, hull 450
Applique Armor (mm): Track skirts. .
Explosive Reactive Armor (mm): Improved ERA on turret and sides, increases protection 500-700 mm CE, and 100-300 mm KE
Active Protective System: N/A
Mineclearing Equipment: Mine plows and roller-plow set
Self-Entrenching Blade: Yes
NBC Protection System: Yes
Smoke Equipment: 12x 81-mm smoke grenade launchers
Vehicle engine exhaust smoke system
Other Survivability Equipment: 4 HE grenades, for use against close-in personnel. Welded turret permits upgrade for improved armor. Bar armor stowage racks on turret sides and rear can pre-detonate grenades launched at those aspects. Paint is IR-reflecting. Other possible upgrades include conformal ERA similar to that on the Chinese 98 Gai.

ARMAMENT
Main Armament:
Caliber, Type, Name: 125-mm smoothbore gun 2A46M/ D-81TM
Rate of Fire (rd/min): 6-8/2 in manual mode
Loader Type: Autoloader (separate loading) and manual
Ready/Stowed Rounds: 22/27 (22 in carousel)
Elevation (°): -5 to +18
Fire on Move: Yes, up to 25 km est. Depending on the road and distance to the target, most crews may halt before firing.

Auxiliary Weapon:
Caliber, Type, Name: 7.62-mm (7.62x 54R) Machine gun
Mount Type: Turret coax
Maximum Aimed Range (m): 1,800
Max Effective Range (m): 1,000 day, 800 night
Fire on Move: Yes
Rate of Fire (rd/min): 250 practical, 600 cyclic, 2-10 rd bursts

Caliber, Type, Name: 12.7-mm (12.7x108) AA MG
Mount Type: Cupola
Maximum Aimed Range (m): 2,000
Max Effective Range (m):
Day: 1,500 ground/1600 for air targets (APDS)
Night: N/A
Fire on Move: Yes
Rate of Fire (rd/min): 80-100 practical, 600 air targets, 2-10 rd bursts

ATGM Launcher:
Name: 2A46M/ D-81TM tank gun
Launch Method: Gun-launched
Guidance: SACLOS, Laser beam rider
Command Link: Encoded infrared laser beam
Rate of Launch: (missiles/min): 2-3, depending on range
Launcher Dismountable: No

FIRE CONTROL
FCS Name: ISFCS-212 (Image-Stabilized Fire Control System)
Main Gun Stabilization: 2-plane
ATGM Fire Control: Yes, laser beam rider
Auto-tracker: Yes
Rangefinder: LRF
Infrared Searchlight: Yes
Sights w/Magnification:

Pakistani Main Battle Tank Al Khalid continued

Gunner:
Day: UI stabilized gunner sight
Field of View (°): INA
Acquisition Range (m): 5,000
Night: Catherine 2nd gen Thermal (See Notes)
Field of View (°): INA
Acquisition Range (m): 4,500 est
Commander Fire Main Gun: Yes, hunter-killer fire control

VARIANTS
The original 48 mt tank was derived from the Chinese joint venture MBT-2000 export prototype, modified for PK as **Type 90-IIM** (pg 5-40). It had 1 gen ERA and 1 gen thermal sights

Original version of Al Khalid

Type 90-IIM: The Chinese export tank (aka: Type 90-II) with 2nd gen ERA, appeared in a Peruvian parade and is contracted for sale to Peru.

The latest version of Al Khalid has several key changes, including new 2nd gen ERA, new FCS with 2nd gen thermal night sight, a new engine and transmission, and added ammunition capacity.

A significant feature of the updated tank is the Integrated Battle Management System (IBMS) a digitally linked system with digital text and graphic display, inlaid maps with overlays, GPS for self navigation and target location, 3-D topographic images, formatted order and report displays.

MAIN ARMAMENT AMMUNITION
Caliber, Type, Name:
125-mm APFSDS-T, BM-42M estimated, based on similar rounds
Maximum Aimed Range (m): 3,000
Max Effective Range (m):
Day: 2,000-3,000
Night: 850-1,300
Armor Penetration (mm KE): 630 at 2,000 meters
125-mm Frag-HE-T, OF-26 estimated, based on similar rounds
Maximum Aimed Range (m): 5,000
Max Effective Range (m):
Day: 5,000
Night: 850-1,300
Armor Penetration (mm): Can defeat IFV and APC

125-mm HEAT, BK-27 estimated, based on similar rounds
Maximum Aimed Range (m): 3,000
Max Effective Range (m):
Day: 2,000-3,000
Night: 850-1,300
Armor Penetration (mm CE): 700-800

125-mm HEAT-MP, BK-29M estimated, based on similar rounds
Maximum Aimed Range (m): 3,000
Max Effective Range (m):
Day: 2,000-3,000
Night: 850-1300
Armor Penetration (mm CE): 650-750

Other Ammunition Types: Giat 125G1 APFSDS-T, Russian BM-42 and BM-32 APFSDS-T. Note: The Russians may have a version of the BM-42M with a DU penetrator.

Recent Russian BK-27 HEAT round offers a triple-shaped charge warhead and increased penetration against conventional armors and ERA. The BK-29 round, with a hard penetrator in the nose is designed for use against reactive armor, and as an MP round has fragmentation effects. If BK-29 HEAT-MP is used, it may also substitute for Frag-HE (as with U.S.) or complement Frag-HE.

Antitank Guided Missiles:
Name: AT-11B/Invar
Warhead Type: Tandem shaped charge (HEAT)
Armor Penetration (mm CE): 900, 850 behind ERA
Range (m): 5,000 day and night

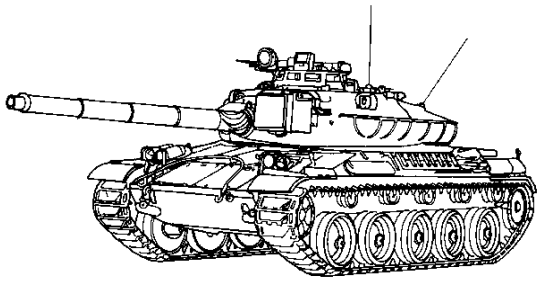
Name: AT-11C/Invar-M/9M119M1
Warhead Type: Tandem shaped charge (HEAT)
Armor Penetration (mm CE): 900, 850 behind ERA
Range (m): 7,000 day and night

Other Missiles: An alternative ATGM for the upgraded tank is the Ukrainian Kombat

NOTES
This is a true international tank. The design was derived from the Chinese P-90/MBT2000, with Pakistani modifications. It is built in Pakistan, with a Ukrainian drive train, Serbian FCS, French thermal sight, with Russian ATGM and ATGM fire control, and possible use of Ukrainian Kombat gun-launch ATGMs.

The previous thermal sight was Sagem 1st gen with 2,500 m est. range. However, the Pakistani Army has contracted for upgrade sights noted above. For an upcoming export deal, they may choose the new 3rd gen Sagem Matis thermal sight with 11,000 m detection range and 5,300 m recognition.

French Main Battle Tank AMX-30



Weapons & Ammunition Types	Typical Combat Load
105-mm rifled gun	**47**
APFSDS-T	
HEAT-T	
HE	
20-mm coaxial cannon	**1,050**
7.62-mm cupola MG	**2,050**

SYSTEM
Alternative Designations: INA
Date of Introduction: 1967
Proliferation: At least 10 countries
Description:
Crew: 4
Combat Weight (mt): 36.00
Chassis Length Overall (m): 6.59
Height Overall (m): 2.29
Width Overall (m): 3.10
Ground Pressure (kg/cm^2): 0.77/0.85 for AMX-30B2

Automotive Performance:
Engine Type: 720-hp Diesel multi-fuel
Cruising Range (km): 500-600
Speed (km/h):
- Max Road: 65
- Max Off-Road: INA
- Average Cross-Country: 35-40
- Max Swim: N/A

Fording Depths (m): 1.3, 2.2 prepared, 4.0 with snorkel

Radio: INA

Protection:
Armor, Turret Front (mm): 81 KE & CE (RHA) /120 AMX-30B2
Applique Armor (mm): N/A
Explosive Reactive Armor (mm): GIAT Brenus ERA available
Active Protective System: Galix decoys and IR jammer available
Mineclearing Equipment: No
Self-Entrenching Blade: No
NBC Protection System: Yes
Smoke Equipment: 2x2 smoke grenade launchers, VEESS

ARMAMENT
Main Armament:
Caliber, Type, Name: 105-mm (56 Cal) rifled gun CN-105-F1
Rate of Fire (rd/min): 6
Loader Type: Manual
Ready/Stowed Rounds: 19/28
Elevation (°): -8 to +20
Fire on Move: No/Yes, AMX-30B2 with COTAC FCS

Auxiliary Weapon:
Caliber, Type, Name: 20-mm (20x139) Auto-cannon M693
Mount Type: Turret Coax
Maximum Aimed Range(m): 2,000
Max Effective Range (m):
- Day: 1,300
- Night: INA

Fire on Move: No
Rate of Fire (rd/min): 1,200

Caliber, Type, Name: 7.62-mm (7.62x51) Machinegun Giat NF1
Mount Type: Turret Cupola
Maximum Aimed Range (m): 1,200
Max Effective Range (m):
- Day: 600
- Night: INA

Fire on Move: Yes
Rate of Fire (rd/min): 900

ATGM Launcher: N/A

FIRE CONTROL
FCS Name: INA
Main Gun Stabilization: None/stabilization for AMX-30B2
Rangefinder: Optical/APX-550 Laser for AMX-30B2
Infrared Searchlight: PH-8-B
Sights w/Magnification:
Gunner:
- Day: M271 telescope, 8x
  - Field of View (°): 9
  - Acquisition Range (m): INA
- Night: OB-17-A IR periscope
  - Field of View (°): INA
  - Acquisition Range (m): 1,000/1,500 white light

Commander Fire Main Gun: No

VARIANTS
AMX-30S: Export for desert use. The engine is downgraded to 620 hp. The FCS is upgraded with Sopelem LRF day/night sight.

AMX-30B2: Upgrade with ERA, improved transmission and suspension, NBC system, gun stabilization, and COTAC FCS with a thermal night sight. French Army AMX-30s were upgraded to -B2.

National War College Photo

French Main Battle Tank AMX-30 continued

AMX-30EM2: Spanish upgrade program with 850-hp engine, new transmission, Hughes FCS, enlarged ammunition stowage, ERA, and C-437 APFSDS-T ammunition.

AMX-30 DCA: AD version - 2x30-mm guns on AMX-30 chassis.
GCT/AU-F1: Self-propelled 155-mm howitzer on AMX-30 chassis.
AMX-30D: Armored recovery vehicle.
AMX-30 EBG: Combat engineer tractor.
AMX-30 Bridge Layer: Scissors bridge on AMX-30 chassis.
Pluton: Theater ballistic missile launcher on AMX-30 chassis.

MAIN ARMAMENT AMMUNITION
Caliber, Type, Name:
105-mm APFSDS-T, OFL 105 F1, French Giat
Maximum Aimed Range (m): 3,000
Max Effective Range (m):
Day: 1,800
Night: INA
Armor Penetration (mm): NATO triple heavy target; 5,500 m

Caliber, Type, Name:
105-mm APFSDS-T, M413, Israeli Military Industries
Maximum Aimed Range (m): 6,000
Max Effective Range (m):
Day: 2,000
Night: INA
Armor Penetration (mm): NATO triple heavy target, 6,000+m

Caliber, Type, Name:
105-mm HEAT-T, OCC 105 F1, French Giat
Maximum Aimed Range (m): 2,500
Max Effective Range (m):
Day: 2,500
Night: INA
Armor Penetration (mm CE): 360 at 0°

105-mm HEAT-T, M456A2, Belgian Mecar
Maximum Aimed Range (m): 2,500-3,500
Max Effective Range (m):
Day: INA
Night: INA
Armor Penetration (mm CE): 432 at 0°

105-mm HE, OE 105 F1, French Giat
Maximum Aimed Range (m): 2,500
Max Effective Range (m):
Day: 2,500
Night: INA
Armor Penetration (mm): Can defeat an IFV or APC

Other Ammunition Types: Any NATO-standard 105-mm ammunition can be used. They include Belgian Mecar M1060, Chinese Norinco 105, German Rheinmetall DM43, Spanish Santa Barbara C-437, British Royal Ordinance L64A4 and H6/6, US M735 and M833 (depleted uranium), and Canadian FP105 APFSDS-T rounds. Other types available are: HE-T, smoke, illuminating, HESH-T, HE plastic tracer (HEP-T), and canister or APERS-T (flechette).

A recent round is the Israeli Military Industries APAM round, which over-flies the target and disperses fragmenting sub munitions outward and downward over a much wider kill zone.

NOTES
AMX-32: Upgraded tank - did not enter production.
AMX-40: Later upgraded tank - did not enter production.

British Main Battle Tanks Challenger 1 and Challenger 2

National War College Photo

Weapons & Ammunition Types	Typical Combat Load
120-mm rifled gun	**52**
APFSDS-T	20
HESH	32
7.62-mm MG	**4,000**
coaxial chain gun	
cupola AA MG	

SYSTEM
Alternative Designations: FV 4030/4
Date of Introduction: 1994
Proliferation: At least 2 countries
Description:
Crew: 4
Combat Weight (mt): 69.0 (6.5 more than Challenger 1)
Chassis Length Overall (m): 8.33
Height Overall (m): 2.50
Width Overall (m): 3.52
Ground Pressure (kg/cm^2): 0.97

Automotive Performance:
Engine Type: 1,200-hp Diesel
Cruising Range (km): 450
Speed (km/h):
- Max Road: 59
- Max Off-Road: 45 est
- Average Cross-Country: 40
- Max Swim: N/A

Fording Depths (m): 1.1 Unprepared

Radio: INA

Protection:
Armor, Turret Front (mm): 650+ KE RHA at 2,000 m and 1,000 CE
Explosive Reactive Armor (mm): N/A
Active Protective System: N/A
NBC Protection System: Yes
Smoke Equipment: Smoke grenade launchers (2x5), VEESS

ARMAMENT
Main Armaments:
Caliber, Type, Name: 120-mm rifled gun, L30 CHARM
Rate of Fire (rd/min): INA
Loader Type: Separate-loading manual
Ready/Stowed Rounds: INA
Elevation (°): -10 to +20
Fire on Move: Yes

Auxiliary Weapon:
Caliber, Type, Name: 7.62-mm McDonnell Douglas Chain Gun
Mount Type: Turret Coax
Maximum Range (m): INA
Fire on Move: Yes
Rate of Fire: INA

Caliber, Type, Name: 7.62-mm (7.62x 51) AA Machinegun L37A2
Mount Type: Cupola
Maximum Aimed Range (m): INA
Max Effective Range (m): 800 day, INA night
Fire on Move: Yes
Rate of Fire (rd/min): INA

ATGM Launcher: None

FIRE CONTROL
FCS Name: Improved Fire Control System (Marconi IFCS)
Main Gun Stabilization: 2-plane electric
Rangefinder: SAGEM Laser rangefinder
Infrared Searchlight: No
Sights w/Magnification:
Gunner: Thermal Observation and Gun Sighting System (TOGS-2)
- Day: Gunner's Primary Sight, L30 telescope, 3x and 10x
  - Field of View (°): INA
  - Acquisition Range (m): 5,000
- Night: Barr & Stroud TOGS-2 (with SAGEM thermal imager)
  - Acquisition Range (m): 3,000 +

Commander Fire Main Gun: INA

VARIANTS
Challenger 1: Base tank from which Challenger 2 was derived. The latter tank includes 150 improvements, including mobility upgrades, TOGS-2 FCS, guns, and land navigation system, and an APU.
Challenger 2E/Desert Challenger: The tank has a 1,500-hp engine, loader .50-cal MG, and L30A1 gun.
Omani Challenger 2: Variant with GPS, loader .50-cal MG, air conditioning and additional radiators.

MAIN ARMAMENT AMMUNITION
Caliber, Type, Name:
120-mm APFSDS-T, CHARM 3, depleted uranium
- Maximum Aimed Range (m): 5,000-6,500
- Max Effective Range (m): 3,000+ day and night
- Armor Penetration (mm): INA

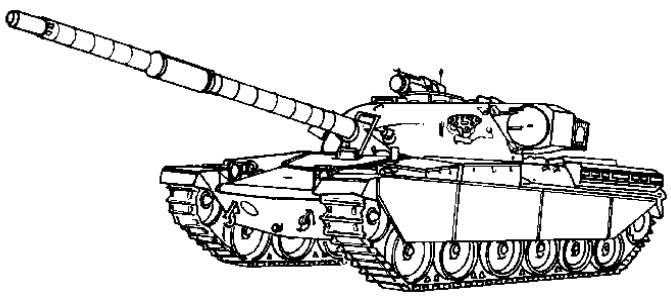
120-mm High-Explosive Squash-Head (HESH), L31
- Maximum Aimed Range (m): 5,000
- Max Effective Range (m): 3,000 day and night
- Armor Penetration (mm): NATO single heavy target

The HESH round is used for antitank chemical-energy (CE) anti-armor missions, and for HE effects against personnel and materiel.

Other Ammunition Types: L15 APDS, L34 WP Smoke

NOTES: None

British Main Battle Tank Chieftain Mk 5, Mk 12



Chieftain Mk 5

Weapons & Ammunition Types	Typical Combat Load
120-mm rifled gun	**64**
APFSDS-T	20
HESH	44
7.62-mm MG	**6,200**
--Coaxial and Stowed	6,000
--Cupola AA MG	200
	(Reloads from stowed rds)

SYSTEM
Alternative Designations: FV 4201
Date of Introduction: 1967 Original Chieftain
Proliferation: At least 6 countries
Description:
Crew: 4
Combat Weight (mt): 55.00
Chassis Length Overall (m): 7.48
Height Overall (m): 2.90
Width Overall (m): 3.51
Ground Pressure (kg/cm^2): 0.90

Automotive Performance:
Engine Type: 750-hp Diesel
Cruising Range (km): 400-500
Speed (km/h):
Max Road: 48
Max Off-Road: INA
Average Cross-Country: 30
Max Swim: N/A
Fording Depths (m): 1.1 Unprepared. The Iranians claim to employ a snorkel system on Chieftain, for fording to 5 meters depth.

Radio: C42/Larkspur VHF

Protection:
Armor, Turret Front (mm): 300 (RHA)
Applique Armor (mm): Side skirts
Explosive Reactive Armor (mm): N/A
Active Protective System: N/A
Mineclearing Equipment: Plow variant, and AVLB/engineer variant
Self-Entrenching Blade: No
NBC Protection System: Yes
Smoke Equipment: Smoke grenade launchers (6 each side of turret)

ARMAMENT
Main Armaments:
Caliber, Type, Name: 120-mm rifled gun, L11A5
Rate of Fire (rd/min): 8-10 first minute/6 sustained
Loader Type: Separate-loading manual
Ready/Stowed Rounds: INA
Elevation (°): -10 to +20
Fire on Move: Yes

Auxiliary Weapon:
Caliber, Type, Name: 7.62-mm (7.62x 51) Machine gun L8A1
Mount Type: Turret Coax
Maximum Aimed Range (m): INA
Max Effective Range (m):
Day: 800
Night: INA
Fire on Move: Yes
Rate of Fire: INA

Caliber, Type, Name: 7.62-mm (7.62x 51) AA Machine gun L37A1
Mount Type: Cupola
Maximum Aimed Range (m): INA
Max Effective Range (m):
Day: 800
Night: INA
Fire on Move: Yes
Rate of Fire (rd/min): INA

Early Chieftains and some later modified tanks mount the .50 Cal M2HB machine gun over the main gun as a ranging gun. Iran and Kuwait retained the .50 Cal MG.

ATGM Launcher: N/A

FIRE CONTROL
FCS Name: INA Mk 5, Marconi Improved Fire Control System (IFCS), Mk 11/12
Main Gun Stabilization: 2-plane
Rangefinder: Laser, Nd-Yag
Infrared Searchlight: Yes
Sights w/Magnification:
Gunner: Barr and Stroud Tank Laser Sight
Day: No 70 telescope/No. 59 periscope, Mk 5, 1x and 8x
No 3 Mk 1 for TOGS, 3x and 10x Mk 11/12
Field of View (°): INA
Acquisition Range (m): 4,000
Night: Marconi II/IR white light sight, Mk 5, 3x
1R18 Themal sight for TOGS, Mk 11/1212
Field of View (°): 13.6 and 4.75, Mk 11/1212
Acquisition Range (m): INA Mk 5
3,000 Mk 11/12

A variety of fire control systems and thermal sights are available for Chieftain. Marconi, Nanoquest, and Pilkington offer day and night sights for the Chieftain. At least 324 Chieftains have been upgraded with the Barr and Stroud TOGS thermal sight system. The 1R26 thermal camera can be used with the 1R18 thermal night sight. It has wide (13.6°) and narrow (4.75°) fields of view, and is compatible with TOGS format. GEC Sensors offers a long list of sights including: Multi-sensors Platform, Tank Thermal Sensor, and SS100/110 thermal night sight.

Commander Fire Main Gun: INA

VARIANTS
Mk 5: Final production variant, with a new engine and NBC system, modified auxiliary weapons and sights.

A variety of support vehicles were developed from the tank. They include recovery vehicles, AVLB, dozer, mine clearer, air defense and 155-mm SP artillery systems.

British Main Battle Tank Chieftain Mk 5, Mk 12 continued

Mk 6-11 are upgrades of earlier models.
Mk 9 and after have IFCS FCS.
Mk 11 and **Mk 12** have TOGS.
Mk 12 added ROMOR (aka: Stillbrew) spaced armor boxes on turret front. A 1R18 thermal sight was added to TOGS.

National War College Photo

Khalid/Shir 1: Jordanian variant which has chassis, turret and weaponry of the Chieftain, but which incorporates engine and running gear upgrades of Challenger I. The fire control has seen a number of improvements, including a new ballistic computer.

MAIN ARMAMENT AMMUNITION
Caliber, Type, Name:
120-mm APFSDS-T, L23A1
Maximum Aimed Range (m): 5,000
Max Effective Range (m):
Day: 3,000
Night: INA Mk 5
3,000 Mk 11/12
Armor Penetration (mm): INA

120-mm High-Explosive Squash-Head (HESH), L31
Maximum Aimed Range (m): 5,000
Max Effective Range (m):
Day: 3,000
Night: INA Mk 5
3,000 Mk 11/12

Armor Penetration (mm): NATO single heavy target
The HESH round is used for antitank chemical-energy (CE) anti-armor missions, and for HE effects against personnel and materiel.

Other Ammunition Types: L15 APDS, L34 WP Smoke

NOTES
Charm Armament upgrade program, with the 120-mm L30 gun incorporated in Challenger 1, is available for Chieftain modification programs.

German Main Battle Tank Leopard 1A1

National War College Photo

Weapons & Ammunition Types	Typical Combat Load
105-mm rifled gun	**60/later 55**
APFSDS-T	
HESH-T	
7.62-mm MG	**5,500**
coaxial	1,250
cupola	1,250

SYSTEM
Alternative Designations: INA
Date of Introduction: 1965
Proliferation: At least 12 countries
Description:
Crew: 4
Combat Weight (mt): 40/42.4 LA1A1 and after
Chassis Length Overall (m): 7.09
Height Overall (m): 2.61
Width Overall (m): 3.37
Ground Pressure (kg/cm^2): 0.86/0.88 LA1A1 and after

Automotive Performance:
Engine Type: 830-hp Diesel multi-fuel
Cruising Range (km): 600
Speed (km/h):
- Max Road: 65
- Max Off-Road: INA
- Average Cross-Country: INA
- Max Swim: N/A

Fording Depths (m): 1.2 Unprepared, 2.25 prepared, 4.0 snorkel

Radio: INA

Protection:
Armor, Turret Front (mm): 250 RHA, KE/230 CE
Applique Armor (mm): Available, standard on L1A1A1 and after
Explosive Reactive Armor (mm): Brenus available
Active Protective System: N/A
Mineclearing Equipment: No
Self-Entrenching Blade: No
NBC Protection System: Yes
Smoke Equipment: 2x4 76-mm smoke grenade launchers

ARMAMENT
Main Armament:
Caliber, Type, Name: 105-mm (51 Cal) L7A3 rifled gun
Rate of Fire (rd/min): 10
Loader Type: Manual
Ready/Stowed Rounds: 13/47
Elevation (°): -9 to +20
Fire on Move: No/Yes (to 28 km/h) Leopard 1A1A1 and after

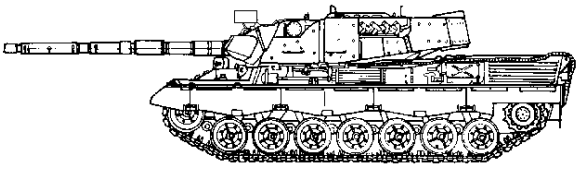
Auxiliary Weapons:
Caliber, Type, Name: 7.62-mm (7.62x51) Machinegun M3
Mount Type: Turret Cupola
Maximum Aimed Range (m): 1,400
Max Effective Range (m): INA
Fire on Move: Yes
Rate of Fire (rd/min): INA Caliber, Type, Name: 7.62-mm (7.62x51) Machinegun MG3
Mount Type: Turret Cupola
Maximum Aimed Range (m): INA
Max Effective Range (m): INA
Fire on Move: Yes
Rate of Fire (rd/min): INA
ATGM Launcher: N/A

FIRE CONTROL
FCS Name: N/A
Main Gun Stabilization: None/stabilization for -1A1A1 and after
Rangefinder: TEM 2A Optical
Infrared Searchlight: XSW-30-U red/white
Sights w/Magnification:
Gunner:
- Day: TZF 1A telescope, 8x
  - Field of View (°): INA
  - Acquisition Range (m): 1,400
- Night: IR available
  - Field of View (°): INA
  - Acquisition Range (m): 1,000/1,500 white light

Commander Fire Main Gun: No

VARIANTS
Leopard 1 was the baseline tank (first production batch) with original tracks, and without track skirts, stabilization or thermal sleeve for gun.

The **Leopard 1A1** version, as featured, can be fitted with applique armor. **Leopard 1A1A1** is the third production lot, with applique, air filter intakes. Early tanks have been upgraded to this standard.



Leopard 1A2: Production batch and -1A1 upgrade with a new cast turret, improved NBC system, II night sights, and air conditioning.
Italian Leopard 1A2: Upgrade with Sirio thermal FCS, gun stabilization and turret drive.

German Main Battle Tank Leopard 1A1 continued

Leopard 1A3: Production system with previous improvements, larger welded spaced armor turret, and improved FCS (by country).

Leopard 1A4: Final production system with AEG-Telefunken FCS.

Leopard 1A5: More than 1,300 –1A1/1A2 tanks have been refitted with an EMES-18 FCS and thermal sights. **Leopard 1A5 (BE):** Belgian upgraded -1A1/1A2s, with new FCS, FN MAG 7.62-mm MGs, and thermal sights.

Leopard 1-V: Dutch version, of -1A1A1, with German EMES-12A3 FCS and PZB II night sight.

A variety of systems use Leopard 1 chassis. These include Gepard air defense gun, engineer and recovery vehicles, and bridge layer.

MAIN ARMAMENT AMMUNITION
Caliber, Type, Name:

105-mm APFSDS-T, DM43, German Rheinmetall
- Maximum Aimed Range (m): 2,000+
- Max Effective Range (m):
  - Day: 1,400
  - Night: 1,000 IR/1,500 white light/more with thermal
- Armor Penetration (mm): NATO triple heavy target, 5,500 m

105-mm APFSDS-T, M413, Israeli Military Industries
- Maximum Aimed Range (m): 6,000
- Max Effective Range (m):
  - Day: 1,400
  - Night: 1,000 IR/1,500 white light/more with thermal
- Armor Penetration (mm): NATO triple heavy target, 6,000+m

105-mm HEAT-T, OCC 105 F1, French Giat
- Maximum Aimed Range (m): 2,500
- Max Effective Range (m):
  - Day: 1,400
  - Night: 1,000
- Armor Penetration (mm CE): 360 at 0°

105-mm HEAT-T, M456A2, Belgian Mecar
- Maximum Aimed Range (m): 2,500-3,500
- Max Effective Range (m):
  - Day: 1,400
  - Night: 1,000
- Armor Penetration (mm CE): 432 at 0°

105-mm HESH-T, DM512, Rheinmetall
- Maximum Aimed Range (m): 4,000
- Max Effective Range (m):
  - Day: 1,400
  - Night: 1,000 IR/1,500 white light/more with thermal
- Armor Penetration (mm): NATO single heavy target

105-mm HE, OE 105 F1, French Giat
- Maximum Aimed Range (m): 2,500
- Max Effective Range (m):
  - Day: 1,400
  - Night: 1,000
- Armor Penetration (mm): Can defeat an IFV and APC

Other Ammunition Types: Any NATO-standard 105-mm ammunition can be used. They include: Chinese Norinco 105, British Royal Ordinance L64A4 and H6/6, Belgian Mecar M1060, French Giat OFL 105 F1, Spanish Santa Barbara C-437, US M735 and M833 (depleted uranium), and Canadian FP105 APFSDS-T rounds. Other types available are: HE-T, smoke, illuminating, HESH-T, HE plastic tracer (HEP-T), and canister or APERS-T (flechette).

A recent round is the Israeli Military Industries APAM round, which Over-flies the target and disperses fragmenting submunitions outward and downward over a much wider kill zone.

NOTES
More than a dozen fire control systems, many with thermal sights, are available for this tank. A version with LLLTV sights is the Leopard 1A1A2. Improved stabilization systems include US HR Textron, French SAMM, and German FWM. Other options include a front mounted dozer blade, improved air conditioning, a 120-mm smoothbore gun, and other secondary weapons.

German Main Battle Tank Leopard 2A4, 2A5, 2A6, and 2A7+

Leopard 2A4

Weapons & Ammunition Types	Typical Combat Load
120-mm smoothbore gun	**42**
APFSDS-T	
HEAT-MP-T	
7.62-mm machineguns	**4750**
--Coaxial	**2000**
--Cupola MG/stowed	**2750**

SYSTEM
Alternative Designations: Swiss Pz 87, Swedish Strv 121
Date of Introduction: 1979
Proliferation: At least 7 countries
Description:
Crew: 4
Combat Weight (mt): 55.15
Chassis Length Overall (m): 7.69
Height Overall (m): 2.79
Width Overall (m): 3.70
Ground Pressure (kg/cm^2): 0.83

Automotive Performance:
Engine Type: 1,500-hp Diesel
Cruising Range (km): 550
Speed (km/h):
- Max Road: 72
- Max Off-Road: 45
- Average Cross-Country: 40
- Max Swim: N/A

Fording Depths (m): 1.0 Unprepared, 4.0 with snorkel

Radio: INA

Protection:
Armor, Turret Front (mm): 700 KE/1,000 against HEAT (Leo 2A4)
Applique Armor (mm): Track skirt
Explosive Reactive Armor (mm): N/A
Active Protective System: Galix (See note Strv 122)
Mineclearing Equipment: No
Self-Entrenching Blade: No
NBC Protection System: Yes
Smoke Equipment: Smoke grenade launchers, 8 each side of turret

ARMAMENT
Main Armaments:
Caliber, Type, Name: 120-mm smoothbore gun M256
Rate of Fire (rd/min): INA
Loader Type: Manual
Ready/Stowed Rounds: 15/27
Elevation (°): -9 to +20
Fire on Move: Yes

Auxiliary Weapon:
Caliber, Type, Name: 7.62-mm (7.62x 51) Machinegun MG3A1
Mount Type: Turret Coax
Maximum Aimed Range (m): INA
Max Effective Range (m): INA
Fire on Move: Yes
Rate of Fire (rd/min): 1,200
Caliber, Type, Name: 7.62-mm (7.62x 51) Machinegun MG3A1
Mount Type: Turret Cupola
Maximum Aimed Range (m): INA
Max Effective Range (m):
- Day: INA
- Night: INA

Fire on Move: Yes
Rate of Fire (rd/min): 1,200
ATGM Launcher: N/A

FIRE CONTROL
FCS Name: INA
Main Gun Stabilization: WNA-H22, 2-plane
Rangefinder: Laser neodymium
Infrared Searchlight: Yes
Sights w/Magnification:
Gunner:
- Day: Krupp-Atlas EMES-15, 12x / FERO Z18 secondary, 8x
  - Field of View (°): 5/10
  - Acquisition Range (m): INA
- Night: Zeiss thermal imager
  - Field of View (°): INA
  - Acquisition Range (m): INA

Commander Fire Main Gun: Yes

VARIANTS
A variety of MBT variants from 2A1 to 2A4 denote minor changes, as well as FCS upgrades. Combat support variants include an armored recovery vehicle.

Pz87: Swiss variant with indigenous MGs, comms, FCS, and improved NBC equipment.

Dutch Leopard 2: Uses indigenous equipment as noted above.

Leopard 2A5/Leopard 2 (Improved): Upgrade with substantially increased spaced armor on turret front, hull, and sides. Other improvements include improved stabilization, suspension, navigation, 2nd gen thermal fire control, hatch design, and APFSDS-T rounds. This is a standard German tank and is widely exported in NATO.

National War College Photo

German Main Battle Tank Leopard 2A4, 2A5, and 2A6 continued

NATO countries use the following custom variants of the Leo 2A5:

Leopard 2A5M: Canadian upgrade variant.

Leopard 2A6: German upgrade with 55-caliber L55 gun, improved ammo, new APU, battle management system, etc.

Leopard 2A7+
This evolution of the Leopard PSO was introduced at the 2010 Eurosatory exhibition. It has very similar capabilities to the PSO, as well as combat engineering attachments for dozer blades, mine plows and other equipment.
It features redesigned final drive, tracks and suspension. The army is reportedly upgrading part of its Leopard 2A6 fleet to the 2A7 standard.
The Leopard 2A7+ package can be retrofitted to existing vehicles or supplied as a newbuild tank. The upgrade package is modular and can be tailored to customer requirements. It is typically armed with the longer L55 gun. Improvised explosive device (IED) jammers and a hard- or soft-kill defensive aids system can be fitted.
The driver has a suspended Autoflug seat and a new day thermal camera on the glacis plate, which feeds a multipurpose screen. The tank commander is equipped with the Carl Zeiss RTWL-B roof-mounted stabilized panoramic sight. This has a direct optical sight with three fields of view plus a third-generation Attica thermal imager, laser rangefinder and daylight camera for hunter-killer target engagements.
Electronics and systems are linked through a CAN bus, which provides information to all crewmembers on flat-panel displays and can also show information from a standard battle-management system.
An infantry telephone is fitted at the rear, along with a day/night camera feeding a screen at the driver's position for driving in reverse.
An air-conditioning system is installed in the turret bustle and Saab's Barracuda camouflage system is fitted to reduce the thermal load.
The vehicle retains the standard 1,500-hp MTU MB 873 Ka-501 diesel engine coupled to a Renk HSWL 354 automatic transmission.
An auxiliary power unit is fitted to the rear right of the chassis and can support all subsystems without requiring the main engine.

The Leopard 2A7+ has a combat weight of about 67.5 tons in its urban operations configuration. This results in a reduced power-to-weight ratio of about 22 hp/ton, which is considered sufficient for most roles. However, the weight increase required other upgrades, including modified final drives, new and stronger torsion bars, upgraded brakes, new Diehl tracks and a hydraulic jack-tensioning system.
Improved situational awareness is provided through extra day and thermal cameras covering 360-deg around the tank, with images displayed at all crewmembers monitors.
Slat armor is provided around the rear of the turret and chassis to protect against rocket-propelled grenades. Additional top protection for the forward part of the hull and turret is available as an option.

Leopard 2 Hel: Version of 2A6 exported to Greek forces.

The export version with even more armor protection is called **Leopard 2A6 Ex**. Customers include Spain and the Netherlands. It is probably the best-protected tank in the world.

Leopard 2 PSO (Peace Support Operations): Ex version optimized for MOUT operations.

Leopard 2A6M CAN: Ex version for Canadian forces with slat armor added.

Strv 122: Swedish-licensed variant resembling 2A5 with an indigenous turret and other upgrades. The tank features French Galix active protection system and improved command and control.
Sweden developed an HE-T round designed to range 2,000 meters or more for its Leopard-2 and Strv-122 tanks. With additional armor, Strv 122 will weigh 62 mt.

MAIN ARMAMENT AMMUNITION
Caliber, Type, Name:
120-mm APFSDS-T, DM43
Maximum Aimed Range(m): 3,500
Max Effective Range (m):
Day: INA
Night: INA
Armor Penetration (mm KE): 450 at 2,000 meters

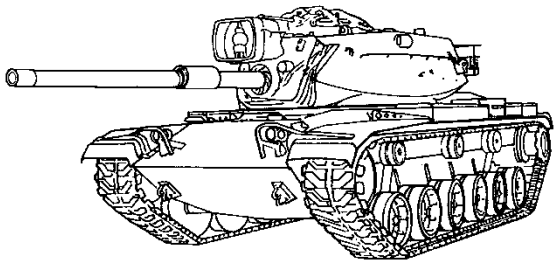
120-mm APFSDS-T, US Olin GD120
Maximum Aimed Range (m): 3,500
Max Effective Range (m):
Day: 3,000
Night: INA
Armor Penetration (mm KE): 520 at 2,000 meters

120-mm HEAT-MP-T, DM-12A1/US Olin M830
Maximum Aimed Range (m): INA
Max Effective Range (m):
Day: 2,500
Night: INA
Armor Penetration (mm): INA

Other Ammunition Types: US-produced M829, M829A1 APFSDS-T; US M830A1 HEAT-MP-T (MPAT), GE DM12A1 (US copy M830) HEAT-MP-T (MPAT)

NOTES
A variety of upgrade programs and options are available for the Leopard 2. These include the Atlas Elektronik Vehicle Integrated Command and Information System (IFIS), a digital command and information system. The new longer gun barrel (L55 gun barrel, 1.30 meters longer) is available for earlier vehicles. It permits effective use of a new APFSDS-T round, DM53 (LKE II), with a longer rod penetrator, and which is under development. The German Army has decided not to buy the DM43 APFSDS-T round (aka LKE 1), rather wait and upgrade to the DM53 round. An expected near-term upgrade is addition of the Spear gun-launch ATGM, which was derived from the Russian AT-10B Arkan.

United States Main Battle Tank M60A1/M60A3



M60A1

Weapons & Ammunition Types	Typical Combat Load
105-mm rifled gun	**63**
APFSDS-T	
HEAT	
HE	
APERS-T/Canister	
.50 cal AA MG	**900**
7.62-mm coaxial MG	**5,950**

SYSTEM (M60A1 / M60A3, where their data differs)
Alternative Designations: INA
Date of Introduction: 1963/1979
Proliferation: At least 17 countries
Description:
Crew: 4
Combat Weight (mt): 52.5
Chassis Length Overall (m): 6.95
Height Overall (m): 3.27
Width Overall (m): 3.63
Ground Pressure (kg/cm^2): 0.87

Automotive Performance:
Engine Type: 750-hp Diesel
Cruising Range (km): 550
Speed (km/h):
Max Road: 48
Max Off-Road: 45
Average Cross-Country: 35
Max Swim: N/A
Fording Depths (m): 1.2, 2.4 Prepared, 4 with snorkel
Radio: AN/VRC-12, or compatible with army net radios

Protection:
Armor, Turret Front (mm): 325 KE RHA at 2,000 m/325 CE
Applique Armor (mm): Available, including modular armor
Explosive Reactive Armor (mm): BLAZER and others available
Active Protective System: N/A
Mineclearing Equipment: GDLS mine roller system available
Self-Entrenching Blade: INA
NBC Protection System: Yes
Smoke Equipment: Smoke grenade launchers (2 x 6) on M60A3
VEESS on later M60A3s

ARMAMENT
Main Armaments:
Caliber, Type, Name: 105-mm 51-cal rifled gun, M68
Rate of Fire (rd/min): 6-8
Loader Type: Manual
Ready/Stowed Rounds: 16/ 47
Elevation (°): -10 to +20
Fire on Move: No

Auxiliary Weapon:
Caliber, Type, Name: 7.62-mm (7.62x51) Machinegun, M73/M240
Mount Type: Turret coax
Max Aimed Range (m): 2,000 (est)
Max Effective Range (m):
Day: 1,800
Night: INA
Fire on Move: Yes
Rate of Fire (rd/min): 600-950

Caliber, Type, Name: .50 cal (12.7-mm) AA Machinegun, M85
Mount Type: Cupola
Max Aimed Range (m): 2,000
Max Effective Range (m):
Day: 2,000 (est)
Night: INA
Fire on Move: Yes
Rate of Fire (rd/min): 450-550 (est)

FIRE CONTROL
FCS Name: M32E1 day/night periscope / M35 or M36E1 sight
Main Gun Stabilization: Available / poor 2-plane
Rangefinder: M17C coincidence / AN/VVG-2 ruby laser
Infrared Searchlight: Number 2 IR and white light
Sights w/Magnification:
Gunner:
Day: M31, 8x / M35 or M36E1, 8x
Field of View (°): 7.5
Acquisition Range (m): 2,000 / 3,000
Night: II for M60A1, thermal TTS for M60A3
Field of View (°): INA / See NOTES
Acquisition Range (m): INA
Commander Fire Main Gun: INA

VARIANTS
M60: Original tank was derived from M48, but with a 105-mm gun. Vehicles derived from the M60 include **M60 AVLB**, the **M9** bulldozer, and **M728** Combat Engineer Vehicle.

M60A1: Features a reshaped turret, added ammunition stowage, rangefinder, improved fire control, and improved running gear.

M60A2: Unique and less successful tank version with a 152-mm gun and Shillelagh ATGM from the M-551/Sheridan.

M60A3: This version has better engine, fire control, thermal sights, ballistic computer, thermal sleeve, and improved stabilizer. A number of countries have upgraded M60A1s to comparability to the M60A3 standard. These include Israel, Austria, and Saudi Arabia.

MAGACH-7: Israeli variant with improved engine, track, fire control system, added stabilized sights, modular armor, armor track skirts, thermal sleeve, and with two 7.62-mm only cupola MGs.

MAIN ARMAMENT AMMUNITION
Caliber, Type, Name:
105-mm APFSDS, UI (New Chinese)
Max Aimed Range (m): 3,000
Max Effective Range (m):
Day: 2,000 / 3,000 (est)
Night: INA
Armor Penetration (mm KE): 460 at 2,000 m

United States Main Battle Tank M60A1/M60A3 continued

Caliber, Type, Name: 105-mm APFSDS, H6/62 (UK)
Max Aimed Range (m): 3,000
Max Effective Range (m):
Day: 2,000 / 3,000
Night: INA
Armor Penetration (mm): NATO single heavy target, 5,000 m

Caliber, Type, Name: 105-mm APFSDS, DM23 (GE)
Max Aimed Range (m): 3,000
Max Effective Range (m):
Day: 2,000 / 3,000
Night: INA
Armor Penetration (mm): 150, NATO single heavy target, 60° at 2,000 m

Caliber, Type, Name: 105-mm HEAT, M456 (multinational)
Max Aimed Range (m): 3,000
Max Effective Range (m):
Day: 1,500-2,000 / 1,500-2,500 (est.)
Night: INA
Armor Penetration (mm): 432, NATO single heavy target

Caliber, Type, Name: 105-mm HESH, L35 (UK)
Max Aimed Range (m): 3,000
Max Effective Range (m):
Day: 2,000 / 2,000-2,500 (est.)
Night: INA
Armor Penetration (mm): NATO single heavy target

Caliber, Type, Name: 105-mm HE, HE-OE (FR)
Max Aimed Range (m): 3,000
Max Effective Range (m):
Day: 2,000 / 2,500-3,000 (est.)
Night: INA
Armor Penetration (mm): Can defeat an IFV and APC

Caliber, Type, Name: 105-mm APERS-T, M494 (Flechette)
Max Aimed Range (m): 3,000
Max Effective Range (m):
Day: 2,000 / 3,000
Night: INA
Armor Penetration (mm): N/A

Other Ammunition Types: Chinese Type 83/ UK L64/ US M735 APFSDS, UK L52 APDS, multinational M393 HEP-T, L39 Smoke, French OBUS 105 F1 Illuminating, Australian TC800 Canister (balls)

NOTES
A variety of day and night sights (including thermal and stabilized), stabilization systems and ballistic computers are available for M60A1 and M60A3. The TTS thermal sight (5x and 10x, FOV 6x4 and 12x8°) was added to US M60A3, and has been widely fielded.

The Swiss 120-mm Compact Tank Gun is available.

Israeli IMI offers the APAM round with submunitions and a time fuze.

Israeli IAI now offers LAHAT gun-launched ATGM, with semi-active laser homing and tandem warhead; but it requires modified fire control.

Israeli IMI offers several upgrade packages, such as SABRA, for the SABRA MBT. This private venture includes extensive upgrades for mobility, lethality, and protection, including a 120-mm main gun.

Russian Main Battle Tank T-34/85

National War College Photo

Weapons & Ammunition Types	Typical Combat load
85-mm rifled gun	**55**
APC-T/HVAP-T	
HEAT-FS	
AP HE	
Frag-HE, HE	
2 x 7.62-mm MG (7.62x54R)	**2,745**

SYSTEM
Alternative Designations: T-34-85 Model 1944
Date of Introduction: 1944
Proliferation: At least 20 countries with T-34 tanks and variants
Description:
Crew: 5
Combat Weight (mt): 32
Chassis Length Overall (m): 6.1
Height Overall (m): 2.7
Width Overall (m): 2.99
Ground Pressure (kg/cm^2): 0.88

Automotive Performance:
Engine Type: 500-hp Diesel
Cruising Range (km): 300, 500 with extra tanks
Speed (km/h):
Max Road: 56
Max Off-Road: 35
Average Cross-Country: INA
Max Swim: N/A
Fording Depths (m): 1.3, 5.5 with snorkel

Radio: R-113, R-123 in later versions

Protection:
Armor, Turret Front (mm): 75-85
Applique Armor (mm): No
Explosive Reactive Armor (mm): No
Mineclearing Equipment: Plow, roller, and dozer blade available
Self-Entrenching Blade: N/A
Active Protective System: No
NBC Protection System: No
Smoke Equipment: 2 x BDSh smoke charges

ARMAMENT
Main Armament: 85-mm rifled gun, D-5T or ZIS-S-53
Rate of Fire (rd/min): 3-4
Loader Type: Manual
Ready/Stowed Rounds: INA
Elevation (°): -5 to + 25
Fire on Move: No

Auxiliary Weapon:
Caliber, Type, Name: 7.62-mm MG, SGMT (early upgrade)
Mount Type: Coaxial
Maximum Aimed Range (m): 2,000
Max Effective Range (m):
Day: 1,000/ 400-500 on the move
Night: N/A
Fire on Move: Yes
Rate of Fire (rd/min): 250 practical /650 cyclic, 2-10 rd bursts

Caliber, Type, Name: 7.62-mm MG, SGMB (early upgrade)
Mount Type: Bow
Maximum Aimed Range (m): 2,000
Max Effective Range (m):
Day: 1,000/ 400-500 on the move
Night: N/A
Fire on Move: Yes
Rate of Fire (rd/min): 250 practical/650 cyclic, 2-10 rd bursts

FIRE CONTROL
FCS Name: INA
Main Gun Stabilization: None
Rangefinder: Stadiametric
Infrared Searchlight: No
Sights w/Magnification:
Gunner:
Day: TSh-15 or TSh-16 articulated telescope, 4.5x
Field of View (°): 15
Acquisition Range (m): 1,500 direct fire, 5,200 indirect fire
Night: N/A
Field of View (°): N/A
Acquisition Range (m): N/A
Commander Fire Main Gun: No

VARIANTS:
T-34: The baseline tank, also referred to as **T-34/76**, has a 76-mm main gun. Many T-34s have been modified. Earlier versions use the 7.62-mm DTM MG, and later versions 7.62-mm SGMT or PKT MG. Some countries have replaced 7.62-mm AAMG with a 12.7-mm MG. Some Chinese variants have LRFs. Egyptian variants have rubber skirts and a VEESS system. Conversions include 122-mm SP guns, self-propelled AA guns, armored recovery vehicles, bridge layers, bulldozers, and flamethrowers. Most are no longer in service.

OT-34-85: Flamethrower version is indistinguishable from the **T-34/85**, with a ZIS-S-53 gun and 60-70 m flame range.

Poland and Czechoslovakia also produced **T-34/85**.

MAIN ARMAMENT AMMUNITION
Caliber, Type, Name: 85-mm HVAP-T, BR-365PK
Max Aimed Range (m): 1,500
Max Effective Range (m):
Day: 1,150 (direct fire range)
Night: N/A
Armor Penetration (mm KE): 130 (0°) at 1,000 m, 167 (0°) at muzzle

Russian Main Battle Tank T-34/85 continued

Caliber, Type, Name: 85-mm APC-T, BR-367
Max Aimed Range (m): 1,500
Max Effective Range (m):
Day: 1,150 (est)
Night: N/A
Armor Penetration (mm KE): 120 (0°) at 1,000 m

Caliber, Type, Name: 85-mm HEAT-FS, BK-2M
Max Aimed Range (m): 1,500 (est)
Max Effective Range (m):
Day: 970 direct fire range
Night: N/A
Armor Penetration (mm CE): 100 at 65°, 300-400 at 0° all ranges

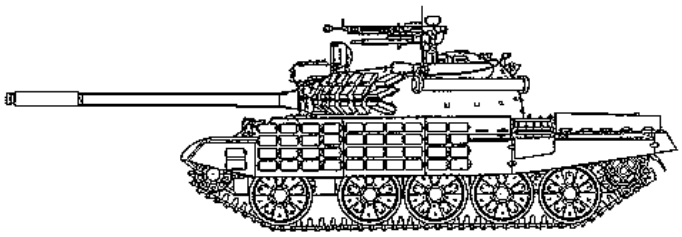
Caliber, Type, Name: 85-mm, AP HE,
Max Aimed Range (m): 1,500 (est)
Max Effective Range (m):
Day: 1,150 (est)
Night: N/A
Armor Penetration (mm KE): 102 (0°) at 1,000 m

Caliber, Type, Name: 85-mm Frag-HE, O-365K
Max Aimed Range (m): 5,200
Max Effective Range (m):
Day: INA
Night: N/A
Armor Penetration (mm): Can defeat most IFVs on impact

Other Ammunition Types: Chinese smoke, Russian HVAP-T BR-365P, Russian AP-T BR-365 and BR-365K, Russian Frag-HE O-365, North Korean APC-T Type 367

NOTES
Main gun is in the family with D-44 and SD-44 field guns, KS-12 AA Gun and ASU-85 assault gun. Ammunition options include the variety of ammunition available for these guns.

Russian Main Battle Tank T-55AMV



Weapons & Ammunition Types	Typical Combat Load
100-mm rifled gun	(mix est) **43**
APFSDS-T	14
HEAT	3
Frag-HE	21
ATGM	5
7.62-mm coax PKT MG	**1,250**
12.7-mm AA MG	**500**

SYSTEM
Alternative Designations: INA
Date of Introduction: 1983
Proliferation: At least 3 countries
Description:
Crew: 4
Combat Weight (mt): 40.5
Chassis Length Overall (m): 6.20
Height Overall (m): 2.32
Width Overall (m): 3.60
Ground Pressure (kg/cm^2): 0.89

Automotive Performance:
Engine Type: 620-690 hp Diesel
Cruising Range (km): 390/600 with extra tanks
Speed (km/h):
- Max Road: 50
- Max Off-Road: 35
- Average Cross-Country: 25
- Max Swim: N/A

Fording Depths (m): 1.4 Unprepared, 5.5 with snorkel

Radio: R-173, R-173P, R-124 intercom

Protection:
Armor, Turret Front (mm): 200 (base T-55 armor)
Applique Armor (mm): Rubber screens and box armor
Explosive Reactive Armor (mm): 1st Gen raises CE only to 700-800 against HEAT; 2nd Gen raises to 350-480 KE/700-900 HEAT
Active Protective System: Russian Drozd APS available
Mineclearing Equipment: Roller-plow set, and plows available
Self-Entrenching Blade: No
NBC Protection System: Yes
Smoke Equipment: Smoke grenade launchers (4x 81-mm each side of turret), and 24 grenades. Vehicle engine exhaust smoke system

ARMAMENT
Main Armaments:
Caliber, Type, Name: 100-mm rifled gun, D-10T2S
Rate of Fire (rd/min): 5-7
Loader Type: Manual
Ready/Stowed Rounds: INA
Elevation (°): -5 to +18
Fire on Move: Yes (gun rounds only--ATGMs require a short halt)

Auxiliary Weapon:
Caliber, Type, Name: 7.62-mm (7.62x 54R) Machinegun PKT-T
Mount Type: Turret coax
Maximum Aimed Range (m): 2,000
Max Effective Range (m):
- Day: 800
- Night: 800

Fire on Move: Yes
Rate of Fire (rd/min): 250 rpm practical, 800 cyclic, 2-10 rd bursts

Caliber, Type, Name: 12.7-mm (12.7x108) AA MG DShKM
Mount Type: Turret top
Maximum Aimed Range (m): 2,000
Max Effective Range (m):
- Day: 1,500
- Night: N/A

Fire on Move: Yes
Rate of Fire (rd/min): 80-100 practical, 600 cyclic, 2-10 rd bursts

ATGM Launcher:
Name: D-10T2S gun
Launch Method: Gun-launched
Guidance: SACLOS, Infrared laser-beam rider
Command Link: Encoded laser-beam
Rate of Launch: (missiles/min): 2-3, depending on range
Launcher Dismountable: No

FIRE CONTROL
FCS Name: Volna
Main Gun Stabilization: M1 Tsiklon 2-plane
Rangefinder: KDT-2 Laser
Infrared Searchlight: L-4
Sights w/Magnification:
Gunner:
- Day: TShSM-32PV, 3.5x and 7x
  - Field of View (°): 18 and 8
  - Acquisition Range (m): 4,000
- Night: 1K13-1
  - Field of View (°): INA
  - Acquisition Range (m): 800-1,300, gun rounds only

Note: The 1K13 sight is both night sight and ATGM launcher sight; however, it cannot be used for both functions simultaneously.
Commander Fire Main Gun: No

VARIANTS
More than a dozen countries have produced upgraded T-54 and T-55 variants with similar capabilities in protection and lethality. Many countries have upgraded to a larger main gun.

T-55AMV is derived from a line of variants of T-55 MBT. **T-55A** added an NBC protection system. **T-55M** added the Volna fire control system (with ATGM launcher), improved gun stabilization and sights, improved engine, new radio, and increased protection. That included side skirts, smoke grenade launchers, applique armor, and fire protection. **T-55AM** added BDD (aka eyebrow or bra) armor, an armor band around the turret for 180° coverage. The **-AMV** upgrade means substitution of ERA for BDD. Variants ending with **-1** denote the engine replaced w/V-46 from T-72 MBT.
T-55AM2: Czech or East German, or Polish version of T-55AM without ATGM
T-55AM2B: Czech or East German version of T-55AM with Kladivo fire control
T-55AM2P: Polish T-55AM with Merida FCS and ATGM
T-55AMD: Variant with the Drozd APS instead of ERA.
T-55AD Drozd: Variant with Drozd but not Volna FCS and ERA.

Russian Main Battle Tank T-55AMV continued

Other T-54/T-55 Upgrades:
Several former Warsaw Pact countries produced tanks which are similar to the T-55AMV. Other countries have indigenous upgrade programs, which have resulted in different but capable configurations. Here are a few of these configurations.

Al Zarrar: Pakistani modernized Type 59 Chinese copy of T-55. The tank has a 125 smooth-bore gun, Image-Stabilized Fire Control System (ISFCS), thermal sight, 730-hp engine, ERA, including on the skirts and improved APFSDS-T (sabot) round.

Type 59-II tank: It has 105-mm rifled gun and other improvements, as noted on the WEG page. Other tanks based on the Type 59 include **Type 69** and **Type 79** designs. A NORINCO **Type 59 Retrofit Package** is compatible with T-55 and Type 59 upgrades.

M-55 SI: Slovenian T-54/55 upgrade with assistance from Israeli Elbit Corporation. It features an L7 105-mm rifled gun, computer FCS with LRF, stabilized day/night II sight, and hunter-killer fire control. A thermal sight is available. Survivability improvements are ERA plates, track skirts, LWR-triggered smoke grenades, and Halon fire suppression. New engine, tracks, and comms were added.

T-72Z/ Safir 74: Iranian upgrade variant of T-54/55 and Type 59. This constitutes state-of-the-art for upgraded 50s-generation former Warsaw Pact tanks. This tank has a 780-hp diesel engine, track skirts, and smoke grenade launchers. An Iranian ERA package is fitted. Armament includes an M68 105-mm rifled gun, 7.62-mm Type 59T (PKT) MG, and a 12.7-mm Type 59 (DShKM) MG. The cannon can launch AT-10/ Bastion ATGMs to 4,000 meters, and fire a broad range of NATO 105-mm ammunition. Fire control includes the robust Slovenian EFCS-3-55 fire control system with a ballistic computer, stabilization, and a laser rangefinder. The FCS includes a commander's independent viewer and target designation system, and II gunner night sights. Under the Zulfiqar program, subsystem upgrades from this vehicle package could be added to other T-55s.

Czech Upgrade: A prototype was displayed with 2nd Gen ERA, and a new LRF fire control system.

T-55M: Russian upgrade, with 2nd Gen ERA, T-80U side skirts, new FCS, 125-mm smoothbore gun, 22-rd bustle auto-loader, and improved engine and suspension. There is also fire suppression, smoke grenades, IR-absorbing paint and screens, and comms.

T-55AGM: Ukrainian 48 mt modernized tank (based on T-54/55/62 or Type 59 series). Improvements include 120 or 125-mm gun, new hunter-killer FCS, thermal sight, remote AD MG, and auto-loader. There is also improved ERA, new engine, improved running gear, countermeasures, and new fire suppression. Cbt Wt (mt): Approx 46

BTR-T: Heavy APC or recon vehicle (pg 3-19) uses a T-55 chassis.

MAIN ARMAMENT AMMUNITION
Caliber, Type, Name:
100-mm APFSDS-T, BM-412M
- Maximum Aimed Range (m): 2,500
- Max Effective Range (m):
  - Day: 2,000-2,500
  - Night: 800-1,300
- Armor Penetration (mm KE): 418 at 2,000 m, 380 at 3,000 m

100-mm APFSDS-T, M1000, Belgian
- Maximum Aimed Range (m): 2,500
- Max Effective Range (m):
  - Day: 2,500 (est)
  - Night: 800-1,300
- Armor Penetration (mm): NATO triple heavy target, 4,500 m

100-mm HEAT, BK-17
- Maximum Aimed Range (m): 2,500
- Max Effective Range (m):
  - Day: 1,000 (est)
  - Night: 800-1,000 (est)
- Armor Penetration (mm CE): 380

100-mm Frag-HE, OF-32
- Maximum Aimed Range (m): 4,000
- Max Effective Range (m):
  - Day: 2,500-4,000
  - Night: 800-1,300
- Armor Penetration (mm): Can defeat IFV and APC

Other Ammunition Types: Original tank BM-8 sabot round with effective range of 1,500 m. It can only penetrate 200 m at 1,000 m. The later BM-25 APFSDS-T round has an effective range of 2,000-2,500 m, penetration INA. A variety of other rounds within the range noted above are available. They include the GIAT NR 322/ NR 352 APFSDS-T and Slovak JPrSv AP-T with ranges beyond 2,000 m.

Antitank Guided Missiles:
Name: AT-10/BASTION
- Warhead Type: Shaped charge (HEAT)
- Armor Penetration (mm CE): 650 (RHA), 150 behind ERA
- Range (m): 4,000 (day only, see NOTES)

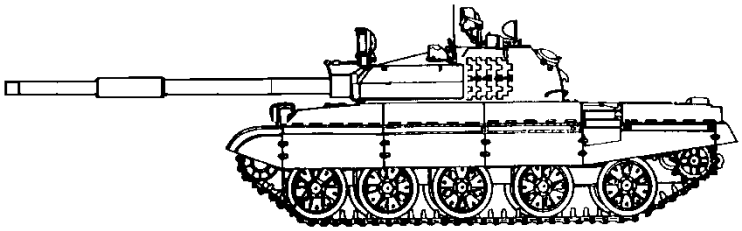
Name: AT-10B/BASTION-M
- Warhead Type: Tandem shaped charge
- Armor Penetration (mm CE): 750 (RHA), 700 behind ERA
- Range (m): 4,000 (day only, see NOTES)

NOTES
The British L7 105-mm rifled gun has been used in several T-54/55/Type 59 tank upgrade programs. Several more recent 105-mm rounds and tank fire control systems have been developed, to increase effectiveness of 105-mm tank guns. There are also now 120-mm low-recoil smoothbore tank guns, such as the Compact Tank Gun (CTG), which fire standard unitary rounds, for T-54/55/Type 59 upgrade programs.

Optional sights and fire control systems include the Israeli El-Op Red Tiger and Matador FCS, Swedish NobelTech T-series sight, and German Atlas MOLF. The Serbian SUV-T55A FCS, British Marconi Digital FCS, South African Tiger, and Belgian SABCA Titan offer upgraded function. One of the best is the Slovenian EFCS-3 integrated FCS. A Romanian/French FCS upgrade package from TR-85M1 tank can be used on T-55 type tanks. It has hunter-killer FC, and thermal gunner sight. A variety of thermal sights are available, including the Russian/French ALIS and Namut-type sight from Peleng. There are also thermal sights which permit night launch of ATGMs.

T-55s with BDD or "bra armor" (semi-circular add-on armor) have turret protection increased to 330 mm (KE) and 400-450 mm (CE). Other improvements available include a hull bottom reinforced against mines, better engines, rubber track pads, and a thermal sleeve for the gun. Some forces have added ERA, applique, or box armor to T-55 tanks. These protection improvements may give marginal improvement against older rounds up to 105 mm, but do not protect sufficiently to defeat most 120-125 mm APFSDS-T rounds at 2,000 m. They offer some degree of protection against some Tier 4 and a few Tier 3 ATGL warheads and ATGMs, but not against more modern AT weapons.

Russian Main Battle Tank T-62M



Weapons & Ammunition Types	Typical Combat Load
115-mm rifled gun	(mix est) **40**
APFSDS-T	12
HEAT	3
Frag-HE	20
ATGM	5
7.62-mm coax PKT MG	**2,500**

SYSTEM
Alternative Designations: INA
Date of Introduction: 1983
Proliferation: At least 1 country

Description:
Crew: 4
Combat Weight (mt): 41.5
Chassis Length Overall (m): 6.63
Height Overall (m): 2.4
Width Overall (m): 3.52
Ground Pressure (kg/cm^2): INA

Automotive Performance:
Engine Type: 620-hp Diesel
Cruising Range (km): 450/650 with extra tanks
Speed (km/h):
Max Road: 45
Max Off-Road: INA
Average Cross-Country: INA
Max Swim: N/A
Fording Depths (m): 1.4 Unprepared, 5.5 with snorkel

Radio: R-173, R-173P, R-124 intercom

Protection:
Armor, Turret Front (mm): 230
Applique Armor (mm): Bra armor (+100 on turret) and track skirts
Explosive Reactive Armor (mm): Available, replaces bra armor
Active Protective System: Russian Drozd APS will fit
Mineclearing Equipment: Roller-plow set, and plows
Self-Entrenching Blade: No
NBC Protection System: Nuclear radiation only
Smoke Equipment: Vehicle engine exhaust smoke system
2 x 4 Smoke grenade launchers

ARMAMENT
Main Armaments:
Caliber, Type, Name: 115-mm smoothbore gun, 2A20/Sheksna
Rate of Fire (rd/min): 3-5
Loader Type: Manual
Ready/Stowed Rounds: INA
Elevation (°): -5 to +18
Fire on Move: Yes (gun rounds only--ATGMs require a short halt)

Auxiliary Weapon:
Caliber, Type, Name: 7.62-mm (7.62x 54R) machinegun PKT
Mount Type: Turret coax
Maximum Aimed Range (m): 2,000
Max Effective Range (m):
Day: 800
Night: 800
Fire on Move: Yes
Rate of Fire (rd/min): 250 rpm practical, 800 cyclic, 2-10 rd bursts

ATGM Launcher:
Name: 2A20 gun
Launch Method: Gun-launched
Guidance: SACLOS, Infrared laser-beam rider
Command Link: Encoded laser-beam
Rate of Launch: (missiles/min): 2-3, depending on range
Launcher Dismountable: No

FIRE CONTROL
FCS Name: Volna
Main Gun Stabilization: M1 Meteor 2-plane
Rangefinder: KTD-2 Laser
Infrared Searchlight: L-4
Sights w/Magnification:
Gunner:
Day: TShSM-41U, 3.5x and 7x
Field of View (°): 18 and 8
Acquisition Range (m): 1,800 day only
Night/ATGM Day: 1K13-1
Field of View (°): INA
Acquisition Range (m): 850-1,300, gun rounds night
Acquisition Range (m): 4,000 ATGM day only
Commander Fire Main Gun: No

VARIANTS
T-62M is one of a variety of T-62 variants.
T-62 variants with a V-46 T-72-type engine add **-1** to their designation.
T-62A: added a 12.7-mm MG.
T-62M adds bra protection, FCS and ATGM capability.
T-62M1: Variant with Volna FCS but no missile-launch capability.
T-62MK: Command variant.
T-62MV: Version with ERA in place of the BDD armor. The ERA includes Kontakt ERA and Kontakt-5 2nd-Generation ERA.
T-62D: Variant of T-62M with the Drozd APS vs ERA.
T-55AGM: Ukrainian upgrade can use T-62 chassis (see pg 5-21).

MAIN ARMAMENT AMMUNITION
Caliber, Type, Name:
115-mm APFSDS-T, BD/36-2
Maximum Aimed Range (m): 3,000
Max Effective Range (m):
Day: 1,800
Night: 850-1,300
Armor Penetration (mm KE): 520 (RHA, 71° angle) at 1,000 m

115-mm APFSDS-T, BM-6 Russian
Maximum Aimed Range (m): 3,000
Max Effective Range (m):
Day: 1,800
Night: 850-1,300
Armor Penetration (mm KE): 237 (RHA) at 1,000 m

Russian Main Battle Tank T-62M

115-mm HEAT, BK-4 Maximum Aimed Range (m): 1,500 (est) Max Effective Range (m): Day: 1,500 Night: 850-1,200 Armor Penetration (mm CE): 495 (RHA) 115-mm Frag-HE-T, OF-27 Maximum Aimed Range (m): 4,000 Max Effective Range (m): Day: 4,000 adjust using 1K13-1 for adjustment Night: 850-1,300 Armor Penetration (mm): Can defeat IFV and APC. A near miss will seriously damage or destroy most IFVs and APCs. **Other Ammunition Types:** BM-3 APFSDS, BM-4 APFSDS, BK-4M HEAT, BK-15 HEAT, OF-11 Frag-HE, OF-18 Frag-HE	**Antitank Guided Missiles** Name: AT-10/Sheksna Warhead Type: Shaped charge (HEAT) Armor Penetration (mm CE): 750, 250 behind ERA Range (m): 4,000 day only (5,000 limited by sight range) Name: AT-10b/9M117M2 Warhead Type: Tandem shaped charge Armor Penetration (mm CE): 800, 750 behind ERA Range (m): 4,000 day only (6,000 limited by sight range)

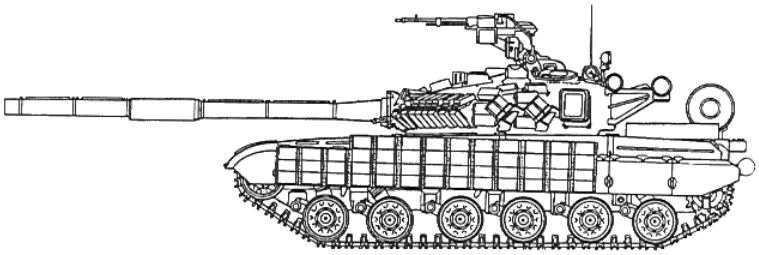
NOTES
The 1K13 sight is both night sight and ATGM launcher sight; however, it cannot be used for both functions simultaneously. With a simple upgrade (replacing the laser timer), the sight can accommodate a range increase to the missile range. For most Tier 3 and 4 portrayals, the upgrade is not likely. But the option is a cost-effective one.

Optional sights and fire control systems include the Israeli El-Op Red Tiger and Matador FCS, Swedish NobelTech T-series sight, and German Atlas MOLF. The British Marconi Digital FCS, South African Tiger, and Belgian SABCA Titan offer upgraded function. One of the best is the Slovenian EFCS-3 integrated FCS.

A variety of thermal sights is available. They include the Russian Agava, French SAGEM-produced ALIS and Namut sight from Peleng. There are thermal sights available for installation, which permits night launch of ATGMs.

Other improvements available include a hull bottom reinforced against mines, rubber track pads, and a thermal sleeve for the gun.

Russian Main Battle Tank T-64B



T-64BV

Weapons & Ammunition Types	Typical Combat Load
125-mm smoothbore gun	**37**
APFSDS-T	(mix est) 12
HEAT	2
Frag-HE	17
ATGM	6
7.62-mm coax MG	**1,250**
12.7-mm NSVT AA MG	**300**

SYSTEM
Alternative Designations: INA
Date of Introduction: 1979
Proliferation: At least 2 countries
Description:
Crew: 3
Combat Weight (mt): 40.3, 42.5 for T-64BV with ERA
Chassis Length Overall (m): 6.45
Height Overall (m): 2.17
Width Overall (m): 3.41
Ground Pressure (kg/cm^2): 0.86

Automotive Performance:
Engine Type: 720-hp Diesel
Cruising Range (km): 500 with extra tanks
Speed (km/h):
- Max Road: 60
- Max Off-Road: INA
- Average Cross-Country: INA
- Max Swim: N/A

Fording Depths (m): 1.8 Unprepared, 5.0 w/snorkel

Radio: R-123M, R-124 intercom

Protection:
Armor, Turret Front (mm): 450 KE RHA at 2,000 m/950 HEAT
Applique Armor (mm): N/A
Explosive Reactive Armor (mm): Standard on T-64BV
Active Protective System: Available
Mineclearing Equipment: Mine rollers and plows available
Self-Entrenching Blade: Yes
NBC Protection System: Yes
Smoke Equipment: Smoke grenade launchers (4x 81-mm each side of turret), and 24 grenades. Vehicle engine exhaust smoke system

ARMAMENT
Main Armament:
Caliber, Type, Name: 125-mm smoothbore gun 2A46-2
Rate of Fire (rd/min): 6-8 (lower in manual mode)
Loader Type: Separate-loading autoloader, ATGMs manual
Ready/Stowed Rounds: 24 in carousel, 6 ATGMs manual/7 stowed
Elevation (°): -6 to +18
Fire on Move: Yes (30 km/h rounds/low speed or stop ATGMs)

Auxiliary Weapon:
Caliber, Type, Name: 7.62-mm (7.62x 54R) Machinegun PKT
Mount Type: Turret coax
Maximum Aimed Range (m): 2,000
Max Effective Range (m):
- Day: 1,000
- Night: 850-1,300

Fire on Move: Yes
Rate of Fire (rd/min): 250 practical / 650 cyclic, 2-10 round bursts

Caliber, Type, Name: 12.7-mm (12.7x108) AA MG NSVT
Mount Type: Turret top
Maximum Aimed Range (m): 2,000
Max Effective Range (m):
- Day: 1,500 ground/1,600 for air targets (APDS)
- Night: 800-1,300

Fire on Move: Yes
Rate of Fire (rd/min): 210 practical/ 800 air targets in bursts

ATGM Launcher:
Name: 2A46-2 tank gun
Launch Method: Gun-launched
Guidance: SACLOS
Command Link: Encoded radio frequency
Rate of Launch: (missiles/min): 2-3, depending on range
Launcher Dismountable: No

FIRE CONTROL
FCS Name: INA
Main Gun Stabilization: 2E26M 2-plane
Rangefinder: Laser
Infrared Searchlight: Yes
Sights w/Magnification:
Gunner:
- Day: 1G42
  - Field of View (°): INA
  - Acquisition Range (m): 5,000
- Night: TPN-1-49-23
  - Field of View (°): INA
  - Acquisition Range (m): 800-1,300 (est)

Commander Fire Main Gun: No

VARIANTS
T-64A: Production version of base tank. That tank has a history of reliability problems. It also lacks the high armor protection, track skirts, a FCS and ATGM launch capability for T-64B.

T-64BK: Command tank version, with 10-m whip antenna.

T-64B1: Version of -B tank without ATGM launch capability.

T-64BV: Variant noted in the above line drawing has Kontakt ERA mounted. This variant is more likely for encounter by US forces.

Russian Main Battle Tank T-64B continued

T-64U/T-64BM2: Upgrade series marketed by Ukrainian Malyshev (T-64 producer) in 2001. The T-64U prototype featured 2nd Gen ERA, composite armor and fire suppression equipment. A variant added T-80U fire control (1A42 gunner day sight) and thermal night sight. This permits it to replace the RF-guided AT-8/Kobra ATGM with the better Refleks series (Svir/Invar) of laser-beam rider ATGMs. A Ukrainian-developed LBR-guided ATGM called Kombat is similar to Refleks. A later variant changed the FCS to T-80UD/ T-90 type, with 1A45 day sight, and Agat thermal night sight.

BM Bulat: This 45 mt upgrade variant is currently being advertised. It includes an 850-hp engine, FCS with 1G46M LRF-based sight and Catherine-based thermal night sight. Remote fired 12.7-mm MG and 5,000 m ATGM are included. Protection includes 2nd Gen ERA.

MAIN ARMAMENT AMMUNITION
Caliber, Type, Name:
125-mm APFSDS-T, BM-42M
Maximum Aimed Range (m): 3,000-4,000
Max Effective Range (m):
Day: 2,000-3,000
Night: 800-1,300
Armor Penetration (mm KE): 590-630 at 2,000 meters

125-mm Frag-HE-T, OF-26
Maximum Aimed Range (m): 5,000
Max Effective Range (m):
Day: 5,000
Night: 800-1,300
Armor Penetration (mm): Can defeat IFV and APC. A near miss will seriously damage or destroy most IFVs and APCs.

125-mm HEAT-MP, BK-29M
Maximum Aimed Range (m): 4,000
Max Effective Range (m):
Day: 3,000
Night: 800-1300
Armor Penetration (mm CE): 650-750 It has some HE effects.

125-mm HEAT, BK-27
Maximum Aimed Range (m): 4,000
Max Effective Range (m):
Day: 2,000-3,000
Night: 800-1,300
Armor Penetration (mm CE): 700-800

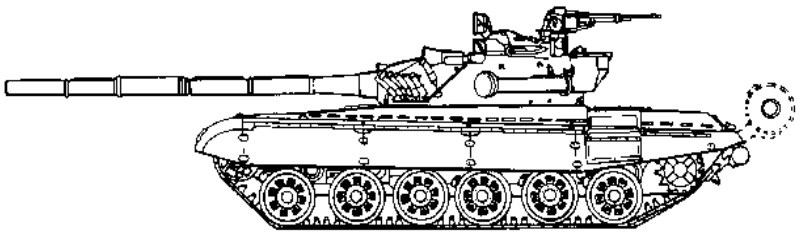
Other Ammunition Types: Giat 125G1 APFSDS-T, Russian BM-42 and BM-32 APFSDS-T. Note: The Russians may have a version of the BM-42M with a DU penetrator.

Antitank Guided Missile:
Name: AT-8/SONGSTER/Kobra
Warhead Type: Shaped charge (HEAT)
Armor Penetration (mm CE): 700 (RHA), 200 behind ERA
Range (m): 4,000

NOTES
The night sight cannot be used to launch the ATGM. The day sight can be used at night for launching ATGMs if the target is illuminated. A variety of thermal sights are available. They include the Russian Agava-2, French SAGEM-produced ALIS and Namut sight from Peleng. There are thermal sights available for installation, which permits night launch of ATGMs.

The more recent BK-27 HEAT round offers a triple-shaped charge warhead and increased penetration against conventional armors and ERA. The BK-29 round, with a hard penetrator in the nose is designed for use against reactive armor, and as an MP round has fragmentation effects. If the BK-29 HEAT-MP is used, it may substitute for Frag-HE (as with NATO countries) or complement Frag-HE. With three round natures (APFSDS-T, HEAT-MP, ATGMs) in the autoloader versus four, more antitank rounds would available for the higher rate of fire.

Russian T-72A and Polish/Czechoslovakian Main Battle Tank T-72M1



Weapons & Ammunition Types	Typical Combat Load
125-mm smoothbore gun	**44**
APFSDS-T	(mix est) 15
HEAT	7
Frag-HE	22
7.62-mm coax MG	**2,000**
12.7-mm AA MG	**300**

SYSTEM
Alternative Designations: The Russian T-72 upgrade was a model for Warsaw Pact T-72M upgrade standardization.
Date of Introduction: 1975
Proliferation: At least 7 countries

Description:
Crew: 3
Combat Weight (mt): 41.5 (without ERA)
Chassis Length Overall (m): 6.91
Height Overall (m): 2.19
Width Overall (m): 3.59
Ground Pressure (kg/cm^2): 0.90

Automotive Performance:
Engine Type: 780-hp Diesel
Cruising Range (km): 460/700 with extra tanks
Speed (km/h):
- Max Road: 60
- Max Off-Road: 45
- Average Cross-Country: 35
- Max Swim: N/A

Fording Depths (m): 1.2 Unprepared/5.0 with snorkel

Radio: R-173M

Protection:
Armor, Turret Front (mm): 500 KE, 560 against HEAT
Applique Armor (mm): Side of hull over track skirt, turret top
Explosive Reactive Armor (mm): 1st or 2nd Gen ERA available
Active Protective System: Arena or Drozd available
Mineclearing Equipment: Roller-plow set, and plows available
Self-Entrenching Blade: Yes
NBC Protection System: Yes
Smoke Equipment: Smoke grenade launchers (6x 81-mm each side of turret), and 24 grenades. Vehicle engine exhaust smoke system.

ARMAMENT
Main Armaments:
Caliber, Type, Name: 125-mm smoothbore gun 2A46M/ D-81TM
Rate of Fire (rd/min): 4-6/2 in manual mode
Loader Type: Autoloader (separate loading) and manual
Ready/Stowed Rounds: 22/22 (22 in carousel)
Elevation (°): -6 to +14
Fire on Move: Yes, up to 25 km/h. Depending on the road and distance to the target, most crews may halt before firing.

Auxiliary Weapon:
Caliber, Type, Name: 7.62-mm (7.62x 54R) Machinegun PKT
Mount Type: Turret coax
Maximum Aimed Range (m): 1,800
Max Effective Range (m):
- Day: 1,000
- Night: 800

Fire on Move: Yes
Rate of Fire (rd/min): 250 practical, 600 cyclic in 2-10 round bursts

Caliber, Type, Name: 12.7-mm (12.7x108) AA MG NSVT
Mount Type: Turret top
Maximum Aimed Range (m): 2,000
Max Effective Range (m):
- Day: 1,500, 1,000 AA
- Night: N/A

Fire on Move: Yes
Rate of Fire (rd/min): 200 practical, 600 cyclic in bursts

ATGM Launcher: N/A

FIRE CONTROL
FCS Name: INA
Main Gun Stabilization: 2E28M, 2-plane
Rangefinder: TPD-K1 laser rangefinder
Infrared Searchlight: Yes
Sights w/Magnification:
Gunner:
- Day: TPD-K1 laser rangefinder sight, 8 x
  - Field of View (°): 9
  - Acquisition Range (m): 3,000 with LRF, 5000 without
- Night: TPN-1-49, 5.5 x
  - Field of View (°): 6
  - Acquisition Range (m): 800

Commander Fire Main Gun: No

VARIANTS
T-72: Original Russian tank from which T-72 variants were derived.

T-72M: Original Polish and former-Czechoslovakian T-72-series tank from which Polish/Czechoslovakian T-72M1 was derived. T-72M differs from T-72 in replacing the right-side coincident rangefinder with a centerline-mounted TPDK-1 LRF. A Middle East export version is **T-72G**.

T-72M1: Modernized version corresponding to the Russian **T-72A** (next page). It added thicker turret front armor and smoke grenade launchers. The Russian export version is aka **T-72M1**.

Many other countries have inventories of T-72, T-72M and T-72M1, with different versions of each variant. Many variants were upgraded or modified. Some T-72M1s do not have smoke grenade launchers or track skirts. Other T-72s/T-72Ms have smoke grenade launchers. More reliable discriminators are armor and rangefinder/FCS.

Russian T-72A and Polish/Czechoslovakian Main Battle Tank T-72M1 continued _

T-72A: The Russian variant differs from T-72 with the TPDK-1 LRF, added side skirts, additional armor on the turret front and top, smoke grenade launchers, internal changes, and a slight weight increase. The Russian export version and Polish/Czechoslovakian counterparts are called **T-72M1**.

T-72AK/7T-2M1K: Commander's variant with additional radios

T-72AV /T-72 M1V: Versions with Kontakt ERA. Hull ERA for the T-72AV uses the same Kontakt ERA as the T-72B/-72S, but is fitted in a more modern and effective "clam-shell" arrangement similar to Kontakt-5 (pg 5-48). In this arrangement, the boxes form a wedge shape to offer a shallower angle to incoming rounds, for greater deflection of KE penetrators and shaped-charge plasma streams.

T-72AV on a low-boy trailer

Ajeya: Indian T-72M tank. The **Ajeya Mk1** version updated the tank to the T-72M1 standard. **Ajeya Mk2** is a further upgrade with "clam-shell" ERA to the T-72AV/T-72MV standard.

Indian Ajeya Mk2 tank

M-84: Former Yugoslavian tank is upgraded to T-72M1 standard, but with indigenous sights. The Slovenian upgrade features state-of-the-art (and the well-marketed) EFCS-3 FCS. Chinese, Iranian, and other tanks use this FCS. With an upgraded engine, the tank is **M-84A**. A Croatian improved version of M-84 is **M84A4/Sniper**, with improved fire control and thermal night sights.

National War College Photo

MAIN ARMAMENT AMMUNITION
Caliber, Type, Name:
125-mm APFSDS-T, BM-42M
Maximum Aimed Range (m): 3,000
Max Effective Range (m):
Day: 2,000-3,000
Night: 800
Armor Penetration (mm KE): 590-630 at 2,000 meters

125-mm Frag-HE-T, OF-26
Maximum Aimed Range (m): 5,000
Max Effective Range (m):
Day: 5,000
Night: 800
Armor Penetration (mm): Can defeat IFV and APC. A near miss will seriously damage or destroy most IFVs and APCs.

125-mm HEAT-MP, BK-29M
Maximum Aimed Range (m): 4,000
Max Effective Range (m):
Day: 2,500-3,000
Night: 800
Armor Penetration (mm CE): 650-750
It has some HE effects.

125-mm HEAT, BK-27
Maximum Aimed Range (m): 3,000
Max Effective Range (m):
Day: 2,500
Night: 800
Armor Penetration (mm CE): 700-800

Other Ammunition Types: Giat 125G1 APFSDS-T, Russian BM-42 and BM-32 APFSDS-T. Note: The Russians may have a version of the BM-42M with a DU penetrator.

NOTES
A variety of thermal sights are available. They include the Russian Agava-2, French SAGEM-produced ALIS and Namut sight from Peleng.
The more recent BK-27 HEAT round offers a triple-shaped charge warhead and increased penetration against conventional armors and ERA. The BK-29 round, with a hard penetrator in the nose is designed for use against reactive armor, and as an MP round has fragmentation effects. If the BK-29 HEAT-MP is used, it may substitute for Frag-HE (as with NATO countries) or complement Frag-HE. With three round natures (APFSDS-T, HEAT-MP, ATGMs) in the autoloader versus four, more antitank rounds would available for the higher rate of fire.

Russian Main Battle Tank T-72B and Other T-72 Upgrade Tanks

Weapons & Ammunition Types	Typical Combat Load
125-mm smoothbore gun	**45**
APFSDS-T	(mix est) 15
HEAT-MP or HEAT	3
Frag-HE	21
ATGM	6
7.62-mm coax MG	**2,000**
12.7-mm AA MG	**300**

SYSTEM
Alternative Designations: Rogatka and SMT M1988. It is almost the same as T-72S (export), except more ERA on the side skirts.
Date of Introduction: 1985 original T-72B.
Proliferation: At least 12 countries with sales, copies, and variants.

Description:
Crew: 3
Combat Weight (mt): 44.5
Chassis Length Overall (m): 6.91
Height Overall (m): 2.19
Width Overall (m): 3.58
Ground Pressure (kg/cm^2): 0.90

Automotive Performance:
Engine Type: 840 original diesel engine
Cruising Range (km): 500/ 900 with external tanks
Speed (km/h):
Max Road: 60
Max Off-Road: 45
Average Cross-Country: 35
Max Swim: N/A
Fording Depths (m): 1.2 Unprepared/5.0 with snorkel
Radio: R-173 and R-134

Protection:
Armor, Turret Front (mm): 600, 1000 against HEAT
Applique Armor (mm): Side of hull over track skirt, turret top
Explosive Reactive Armor (mm): Kontakt ERA
Active Protective System: Arena available
Mineclearing Equipment: Roller-plow set, and plows available
Self-Entrenching Blade: Yes
NBC Protection System: Yes
Smoke Equipment: Smoke grenade launchers (8x 81-mm left side of turret), and 32 grenades. Vehicle engine exhaust smoke system.

ARMAMENT
Main Armament:
Caliber, Type, Name: 125-mm smoothbore gun 2A46M/ D-81TM
Rate of Fire (rd/min): 4-6/2 in manual mode
Loader Type: Autoloader (separate loading) and manual
Ready/Stowed Rounds: 22/23
Elevation (°): -6 to +14
Fire on Move: Yes, up to 25 km/h. Depending on the road and distance to the target, most crews may halt before firing.

Auxiliary Weapon:
Caliber, Type, Name: 7.62-mm (7.62x 54R) Machinegun PKT
Mount Type: Turret coax
Maximum Aimed Range (m): 2,000
Max Effective Range (m): 1,000 day, 800 night, vehicle sights
Fire on Move: Yes
Rate of Fire (rd/min): 250 practical, 600 cyclic in 2-10 round bursts

Caliber, Type, Name: 12.7-mm (12.7x108) AA MG NSVT
Mount Type: Turret top
Maximum Aimed Range (m): 2,000
Max Effective Range (m): 1,500/1,000 antiaircraft day, night N/A
Fire on Move: Yes
Rate of Fire (rd/min): 200 practical, 600 cyclic in bursts

ATGM Launcher:
Name: 2A46M
Launch Method: Gun-launched
Guidance: SACLOS, Laser beam rider
Command Link: Encoded infrared laser beam
Rate of Launch: (missiles/min): 2-3, depending on range
Launcher Dismountable: No

FIRE CONTROL
FCS Name: 1A40-1
Main Gun Stabilization: 2E42-2, 2-plane
Rangefinder: TPD-K1M laser rangefinder
Infrared Searchlight: Yes
Sights w/Magnification:
Gunner:
Day: TPD-K1M
Field of View (°): 9
Acquisition Range (m): 5,000
Night: 1K13-49 for 9K120 missile FCS. The sight is used as either gun night sight or ATGM launch sight. However, it cannot be used for both functions simultaneously.
Night Acquisition Range (m): 800-1,300 for II sight
ATGM Day Range (m): 5,000 (4,000 w/ minor changes)
Commander Fire Main Gun: No

VARIANTS
T-72B is the second main variant of the Russian T-72 after T-72A. The original T-72B is generally considered inferior to more modern Russian tanks, such as the T-80U. **T-72BK** is the commander's variant with additional radios. In 1986 a limited production variant was the **T-72B1**, without ATGM launch capability.

T-72S/Shilden: Russian export T-72A upgraded to the T-72B standard. Although visually similar to T-72B, it has slightly less chassis and turret protection. Former WP countries such as Slovakia (see tank below) have upgraded their tanks to the T-72S standard.

Russian Main Battle Tank T-72B and Other T-72 Upgrade Tanks continued _____

T-72B1: Variant with simpler fire control system. Some of these do not have ERA.

T-72BM: Upgrade version of T-72B with Kontakt-5 2nd gen explosive reactive armor (see pg 5-29).

T-72BU: Upgrade variant with the fire control system from the T-80U, as well as a variety of other changes. It was renamed T-90.

With the limited market for new tanks, the world tank industry has developed upgrades and whole vehicle upgrade packages to tap into the market. Older T-72 tanks can be brought up to the T-72B standard. Some approach the T-90 standard (pg 5-36). Most of the tens of thousands of T-72-type tanks fielded reflect some level of upgrade. Upgrade options are expanding from former Warsaw Pact, Asian, Israeli, and other international firms. See Chapter 15 for additional options.
The following show other countries' comparable upgrade tanks.

M-84AB1: Yugoslav upgrade to the M-84, bringing it close to T-90, and the latest T-72B Improved tanks.

M-95 Degman: Croatian M-84 upgrade with box composite armor, ERA, 1,200 hp, and thermal FCS. An export upgrade conversion, aka **M-84D,** is offered for Kuwaiti M-84A tanks.

PT-91: Polish upgrade tanks with ERA, DRAWA improved FCS, SAVAN-5 thermal sight, improved gun stabilization, and countermeasures. The **PT-91M** has a 1,000-hp engine, new guns and FCS, armor changes, and other improvements. **PT-91M** will be exported to Singapore. **PT-91P** is designed for export to Peru.

T-72M1M: T-72M1 variant upgraded to T-72B standard.

T-72M2/Moderna: Slovakian upgrade with ERA, new engine and gun, improved FCS, SFIM thermal sight, laser warning receiver. Early versions added 20 or 30-mm cannons for AD.

T-72M4CZ: Czech limited-product variant with TURMS FCS and thermal sight, new engine, increased protection ERA, and 48t weight. **T72M3CZ** is a less radical upgrade, e.g. existing engine is modified.

T-72 SIM-1: Georgian upgrade with 2nd gen ERA, new FCS, thermal sight, GPS, FH comms, etc. Ukrainian tanks such as **T-72MP** and **T-72AG** are upgrades to the earlier T-72s, which bring them close to T-90 in capability. The upgrade **T-72-120** is similar to the above tanks, but uses a French Giat 120-mm gun and bustle autoloader.

T-72AM/Banan: Ukrainian T-72A upgrade with ERA, a new engine, and additional smoke grenade launchers. The **T-72AG** upgrade has a 1200-hp engine, Shtora-1 ATGM jammer, and 1G46 (T-80U) FCS with thermal night sights.

T-72MP: Ukrainian upgrade with a 1,000-hp engine, added armor, Shtora-1, and SAGEM FCS and thermal sights.

T-90: Successor to T-72BM with upgrades from T-80U. It was originally called T-72BU. See pages 5-35 to 5-38 for details.

T-72B Improved: This T-72B upgrade was used in previous WEG editions as a representative OPFOR Tier 2 tank. It has been replaced by T-72BM (pg 5-29), and by T-90S (pg 5-37) as the Tier 2 tank.

MAIN ARMAMENT AMMUNITION
Caliber, Type, Name:
125-mm APFSDS-T, BM-42M
Maximum Aimed Range (m): 3,000
Max Effective Range (m):
Day: 3,000
Night: 2,600
Armor Penetration (mm): 590-630 at 2,000 meters

125-mm Frag-HE-T, OF-26
Maximum Aimed Range (m): 5,000
Max Effective Range (m):
Day: 5,000
Night: 2,600
Armor Penetration (mm): Can defeat IFV and APC. A near miss will seriously damage or destroy most IFVs and APCs.

125-mm HEAT-MP, BK-29M
Maximum Aimed Range (m): 4,000
Max Effective Range (m):
Day: 3000-4,000
Night: 2,600
Armor Penetration (mm CE): 650-750. It has some HE effects.

Other Ammunition Types: Giat 125G1 APFSDS-T, Russian BM-42 and BM-32 APFSDS-T. HE-Shrapnel/Ainet electronically-fuzed round (requires FCS upgrade). Note: The Russians may have a version of the BM-42M with a DU penetrator.

The more recent BK-27 HEAT round offers a triple-shaped charge warhead and increased penetration against conventional armors and ERA. See pg 5-28 for details and other options, e.g. HEAT-MP.

Antitank Guided Missiles:
Name: AT-11/Svir (original - outdated - round)
Warhead Type: Shaped charge (HEAT)
Armor Penetration (mm): 770, 270 behind ERA
Range (m): 4,000

Name: AT-11B/Invar
Warhead Type: Tandem Shaped charge (HEAT)
Armor Penetration (mm CE): 900, 850 behind ERA
Range (m): 5,000

NOTES
A variety of FCS is available. Unified Fire Control System is an option. The 12x stabilized TV day sight with an IR auto-tracker is matched to a stabilized 2nd gen FLIR night sight with acquisition range to 7,000 m. ATGM FCS range is to 6,000 m. They include the Russian Agava-2, French SAGEM-produced ALIS and Namut sight from Peleng. Thermal gunner night sights are available which permit night launch of ATGMs.

Russian Main Battle Tank T-72BM

T-72BM with Kontakt-5 ERA

Weapons & Ammunition Types	Typical Combat Load
125-mm smoothbore gun	**45**
APFSDS-T	(mix est) 15
HEAT-MP or HEAT	3
Frag-HE	21
ATGM	6
7.62-mm coax MG	**2,000**
12.7-mm AA MG	**300**

SYSTEM
Alternative Designations: Object 187
Date of Introduction: 1988
Proliferation: At least 3 countries. See VARIANTS
Description:
Crew: 3
Combat Weight (mt): 44.5
Chassis Length Overall (m): 6.91
Height Overall (m): 2.19
Width Overall (m): 3.58
Ground Pressure (kg/cm^2): 0.90

Automotive Performance:
Engine Type: 840-hp V-84-1 diesel engine
Cruising Range (km): 500/ 900 with external tanks
Speed (km/h):
Max Road: 60
Max Off-Road: 45
Average Cross-Country: 35+
Fording Depths (m): 1.2 Unprepared/5.0 with snorkel
Radio: Digital communications and display monitors

Protection:
Armor, Turret Front (mm): 780/1,220 vs HEAT
Applique Armor (mm): Side of hull over track skirt, turret top
Explosive Reactive Armor (mm): Kontakt-5
Active Protective System: Arena or other available
Mineclearing Equipment: Roller-plow set, and plows available
Self-Entrenching Blade: Yes
NBC Protection System: Yes
Smoke Equipment: Smoke grenade launchers (8x 81-mm left side of turret), and 32 grenades. Vehicle engine exhaust smoke system.

ARMAMENT
Main Armament:
Caliber, Type, Name: 125-mm smoothbore gun 2A46M/ D-81TM
Rate of Fire (rd/min): 4-6/2 in manual mode
Loader Type: Autoloader (separate loading) and manual
Ready/Stowed Rounds: 22/23
Elevation (°): -6 to +14
Fire on Move: Yes, up to 25 km/h. Depending on the road and distance to the target, most crews may halt before firing.

Auxiliary Weapon:
Caliber, Type, Name: 7.62-mm (7.62x 54R) Machinegun PKT
Mount Type: Turret coax
Maximum Aimed Range (m): 2,000
Max Effective Range (m):
Day: 1,000
Night: 800
Fire on Move: Yes
Rate of Fire (rd/min): 250 practical, 600 cyclic in 2-10 round bursts

Caliber, Type, Name: 12.7-mm (12.7x108) AA MG NSVT
Mount Type: Turret top
Maximum Aimed Range (m): 2,000
Max Effective Range (m):
Day: 1,500/1,000 antiaircraft
Night: N/A
Fire on Move: Yes
Rate of Fire (rd/min): 200 practical, 600 cyclic in bursts

ATGM Launcher:
Name: 2A46M
Launch Method: Gun-launched
Guidance: SACLOS, Laser beam rider
Command Link: Encoded infrared laser beam
Rate of Launch: (missiles/min): 2-3, depending on range
Launcher Dismountable: No

FIRE CONTROL
FCS Name: 1A40-1
Main Gun Stabilization: 2E42-2, 2-plane
Rangefinder: TPD-K1M laser rangefinder
Infrared Searchlight: Yes
Sights w/Magnification:
Gunner:
Day: TPD-K1M
Field of View (°): 9
Acquisition Range (m): 5,000
Night: 1K13-49 for 9K120 missile FCS. See note pg 5-28
Night Acquisition Range (m): 800-1,300 for II sight
ATGM Day Range (m): 5,000 (4,000 w/ minor changes)
Commander Fire Main Gun: No

VARIANTS
T-72B: Second Russian main variant of the T-72 (after T-72A). See pg 5-27.

T-72BM: Russian T-72B upgrade with 2nd gen ERA. The system is fielded, available for export, and upgraded

No tank produced in the 1980s (by any country) which has not been improved is equal to most recent production main battle tanks.
Tier 2 and some Tier 3 tanks can challenge US forces under favorable conditions when using modern ammunition and employed by well-trained units with sound tactics.

A variety of upgrades are available for the T-72B. They include protection upgrades, such as improved ERA, APS, defensive aids suites with IR jammers, plate armor, welded turret, and grill armor around tracks and grill. Mobility upgrades include a new power train, improved steering, improved mine plows and rollers, and electronic mine spoofing system. Fire control system upgrades include new sights, gun, ammunition, and improved stabilization. With the

Russian Main Battle Tank T-72BM

expanding number of upgrades offered by former Warsaw Pact, Asian, Israeli, and other firms, most of the tens of thousands of T-72-type tanks fielded reflect some level of upgrade.

The more affordable upgrade approach for most countries is to execute specific upgrades during maintenance work. But this approach may result in only partially modernized tanks at any one point in the life of the vehicle, and which are not as modern as more recent competitors (see several tanks on the previous page). Another alternative is to produce modern tanks but in small numbers, resulting in high per-unit production costs. A few countries are producing new tanks, at various rates of production.

T-72B Improved: This T-72B upgrade was used in previous WEG editions as a representative OPFOR Tier 2 tank. It was actually based on T-72BM with additional upgrades. The page has been replaced by T-72BM. **T-90** was the Russian **s**uccessor to T-72BM, originally called T-72BU, with fire control and armor upgrades similar to those on the T-80U. Thus, in the tier tables, T-72B Improved was replaced by T-90S (pg 5-38) as the OPFOR representative Tier 2 tank.

photo Soldat und Technik

An economical upgrade compromise is to apply upgrade packages. With the limited market for new tanks, the Russian tank industry has developed upgrade packages to tap into that market. Recently **T-72M1** demonstrators with 2nd gen ERA and many other upgrades were displayed at military shows. **T-72M1M** (above) includes 3rd gen Relikt ERA and optional Arena active protection system (APS).

Several countries, e.g., China, Pakistan, and Iran, have developed major modern tank production and upgrade programs. Turkey has decided to build its own tank, the **Altey**.

The most innovative and comprehensive upgrade program is India's **Project Rhino.** India acquired more than 500 Russian T-90S tanks which are upgraded close to T-90A (**Bhishma** in India) standard. Its industry will assemble others from knockdown kits (and in so doing, learn new assembly and refinement methods). Later it will produce several hundred more on its own. These will join the **Arjun**, the domestic Western style tank which was designed and produced indigenously. India will upgrade more than 1,500 **Ajeya** (T-72A) tanks close to the Bhishma standard, to be known as **Ajeya Mk 2**. Other Ajeyas will be upgraded in Israel, Poland, and the Ukraine, so that they can further study tank options and assembly practices. Another possible conversion by India's DRDO is the **EX-Tank**, with some Arjun turrets on Ajeya/T-72A chassis, with 1,000-hp engines.

MAIN ARMAMENT AMMUNITION
Caliber, Type, Name:
125-mm APFSDS-T, BM-42M
Maximum Aimed Range (m): 3,000
Max Effective Range (m):
Day: 3,000
Night: 2,600
Armor Penetration (mm KE): 590-630 at 2,000 meters

125-mm Frag-HE-T, OF-26
Maximum Aimed Range (m): 5,000
Max Effective Range (m):
Day: 5,000
Night: 2,600
Armor Penetration (mm): Can defeat IFV and APC. A near miss will seriously damage or destroy most IFVs and APCs.

125-mm HEAT-MP, BK-29M
Maximum Aimed Range (m): 4,000
Max Effective Range (m):
Day: 3000-4,000
Night: 2,600
Armor Penetration (mm CE): 650-750. It has some HE effects.

125-mm HEAT, BK-27
Maximum Aimed Range (m): 3,000
Max Effective Range (m):
Day: 3,000
Night: 2,600
Armor Penetration (mm CE): 700-800

The more recent BK-27 HEAT round offers a triple-shaped charge warhead and increased penetration against conventional armors and ERA. The BK-29 round, with a hard penetrator in the nose is designed for use against reactive armor, and as an MP round has fragmentation effects. If the BK-29 HEAT-MP is used, it may substitute for Frag-HE (as with NATO countries) or complement Frag-HE. The benefit of HEAT-MP is that three round natures (APFSDS-T, HEAT-MP, ATGMs) in the autoloader versus four, means more antitank rounds available. However, a serious penalty is that HEAT-MP lethal radius against soft targets is much less.

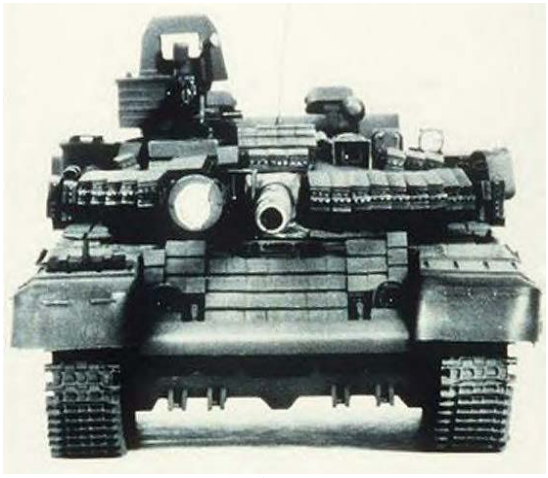
Other Ammunition Types: Giat 125G1 APFSDS-T, Russian BM-42 and BM-32 APFSDS-T. Note: The Russians may have a version of the BM-42M with a DU penetrator. Russian BM-48 APFSDS-T round penetrates 650-700 mm.

Antitank Guided Missiles:
Name: AT-11B/Invar
Warhead Type: Tandem Shaped charge (HEAT)
Armor Penetration (mm CE): 900, 850 behind ERA
Range (m): 5,000

NOTES
A variety of thermal sights is available. They include the Russian Agava-2, Namut sight from Peleng, and French SAGEM-produced ALIS. Some thermal night sights permit night launch of ATGMs. Unified Fire Control System adapts to T-72B. The 12x stabilized TV day sight with an IR auto-tracker is matched to a stabilized 2nd gen FLIR night sight with acquisition range up to 7,000 m. ATGM FCS range is to 6,000 m.

Other possible upgrades include improved armor, more powerful engine, and improved ammunitions, such as the Ainet (HE-shrapnel) electronically fuzed round. Relikt 3rd gen ERA (above) is offered to replace Kontakt-5 in several upgrade packages, or as a separate upgrade. The ERA adds up to 600 mm CE protection and 300 mm KE to turret base armor protection, about 150 mm more than Kontakt-5.

Russian Main Battle Tank T-80B



Model of T-80B National War College Photo

Weapons & Ammunition Types	Typical Combat Load
125-mm smoothbore gun	**45**
APFSDS-T	(mix est) 15
HEAT	3
Frag-HE	21
ATGM	6
7.62-mm coax MG	**1,250**
12.7-mm NSVT AA MG	**500**

SYSTEM
Alternative Designations: T-80B and variants are often mis-identified as T-80. The original T-80 saw very limited production.
Date of Introduction: 1978
Proliferation: At least 1 country
Description:
Crew: 3
Combat Weight (mt): 44.5
Chassis Length Overall (m): 6.98
Height Overall (m): 2.22
Width Overall (m): 3.58
Ground Pressure (kg/cm^2): 0.87

Automotive Performance:
Engine Type: 1,000-hp or 1,100-hp Gas turbine diesel (multifuel),
Cruising Range (km): 370/ 500 with extra tanks
Speed (km/h):
- Max Road: 70
- Max Off-Road: 48
- Average Cross-Country: 40
- Max Swim: N/A

Fording Depths (m): 1.8 unprepared, 5.0 w/snorkel, 12.0 with BROD-M system

Radio: R-173, R-174 intercom

Protection:
Armor, Turret Front (mm): Defeat 120-mm rounds (triple layer)
Applique Armor (mm): N/A. Their turrets include ceramic armor.
Explosive Reactive Armor (mm): 1st Generation ERA, including side skirts. Next page drawing depicts ERA on front and turret only.
Active Protective System: Available
Mineclearing Equipment: Mine rollers and plows available
Self-Entrenching Blade: Yes
NBC Protection System: Yes
Smoke Equipment: Smoke grenade launchers (4x 81-mm each side of turret), and 24 grenades. Vehicle engine exhaust smoke system

ARMAMENT
Main Armaments:
Caliber, Type, Name: 125-mm smoothbore gun 2A46-2
Rate of Fire (rd/min): 6-8 (lower in manual mode)
Loader Type: KORZINA separate-loading autoloader and manual
Ready/Stowed Rounds: 28 in carousel/17 rounds stowed but readily available for manual loading
Elevation (°): -7 to +20
Fire on Move: Yes (30 km/h gun rounds/low speed or stop ATGMs)

Auxiliary Weapon:
Caliber, Type, Name: 7.62-mm (7.62x 54R) Machinegun PKT
Mount Type: Turret coax
Maximum Aimed Range (m): 2,000
Max Effective Range (m):
- Day: 1,000
- Night: 850-1,300

Fire on Move: Yes
Rate of Fire (rd/min): 250 practical / 650 cyclic, 2-10 round bursts

Caliber, Type, Name: 12.7-mm (12.7x108) AA MG NSVT
Mount Type: Turret top
Maximum Aimed Range (m): 2,000
Max Effective Range (m):
- Day: 1,500 ground/1,600 for air targets (APDS)
- Night: 800-1,300

Fire on Move: Yes
Rate of Fire (rd/min): 210 practical/ 800 air targets in bursts

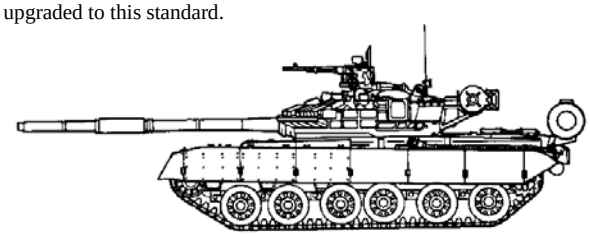
ATGM Launcher:
Name: 2A46-2 tank gun
Launch Method: Gun-launched
Guidance: SACLOS
Command Link: Encoded radio frequency
Rate of Launch: (missiles/min): 2-3, depending on range
Launcher Dismountable: No

FIRE CONTROL
FCS Name: FCS 1A33
Main Gun Stabilization: 2E26M 2-plane
Rangefinder: Laser
Infrared Searchlight: Yes
Sights w/Magnification:
Gunner:
- Day: 1G42
  - Field of View (°): INA
  - Acquisition Range (m): 5,000, 4,000 for ATGM
- Night: 1-4A
  - Field of View (°): INA
  - Acquisition Range (m): 800-1,300 (est)

Commander Fire Main Gun: No

Russian Main Battle Tank T-80B continued

VARIANTS
T-80A: 1982 variant with a different turret and FCS to fire the Svir ATGM later used by the T-72B.
T-80B: Variant in below line drawing has partial ERA mounted. Others have no ERA. The few original T-80s retained were upgraded to this standard.



MAIN ARMAMENT AMMUNITION
Caliber, Type, Name:
125-mm APFSDS-T, BM-42M
Maximum Aimed Range (m): 3,000-4,000
Max Effective Range (m):
Day: 2,500-3,000
Night: 800-1,300
Armor Penetration (mm KE): 590-630 at 2,000 meters

125-mm Frag-HE-T, OF-26
Maximum Aimed Range (m): 5,000
Max Effective Range (m):
Day: 5,000
Night: 800-1,300
Armor Penetration (mm): Can defeat IFV and APC. A near miss will seriously damage or destroy most IFVs and APCs.

125-mm HEAT-MP, BK-29M
Maximum Aimed Range (m): 4,000
Max Effective Range (m):
Day: 3,000
Night: 800-1300
Armor Penetration (mm CE): 650-750. It has some HE effects.

125-mm HEAT, BK-27
Maximum Aimed Range (m): 3,000
Max Effective Range (m):
Day: 2,000-3,000
Night: 800-1,300
Armor Penetration (mm CE): 700-800

Other Ammunition Types: Giat 125G1 APFSDS-T, Russian BM-42 and BM-32 APFSDS-T. Note: The Russians may have a version of the BM-42M with a DU penetrator.

Antitank Guided Missile:
Name: AT-8/SONGSTER/Kobra
Warhead Type: Shaped charge (HEAT)
Armor Penetration (mm CE): 700 (RHA), 200 behind ERA
Range (m): 4,000 day only

NOTES
The night sight cannot be used to launch the ATGM. The day sight can be used at night for launching ATGMs if the target is illuminated.
A variety of thermal sights are available. They include the Russian Agava-2, French SAGEM-produced ALIS and Namut sight from Peleng. There are thermal sights available for installation, which permit night launch of ATGMs.

The 12.7-mm MG NSVT has both remote electronically operated sight PZU-5 and gun-mounted K10-T reflex sight.

The more recent BK-27 HEAT round offers a triple-shaped charge warhead and increased penetration against conventional armors and ERA. The BK-29 round, with a hard penetrator in the nose is designed for use against reactive armor, and as an MP round has fragmentation effects. If the BK-29 HEAT-MP is used, it may substitute for Frag-HE (as with NATO countries) or complement Frag-HE. With three round natures (APFSDS-T, HEAT-MP, ATGMs) in the autoloader versus four, more antitank rounds would available for the higher rate of fire.

The ATGM may be launched while moving slowly (NFI). The AT-8 can be auto-loaded with the two halves mated during ramming; but the stub charge is manually loaded.

Russian Main Battle Tank T-80U

National War College Photo

Weapons & Ammunition Types	Typical Combat Load
125-mm smoothbore gun	**45**
APFSDS-T	(mix est) 15
HEAT	3
Frag-HE	21
ATGM	6
7.62-mm coax MG	**1,250**
12.7-mm NSVT AA MG	**500**

SYSTEM
Alternative Designations: SMT (Soviet Medium Tank) M1989
Date of Introduction: 1987
Proliferation: At least 3 countries
Description:
Crew: 3
Combat Weight (mt): 46.0
Chassis Length Overall (m): 7.01
Height Overall (m): 2.20
Width Overall (m): 3.60
Ground Pressure (kg/cm^2): 0.92

Automotive Performance:
Engine Type: 1250-hp gas turbine (multi-fuel), diesel on T-80UD
Cruising Range (km): 335 km/600 km with extra tanks
Speed (km/h):
- Max Road: 70
- Max Off-Road: 48
- Average Cross-Country: 40
- Max Swim: N/A

Fording Depths (m): 1.8, 5.0 w/snorkel, 12.0 with BROD-M system
GTA-18A Auxiliary Power Unit is used when the engine is off.

Radio: R-173, R-174 intercom

Protection:
Armor, Turret Front (mm): Against 120-mm ammunition
Applique Armor (mm): Side of hull, over track skirt
Explosive Reactive Armor (mm): Kontakt-5 2nd generation ERA
Active Protective System: Arena is available
Mineclearing Equipment: Roller-plow set and plows available
Self-Entrenching Blade: Yes
NBC Protection System: Yes
Smoke Equipment: Smoke grenade launchers (4x 81-mm each side of turret), and 24 grenades. Vehicle engine exhaust smoke system.

ARMAMENT
Main Armaments:
Caliber, Type, Name: 125-mm smoothbore gun 2A46M-1
Rate of Fire (rd/min): 7-8 (lower in manual mode)
Loader Type: Korzina separate-loading autoloader, and manual
Ready/Stowed Rounds: 28 in carousel/17 stowed (manual loaded)
Elevation (°): -4 to +18
Fire on Move: Yes (gun rounds and ATGMs)

Auxiliary Weapon:
Caliber, Type, Name: 7.62-mm (7.62x 54R) machinegun PKT
Mount Type: Turret coaxial
Maximum Aimed Range (m): 2,000
Max Effective Range (m): 800 day and night
Fire on Move: Yes
Rate of Fire (rd/min): 250 practical / 650 cyclic, 2-10 round bursts

Caliber, Type, Name: 12.7-mm (12.7x108) AA MG NSVT
Mount Type: Turret top
Maximum Aimed Range (m): 2,000
Max Effective Range (m): Day 1,500, night 800-1,300
Fire on Move: Yes
Rate of Fire (rd/min): 210 practical/ 800 air targets in bursts
The 12.7-mm MG NSVT has both remote electronically operated sight PZU-5 and gun-mounted K10-T reflex sight.

ATGM Launcher:
Name: 2A46M-1 tank gun
Launch Method: Gun-launched
Guidance: SACLOS, Laser-beam rider
Command Link: Encoded infrared laser-beam
Rate of Launch: (missiles/min): 2-3, depending on range
Launcher Dismountable: No

FIRE CONTROL
FCS Name: FCS 1A42
Main Gun Stabilization: 2E42, 2-plane
Rangefinder: Laser
Infrared Searchlight: Yes
Sights w/Magnification:
Gunner:
- Day: 1G46/Perfect, 3.6/12x
  - Acquisition Range (m): 5,000 (85%P-hit for ATGM)
- Night: Agava-2
  - Acquisition Range (m): 2,600 guns and missiles

Commander Fire Main Gun: Yes

VARIANTS
T-80UK: Command version with R-163-50K and R-163-U radios, TNA-4 land navigation system, and an electronic fuze-setting device that permits use of Ainet shrapnel round. The Agava thermal sight provides a 2,600-meter night acquisition range.

T-80UM1/Bars: Upgrade variant developed for Russian tank competition. It features an improved 1A45 hunter-killer FCS, 2A46M-4 main gun, Shtora-1ATGM IR countermeasure system, optional Arena active protection system (**T-80UM2**), and other upgrade options. It is offered; but there is no record of production.

Russian Main Battle Tank T-80U continued

T-80UD: Ukrainian version with a 1000-hp diesel engine versus the turbine engine, new FCS with 1A45 sight, and 1st generation ERA.

T-84: Ukrainian upgrade of T-80UD, with a welded turret, 6TD-2 1,200-hp diesel engine, KBA-3 125-mm main gun, and new FCS with a SAGEM thermal sight. It fires a Combat gun-launch ATGM to 5 km. It entered service in the Ukraine in 1999, with 320 exported to Pakistan. A T-72 upgrade package to this standard is **T-72AG**. The **T-84U** adds wider track, Shtora-1 active IR ATGM jammer system, improved armor, and other upgrades.

Oplot: Ukrainian T-84 upgrade with a welded compartmented turret, bustle autoloader, cdr's independent sight, French Alis 2nd gen thermal sight, 1,200-hp diesel engine, new conformal 3rd gen ERA, optional use of Arena active protection system (APS) and Shtora-1. The tank is adopted by Ukrainian forces for fielding and available for export. The new Artemis gun-launch ATGM is available.

Yatagan/KERN2-120/T-84-120: Ukrainian Oplot variant with a 120-mm smoothbore cannon, bustle autoloader, and ability to fire NATO-compatible ammunition, including an APFSDS-T round similar to the French Giat 125G1. The gun-launches a Ukrainian laser-guided ATGM with a tandem warhead.

Black Eagle/T-80UM2: Russian private-developed upgrade variant offered for export, and considered in the army tank competition. Displayed first in 1997, it features a new lower-silhouette turret with a bustle auto-loader, on a T-80U chassis. Later versions had modified and lengthened the chassis, one with 7 road wheels per side. Conformal 3rd gen Kaktus ERA is fitted. The turret apparently has blow-out panels, to mitigate damage in case of a hit. Fire control allows electronic-fuzed Ainet rounds. The design assures faster loading and permits longer and more lethal rounds (see T-90AM, pg 5-37). This turret and auto-loader design would free up room inside of the vehicle for sealed compartments and more protection. It offers significant growth room for increased gun caliber as well as ability to move the crew lower in the hull. None have been sold to date, but elements of the design are incorporated in the T-90AM.

MAIN ARMAMENT AMMUNITION
Caliber, Type, Name:
125-mm APFSDS-T, BM-42M
Maximum Aimed Range (m): 3,000-4,000
Max Effective Range (m): 3,000-4,000 day, 2,600 night
Armor Penetration (mm KE): 590-630 at 2,000 meters

125-mm Frag-HE-T, OF-26
Maximum Aimed Range (m): 5,000
Max Effective Range (m): 5,000 day, 2,600 night
Tactical AA Range: 4,000-5,000
Armor Penetration (mm): Can defeat IFV and APC. A near miss will seriously damage or destroy most IFVs and APCs.

125-mm HE-Shrapnel Focused-fragmentation, Ainet (see pg 5-36)
Maximum Aimed Range (m): 5,200
Max Effective Range (m): 5,000 day, 2,600 night
Tactical AA Range: 4,000-5,000
Armor Penetration (mm): Can defeat IFV and APC

125-mm HEAT-MP, BK-29M
Maximum Aimed Range (m): 4,000
Max Effective Range (m): 4,000 day, 2,600 night
Armor Penetration (mm CE): 650-750. It has a hard nose for use against ERA, and has some HE effects for use against area targets.

125-mm HEAT triple charge warhead, BK-27
Maximum Aimed Range (m): 4,000
Max Effective Range (m): 3,000+ day, 2,600 night
Armor Penetration (mm CE): 700-800

Other Ammunition Types: Giat 125G1 APFSDS-T, Russian BM-42 and BM-32 APFSDS-T. Note: The Russians may have a version of the BM-42M with a DU penetrator. The Russian BM-48 APFSDS-T round penetrates 650-700 mm.

Sokol-1 guided antitank round, see pg 5-36

Antitank Guided Missiles:
Name: AT-11B/Invar/9M119M
Warhead Type: Tandem Shaped charge (HEAT)
Armor Penetration (mm CE): 900, 850 behind ERA
Range (m): 5,000 day, 2,600 night

Name: AT-11C/Invar-M/9M119M1
Warhead Type: Tandem shaped charge (HEAT)
Armor Penetration (mm CE): 900, 850 behind ERA
Range (m): 5,000 day, 2,600 night

Other Antitank Guided Missiles: Ukrainian Combat and Artemis/R-211 gun-launch ATGMs (see Vol 1, pg 6-58)

9M119F1: Missile with Frag-HE warhead to 5,000 m

NOTES
Original night sight is the II Buran-PA (800-1300 meters range). The Buran-PA cannot be used to launch the ATGM. The 1G46 day sight can be used at night for launching ATGMs if the target is illuminated. A variety of thermal sights are available. They include the Russian Sanoet, French SAGEM-produced Alis and Namut sight from Belorussian Peleng.

Russian Main Battle Tank T-90A

Weapons & Ammunition Types	Typical Combat Load
125-mm smoothbore gun	(mix est) **43**
APFSDS-T	14
HEAT-MP/HEAT	3
Frag-HE	12
Focused Frag Ainet	8
Invar ATGM	6
7.62-mm coax MG	**2,000**
Additional 7.62-mm	**2,300**
12.7-mm NSVT AA MG	**300**

SYSTEM
Alternative Designations: This upgrade version was developed for Russian and Indian use.
Date of Introduction: circa 2002
Proliferation: At least 2 countries. This tank represents a variety of T-72 tank upgrade programs underway.
Description:
Crew: 3
Combat Weight (mt): 46.5
Chassis Length Overall (m): 6.86
Height Overall (m): 2.23
Width Overall (m): 3.37
Ground Pressure (kg/cm^2): Approx 0.9

Automotive Performance:
Engine Type: 1,000-hp V-92/V-96/Approx1,100 hp V-12, diesel
Cruising Range (km): 500 km/650 km with auxiliary tanks
Speed (km/h):
- Max Road: 65
- Max Off-Road: 45
- Average Cross-Country: 35 est
- Max Swim: N/A

Fording Depths (m): Approx 1.5 Unprepared, 5.0 w/snorkel

Radio: R-173

Protection:
Armor, Turret Front (mm): 840 KE, 1,300-1,350 CE, welded turret.
Applique Armor (mm): Turret roof, front of track skirt
Explosive Reactive Armor (mm): Kontakt-5 2nd Generation ERA
Active Protective System: None. Defensive Aides Suite is **Shtora-1** (laser warning receiver with gun auto-slew, LWR-directed smoke grenade launchers, and EO-IR jammer), or partial package excluding IR jammers. None is on Bhishma. The Shtora-1 IR ATGM countermeasure illuminators can be detected with night sights. Shtora-1 has no effect against most modern ATGM systems, with encoded tracker beacons. Exclusion of Shtora-1 offers more ERA on the turret front and reduces costs.
Mineclearing Equipment: Roller-plow set and plows available
Self-Entrenching Blade: Yes
NBC Protection System: Yes
Smoke Equipment: 12 x launchers, multi-spectral VEESS
Protection probably includes radar-absorbent materials and IR-resistant paint.

ARMAMENT
Main Armaments:
Caliber, Type, Name: 125-mm smoothbore gun 2A46M-4 likely
Rate of Fire (rd/min): 8 stationary and moving
Loader Type: Separate-loading autoloader, and manual
Ready/Stowed Rounds: 22 in carousel, 15 more at hand/ 6 stowed
Elevation (°): Approx depression 5; elevation 15
Fire on Move: Yes (gun rounds and ATGMs)

Auxiliary Weapon:
Caliber, Type, Name: 7.62-mm (7.62x 54R) machinegun PKT
Mount Type: Turret coaxial
Maximum Aimed Range (m): 2,000
Max Effective Range (m):
- Day: 1,500-2,000
- Night: 1,500-2,000

Fire on Move: Yes
Rate of Fire (rd/min): 250 practical / 650 cyclic, 2-10 round bursts

Caliber, Type, Name: 12.7-mm (12.7x108) AA MG NSVT
Mount Type: Turret top
Maximum Aimed Range (m): 2,000
Max Effective Range (m): 2,000 day and night
Fire on Move: Yes AM
Rate of Fire (rd/min): 210 practical/ 800 air targets in bursts
The 12.7-mm MG NSVT has both remote electronically operated sight PZU-5 with vertical stabilization, night acquisition, and a gun-mounted K10-T reflex sight.

ATGM Launcher:
Name: 2A46M-4 tank gun likely; Refleks rg to 5,000m (EST).
Launch Method: Gun-launched, two-piece from tank auto-loader
Guidance: SACLOS laser-beam rider, Refleks missile FCS
Command Link: Encoded infrared laser beam
Rate of Launch: (missiles/min): 2-3, depending on range
Launcher Dismountable: No

FIRE CONTROL
FCS Name: INA Stabilized for gunner and commander, with thermal sight and monitor. Hunter-killer system permits commander and gunner to separately assign targets and fire gun or missile.
Main Gun Stabilization: Improved 2E42-4, 2-plane
Rangefinder: Laser sight, 10,000 m range with LOS
Infrared Searchlight: Yes, but not used with thermal sight
Sights w/Magnification:
Gunner: Sights include an infrared auto-tracker.
- Day: Isloch
  - Field of View (°): 7.2/1.2
  - Acquisition Range (m): 7,000 detection with LOS
- Night: Catherine 2nd gen thermal
  - Field of View (°): INA
  - Acquisition Range (m): 5,000

Commander Fire Main Gun: Yes

Russian Main Battle Tank T-90A continued

VARIANTS
The manufacturer offers different versions of this tank, with engines from 840-1,200 hp, and night sights from II to 2nd gen thermal. The version with improved engine, FCS, ammo, etc. is the one to be portrayed.

Bhishma: Indian variant produced from T-90A knockdown kits. It does not use the Shtora-1 IRCM system. Engine is T-90A upgrade. The tank is sometimes erroneously called T-90S. Various stages of upgrades will be employed in Indian forces, because the final requirement is for more than a thousand upgraded tanks. Russia has sent T-90S tanks, and will also upgrade almost all of its T-90 and T-90S remaining versions in knock-down kits with upgrades to meet the Bhishma standard. Issue remains of no air conditioning system in this export MBT to India that causes overheating of system components and debilitating environment for tank crew.

There are other upgrade versions of the T-72 which include features of the T-90A, such as the improved gun stabilization, improved fire control system, improved engine, and improved ammunition. Improved ammunition includes the Ainet and the Invar.

Other tanks which provide similar capabilities are the Ukrainian T-72AG and T-72MP. The Czech T-72CZM4 also has a 2nd gen thermal sight. Recent Russian tank upgrade packages for the T-72 are the T-72M1, and the T-72M1M (not to be confused with older Polish and Czech T-72M1 tanks). The above Russian upgrades are for modernizing older tanks, versus T-90/T-90A, which are newly produced tanks. Upgraded T-80U, T-80UK, and T-84 tanks also have similar capabilities. See T-72B.

T-72-120: Ukrainian T-72 modernization with a 120-mm gun and other upgrades. The package then led to the **Yatagan** T-84 upgrade. See pg 5-34 for description of the lethality upgrade.

T-90AM: The Russian military decided against T90A for its forces. In Sep 2011, they displayed **T-90AM**. This is a deep modernization of T-90A. They include a low-profile turret with a bustle autoloader and blow-out panels. The new 2A82 gun fires a longer (700+ mm est) and heavier APFSDS-T round to 3,500+ m.
This required a change to the autoloader. The tank has other new developments, e.g., V-93 1130-hp engine, 3rd gen Relikt ERA (see pg 5-30). The new TV digital hunter-killer FCS has a new night sight (likely to be a 3rd gen thermal sight similar to that on Kornet-EM ATGM launcher vehicle (pg 6-31). A Kalina auto-tracker is used. Battle display has a GNSS map. Automatic smoke grenades include vertical launch. The tank has a new remote operated 7.62-mm AD MG. A possible new round is Sokol-1 IR homing ATGM (see right).

T-90MS. In March 2012 the Russians displayed T-90MS.This export version of T-90AM differs with its 2A46M-5 improved precision gun, which fires existing ammunition (e.g., BM-42M to 3,500+ m), but not the new heavier and more powerful APFSDS-T. Initial major production for both tanks has been projected for 2015. Externally, T-90MS and T-90AM are almost indistinguishable. Some sources, including Russian, have mistakenly labeled T-90AM /T-90MS tanks "T-90S". The new models are distinct from T-90S.

MAIN ARMAMENT AMMUNITION
Caliber, Type, Name:
125-mm APFSDS-T, BM-42M
Maximum Aimed Range (m): 4,000
Max Effective Range (m): 3,000-4000 day and night
Armor Penetration (mm KE): 590-630 at 2,000 meters

125-mm Frag-HE-T, OF-26
Maximum Aimed Range (m): 5,000
Max Effective Range (m): 5,000 day, 4,000 night
Armor Penetration (mm): Can defeat IFV and APC

125-mm HE-shrapnel focused-fragmentation, **Ainet**. This round is electronically fuzed by the LRF FCS. It directs fragments forward and laterally. Thus it can be used against aircraft and in a fly-over shoot down mode against ground targets. The electronic fuzing system for this "HE-shrapnel" round uses technology similar to that for Swiss Oerlikon's AHEAD round. The round is specially designed to defeat targets by firing fragmentation patterns forward and radially, based on computer-calculated settings from the LRF and other inputs. Targets are helicopters and dug in or defilade priority ground threats, such as ATGM positions. Rate of fire is 4rd/min (est).
Maximum Aimed Range (m): 5,200 - also tactical AA range
Armor Penetration (mm): It can defeat IFVs and APCs.

Other Ammunition Types: Optional French Giat 125G1 APFSDS-T. Also available are the Russian BK-27 triple-warhead HEAT round (penetrates 700-800 mm), and the BK-29 HEAT-MP round (650-750 mm with blast effects versus soft targets) - see pg 5-34. Note: The Russians may have a version of the BM-42M with a DU penetrator. The Russian BM-48 APFSDS-T round penetrates 650-700 mm.

When the Russian T-90AM begins production, a new longer, heavier, and higher-penetration APFSDS-T round will be fielded to fit its new gun and autoloader. Lethality is comparable to latest western rounds.

The **Sokol-1** guided antitank round uses semi-active laser-homing and/or IR-homing for a 0.1-5 km effective range. A laser target designator (LTD) can be added to the vehicle fire control system. The direct-fire round can be used without an LTD under some circumstances. Hit probability is 75-85%. The round is less expensive than ATGMs, and offers fast response (1-5 sec) flight time to defeat target vehicles before they can employ their weapons. With a synchronizer, laser designation time is 0.5-1 second, for minimal target laser warning time. With a HEAT warhead and 700 mm penetration, lethality is sufficient for a mobility/firepower kill against tanks, a catastrophic kill against tanks at aspect other than front, and catastrophic kill against all other targets. Penetration behind ERA is 200 mm. Fielding status is uncertain.

Antitank Guided Missiles:
Name: AT-11B/Invar
Warhead Type: Tandem shaped charge (HEAT)
Armor Penetration (mm CE): 900, 850 behind ERA
Range (m): 5,000 day and night

Name: AT-11C/Invar-M/9M119M1
Warhead Type: Tandem shaped charge (HEAT)
Armor Penetration (mm CE): 900, 850 behind ERA
Range (m): 7,000 day, 5,000 night

9M119F1: Missile with Frag-HE warhead to 5,000 m.

NOTES
Relikt 3rd gen ERA (above) is offered to replace Kontakt-5 in several upgrade packages, or as a separate upgrade. The ERA adds up to 600 mm CE protection and 300 mm KE to turret base armor protection, or about 150 mm more than Kontakt-5. Arena APS is available.

Russian Main Battle Tank T-90S

T-90S with Shtora-1 next to a T-80U

Weapons & Ammunition Types	Typical Combat Load
125-mm smoothbore gun	**43**
APFSDS-T	(mix est) 14
HEAT-MP/HEAT	3
HE-Shrapnel/Frag-HE	20
ATGM	6
7.62-mm coax MG	**2,000**
12.7-mm NSVT AA MG	**300**

SYSTEM
Alternative Designations: T-90, T-90E, T-72BU
Date of Introduction: 1994
Proliferation: At least 2 countries: India; Algeria
Description:
Crew: 3
Combat Weight (mt): 46.5
Chassis Length Overall (m): 6.86
Height Overall (m): 2.23
Width Overall (m): 3.37
Ground Pressure (kg/cm^2): **Approx** 0.9

Automotive Performance:
Engine Type: 840 hp V-84MS, diesel. Upgrade has 1,000 hp.
Cruising Range (km): 500 km/650 km with auxiliary tanks
Speed (km/h):
Max Road: 60
Max Off-Road: 45 est
Average Cross-Country: 35 est
Max Swim: N/A
Fording Depths (m): Approx1.5 Unprepared, 5.0 w/snorkel

Radio: R-163-504 UHF, R-163-UP receiver/R-173 for T-90S

Protection:
Armor, Turret Front (mm): 780-810 KE, 1,020-1,220 CE
Applique Armor (mm): Turret roof, front of track skirt
Explosive Reactive Armor (mm): Kontakt-5 2nd Generation ERA
Active Protective System: TshU-1-7/Shtora-1 countermeasure suite
Mineclearing Equipment: Roller-plow set and plows available
Self-Entrenching Blade: Yes
NBC Protection System: Yes
Smoke Equipment: 12 x 3D17 smoke grenade launchers, VEESS

ARMAMENT
Main Armaments:
Caliber, Type, Name: 125-mm smoothbore gun 2A46M-1 or -4
Rate of Fire (rd/min): 7-8 (lower in manual mode)
Loader Type: Separate-loading autoloader, and manual
Ready/Stowed Rounds: 22 in carousel, 15 more at hand /6 (est)
Elevation (°): Approx depression 5; elevation 15
Fire on Move: Yes (gun rounds and ATGMs)

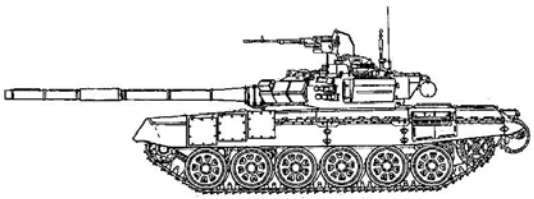
Auxiliary Weapon:
Caliber, Type, Name: 7.62-mm (7.62x 54R) Machinegun PKT
Mount Type: Turret coaxial
Maximum Aimed Range (m): 2,000
Max Effective Range (m): 800 day and night
Fire on Move: Yes
Rate of Fire (rd/min): 250 practical / 650 cyclic, 2-10 round bursts

Caliber, Type, Name: 12.7-mm (12.7x108) AA MG NSVT
Mount Type: Turret top; remote electronic sight PZU-5 vertical stabilization, night acquisition; gun-mounted K10-T reflex sight.
Maximum Aimed Range (m): 2,000
Max Effective Range (m):
Day: 1,500
Night: 800-1,300
Fire on Move: Yes
Rate of Fire (rd/min): 210 practical/ 800 air targets in bursts

ATGM Launcher:
Name: 2A46M-1 tank gun
Launch Method: Gun-launched; eff range 100m to 5000m
Guidance: SACLOS laser-beam rider, REFLEKS missile launcher
Command Link: Encoded infrared laser beam
Rate of Launch: (missiles/min): 2-3, depending on range
Launcher Dismountable: No

FIRE CONTROL
FCS Name: FCS 1A45T
Main Gun Stabilization: 2E42-4, 2-plane
Rangefinder: Laser sight; max range 7500 m.
Infrared Searchlight: Yes, when II sight employed (See NOTES)
Sights w/Magnification:
Gunner:
Day: 1A43 and 1G46/PERFECT, 3.6/12x
Field of View (°): 20/2.5
Acquisition Range (m): 5,000 detection (85%P-hit for ATGM)
Night: AGAVA-2 (See Notes)
Field of View (°): INA
Acquisition Range (m): 2,600
Commander Fire Main Gun: Yes; day/night sight TKN-4S (Agat-S)

VARIANTS
T-90: Successor to T-72BM, originally called T-72BU, with fire control and armor upgrades similar to those on the T-80U. Despite using the lower cost T-72 chassis, this tank incorporated more recent components than the T-80U and is in some ways superior. The original tank had an II night sight, not the thermal sight upgrade, and the under-powered 840-hp engine. Upgrades have been added.



Line drawing of T-90 or T-90S without Shtora-1

Russian Main Battle Tank T-90S continued

T-90S: Export variant with option for upgrades. Several subsystem changes, such as upgrade FCS, new engine, removal of Shtora-1, etc., have been added based on customer preferences, and are included in export versions of the tank. Some early T-90s have been upgraded to this standard. Most of these are being sold to India, with the 1,000 hp engine upgrade, and with addition of air conditioning.

T-90SK: T-90S command variant

T-90A: Originally known as T-90 SM or T-90M, it is now accepted for Russian service as the standard tank. Some sources erroneously call it T-90S (see pg 5-36 to 5-37).

T-90E: Early export variant.

Project Rhino: Most T-90 and T-90S tanks will be imported by India and later upgraded as **Bhishma** under this program and agreement with Russia (see pg 5-37).

T-90MS: Export variant: improved armor protection and ERA; remote control weapon station on turret rook with 12.7 mm MG; traverse forward 316 degrees; elevate -10 to +45 degree.

Improved fire control system for engagement of stationary and moving targets while tank is moving. TC panoramic sight for TC-gunner display linked to laser rangefinder; thermal and 4 television camera-each 95 degree wide/45 degree elev .

Improved battle management and land navigation tracking system.

External auxillary diesel power unit for fuel conservation.

Some reserve main gun ammo in bustle with blowout panels.

Turret and hull rear with bar (lourve) armor; anti-laser warning and protection.

125 mm main gun improved accuracy with 2A46M-5 rather than prveious 2A46M in T90S.

MAIN ARMAMENT AMMUNITION
Caliber, Type, Name:
125-mm APFSDS-T, BM-42M
Maximum Aimed Range (m): 3,000-4,000
Max Effective Range (m):
Day: 3,000-4000
Night: 2,600
Armor Penetration (mm KE): 590-630 at 2,000 meters

125-mm HEAT-MP, BK-29M
Maximum Aimed Range (m): 4,000
Max Effective Range (m):
Day: 4,000
Night: 2,600
Armor Penetration (mm CE): 650-750 It has some HE effects similar to Frag-HE rounds against personnel and materiel targets.

125-mm HEAT, BK-27
Maximum Aimed Range (m): 4,000
Max Effective Range (m):
Day: 3,000+
Night: 2,600
Armor Penetration (mm CE): 700-800

125-mm HE-Shrapnel Focused-Fragmentation, Ainet
Maximum Aimed Range (m): 5,200
Max Effective Range (m):
Day: 5,000
Night: 2,600
Tactical AA Range: 4,000-5,000
Armor Penetration (mm): Can defeat IFV and APC

Electronic fuzing for HE-Shrapnel rounds uses technology similar to that for French Oerlikon's AHEAD round. The round is specially designed to defeat targets by firing fragmentation patterns forward and radially, based on computer-calculated settings from the LRF and other inputs. Targets are helicopters and dug in or defilade priority ground threats, such as ATGM positions. Rate of fire is 4 rd/min.

125-mm Frag-HE-T, OF-26
Maximum Aimed Range (m): 5,000
Max Effective Range (m):
Day: 5,000
Night: 2,600
Armor Penetration (mm): Can defeat IFV and APC. A near miss will seriously damage or destroy most IFVs and APCs.

Other Ammunition Types: French Giat 125G1 APFSDS-T, Russian BM-42 and BM-32 APFSDS-T. Note: The Russians may have a version of the BM-42M with a DU penetrator. The Russian BM-48 APFSDS-T round penetrates 650-700 mm

Sokol-1 guided antitank round, see pg 5-36

Antitank Guided Missiles:
Name: AT-11B/Invar
Warhead Type: Tandem Shaped charge (HEAT)
Armor Penetration (mm CE): 900, 850 behind ERA
Range (m): 5,000 day, 2,600 night

9M119F1: Missile with Frag-HE warhead to 5,000 m

NOTES.
The original version of the tank has an 840-hp diesel engine. The engine in subsequent models is upgraded. Engine options include 950, 1,000 and 1,100 hp.

The original tank had an II sight from the T-80 series (Buran-PA, 800-1300 meters range). However, marketing materials feature the AGAVA-2 thermal sight. Recent gen^3 sights are available. These night sights permit night launch of ATGMs.

The T-90 may be fielded with full **Shtora-1** package (laser warning receiver with auto-slew gun capability, LWR-directed smoke grenade launchers, and EO-IR jammer), with a partial package, or without Shtora-1. Shtora-1 illuminators can be used for night illumination.

An improved gun, 2A46M-4, with improved accuracy and use life is available for fitting to the T-90.

The BK-29 round, with a hard penetrator in the nose is designed for use against reactive armor, and as an MP round has fragmentation effects. The BK-27 HEAT round offers a triple-shaped charge warhead and 50 mm more penetration.

The 12.7-mm MG NSVT has both remote electronically operated sight PZU-5 with vertical stabilization, night acquisition, and a gun-mounted K10-T reflex sight.

CHINESE TANKS, NOMENCLATURES AND FEATURES

Dozens of prototypes and export variants of these tanks exist. Other variants not shown were fielded in small numbers and may still be in use. Below are key fielded tanks with distinctive features. Also listed are transitional tanks (Type 85, Type 90-II, etc.) unfielded or fielded in limited numbers which help clarify development paths.

Name	AKA	Photo	Family/ Generation	Remarks
Type 59	WZ-120		Type 59 1st Gen	Wt 36 mt 6.0m x 3.3m T-54 copy. 100mm gun
Type 59-II Type 59D Al Zarrar (Pk variant)	WZ-120B WZ-120C/D		Type 59 1st Gen 3rd Gen	Wt 36.5 mt 6.0m x 3.3m 105mm gun, II/IR night sight, more engine hp Upgrade with 125-mm gun, 730-hp engine, ERA, 2nd gen thermal sight, etc.
Type 69-I Type 69-II	WZ-121 Type 69-IIB Type 69-IIC		Type 69 1st Gen	Wt 36.7 mt 6.2m x 3.3m 100mm gun. Type 69-II imp FCS, skirts, NBC, etc
Type 79-I Type 79-II	WZ-121D Type 69-IIG Type 69-IIM Type 69-III		Type 69 1st Gen	Wt 37.5 mt 6.2m x 3.3m Type 79-I 105mm gun, imp FCS, II night sight, thermal sleeve on gun. Type 79-II export tank. New FCS, new engine.
Type 88B Type 88A Type 88	Type 80-II Type 80/88		Type 80 2nd Gen	Wt 38.5 mt 6.3m x 3.4m 105 gun, new chassis w/ old turret, ERA some tanks. Stabilized FCS, improved ERA, longer gun tube, etc
Type 85-II	Type 85		Type 85 2nd Gen	Wt 39 mt. 6.3m x 3.5m. Above chassis mated to new welded turret, 105 gun, solid state FCS, etc. Limited production.

CHINESE TANKS, NOMENCLATURES AND FEATURES (Continued)

Name	AKA	Photo	Family/ Generation	Remarks
Type 85-IIM	Type 85-IIA (Pk version)		Type 85 2nd Gen	Wt 41.5 mt 6.3m x 3.5m. 125-mm gun and autoloader.
Type 85-III	Type 88 series upgraded Ch upgrade standard for earlier tanks			Wt 42 mt 6.3m x 3.5m. Upgrade was offered for Type 85 exports, with 1000 hp, ERA, improved FCS, and thermal night sight. Type 88 series tanks have been upgraded to this standard.
Type 96	Type 88C (early version)		Type 85 2nd Gen	Wt 41.7 mt 6.3m x 3.5m. Improved fit and chassis detail, countermeasures. It incorporated many upgrades from Type 85III (e.g., engine) and was further improved.
Type 96G	Production standard for Ch tank force	Photo of Type 96G unavailable		46 mt 6.3m x 3.5m. Add changes from Type 99, 2nd gen ERA, new FCS, FLIR
Type 90-II (Prototype, and exported) Al Khalid (Pk variant)	Type 90-II Type 90-IIA Type 90-IIM	 See pg 5-4	P-90 MBT 2000 (export) 3rd Gen	Wt 48 mt 7.1m x 3.5m. Program of prototypes for new generation China/export tanks (55% new components) and upgrades for older tanks. Sold to Myanmar. Pk tank with several upgrades
Type 98	WZ-123 Type 90-III		P-90/ Type 90II later variant 3rd Gen	Wt 50 mt 7.3m x 3.5m. New or improved features include hull, ERA, 1,200 hp engine, turret, gun, autoloader, gun-launch ATGMs, hunter-killer FCS, thermal night sight, countermeasure laser dazzler.
Type 99 Type 99A2	Type 98Gai Type 99G Type 2000-II	 Photo of Type 99A2 unavailable		Wt 52-54 mt 7.7m x 3.5m. Type 98 upgrade with 3rd gen ERA, 2nd gen thermal sight, countermeasure laser dazzler, and 1,500-hp engine. Type 98s will be upgraded. Fielded in a few high level units. Latest Type 99 with new ERA , active protection, etc.

Chinese Main Battle Tank Type 59-II and Pakistani Al Zarrar

Type 59D

Weapons & Ammunition Types	Typical Combat Load
105-mm rifled gun L7	**34**
New CH APFSDS-T	12
M456 HEAT	6
L35 HESH	16
7.62-mm coax MG	**2,000**
7.62-mm bow MG	**1,000**
12.7-mm AA MG	**500**

SYSTEM
Alternative Designations: WZ 120B, see pg 5-40
Date of Introduction: 1951
Proliferation: At least 2 countries
Description:
Crew: 4
Combat Weight (mt): 36.5
Chassis Length Overall (m): 6.04
Height Overall (m): 2.59
Width Overall (m): 3.30
Ground Pressure (kg/cm^2): 0.8

Automotive Performance:
Engine Type: 520-hp Diesel
Cruising Range (km): 440/600 with external tanks
Speed (km/h):
Max Road: 50
Max Off-Road: 25
Average Cross-Country: INA
Max Swim: N/A
Fording Depths (m): 1.4 Unprepared, 5.5 with snorkel

Radio: INA

Protection:
Armor, Turret Front (mm): 203
Applique Armor (mm): Track skirts are fitted to some tanks
Explosive Reactive Armor (mm): N/A
Active Protective System: N/A
Mineclearing Equipment: Mine plows and roller-plows available
Self-Entrenching Blade: N/A
NBC Protection System: N/A
Smoke Equipment: 8 x 81-mm smoke grenade launchers
Vehicle engine exhaust smoke system

ARMAMENT
Main Armaments:
Caliber, Type, Name: 105-mm rifled gun, similar to L7
Rate of Fire (rd/min): 6-10
Loader Type: Manual
Ready/Stowed Rounds: INA
Elevation (°): -5/+18
Fire on Move: Yes

Auxiliary Weapon:
Caliber, Type, Name: 7.62-mm (7.62x 54R) Machine gun Type 59T
Mount Type: Turret coax
Maximum Aimed Range (m): 2,000
Max Effective Range (m):
Day: 1,000
Night: 800
Fire on Move: Yes
Rate of Fire (rd/min): 250 practical, 600 cyclic in 2-10 round bursts

Caliber, Type, Name: 7.62-mm (7.62x 54R) Machine gun Type 59T
Mount Type: Bow ball mount
Maximum Aimed Range (m): 1,000
Max Effective Range (m):
Day: 1,000
Night: N/A
Fire on Move: Yes
Rate of Fire (rd/min): 250 practical, 600 cyclic in 2-10 round bursts

Caliber, Type, Name: 12.7-mm (12.7x108) AA MG Type 54
Mount Type: Turret cupola
Maximum Aimed Range (m): 2.000
Max Effective Range (m):
Day: 1,500 ground/1,600 for air targets (APDS)
Night: N/A, II sights available
Fire on Move: Yes
Rate of Fire (rd/min): 80-100 practical, 600 air targets 2-10 rd bursts

ATGM Launcher:
Name: 105-mm main gun
Launch Method: Gun-launched
Guidance: SACLOS, Infrared laser-beam rider
Command Link: Encoded laser-beam
Rate of Launch: (missiles/min): 2-3, depending on range
Launcher Dismountable: No

FIRE CONTROL
FCS Name: UI light spot fire control system
Main Gun Stabilization: 2-plane
Rangefinder: LRF/laser target designator
Infrared Searchlight: Yes
Sights w/Magnification:
Gunner:
Day: INA
Field of View (°): INA
Acquisition Range (m): 2,000-3,000
5,500 for ATGM
Night: Type DC 1024/00 II/IR sight, x7
Field of View (°): 6
Acquisition Range (m): 1,000
Commander Fire Main Gun: No

VARIANTS:
Type 59: Original model is a copy of the Former Soviet T-54 MBT and has a 100-mm rifled main gun.

Type 69: Family of tanks derived from the Type 59 chassis. The **Type 69-I** has a smoothbore 100-mm gun.

Chinese Main Battle Tank Type 59-II and Pakistani Al Zarrar continued

Type 69-II has a stabilized rifled 100-mm gun and improved fire control system with LRF and ballistic computer. A thermal sleeve was added to the gun barrel. A limited number of Type 69 tanks have 105-mm guns.

Type 79-I: Type 69 upgrade with 105-mm gun, thermal gun sleeve, and improved FCS with II night sight. Type 79-II export version with modernized FCS, improved side skirts, and a new engine.

T-72Z/ Safir 74: Iranian variant which constitutes state-of-the-art for upgraded 50s-generation former Warsaw Pact tanks. This tank has a 780-hp diesel engine, track skirts, and smoke grenade launchers. An Iranian ERA package fits T-72Z. Armament includes an M68 105-mm rifled gun, 7.62-mm Type 59T (PKT) MG, and a 12.7-mm Type 59 (DShKM) MG. The cannon can launch AT-10/ Bastion ATGMs to 4000 meters, and fire a broad range of NATO 105-mm ammunition. Fire control includes the robust Slovenian EFCS-3-55 fire control system with stabilization, a laser rangefinder, and a ballistic computer. The FCS includes a commander's independent viewer and target designation system, and II gunner night sights.

Type 59D: Modernization upgrade, aka WZ120C. It has ERA, computerized stabilized FCS, the 105-mm rifled gun, and II night sights. **Type 59D1** features a new 105-mm Type 83A longer barrel. Gun range is 2,000 m. A thermal sight is available. The gun has ATGM launch capability to 5,500 m.

T- 55MII: Pakistani Type 59 modernization conducted during overhaul. It includes a 580-hp engine, stabilized 105-mm rifled gun, integrated computer FCS with GPS and thermal sight, APU, etc.

Al Zarrar: Pakistani Type 59 upgrade, with new engine and ERA. Original Al Zarrar had 1st gen ERA. The latest version has a 730-hp engine, 125-mm gun, ISFCS hunter-killer FCS with Catherine 2nd gen thermal sight, and 2nd gen ERA. So far, 300 are in service.

Al Zarrar

MAIN ARMAMENT AMMUNITION
Caliber, Type, Name:
105-mm APFSDS, H6/62
Maximum Aimed Range (m): 3,000
Max Effective Range (m):
Day: 2,000-3,000 (est)
Night: 1,000
Armor Penetration (mm): INA

105-mm APFSDS, UI (New Chinese)
Maximum Aimed Range (m): 3,000
Max Effective Range (m):
Day: 2,000-3,000 (est)
Night: 1,000
Armor Penetration (mm KE): 460 at 2,000 m

105-mm HEAT, M456 (multinational)
Maximum Aimed Range (m): 3,000
Max Effective Range (m):
Day: 1,500-2,500 (est)
Night: 1,000
Armor Penetration (mm CE): 432, NATO single heavy target

105-mm HESH, L35 (UK)
Maximum Aimed Range (m): 5,000
Max Effective Range (m):
Day: 2,000-3,000 (est)
Night: 1,000
Armor Penetration (mm): NATO single heavy target

Other Ammunition Types: Chinese Type 83/ UK L64/ US M735 APFSDS, UK L52 APDS, multinational M393 HEP-T, French OE 105-F1 HE, L39 Smoke, canister

Antitank Guided Missiles:
Name: AT-10/BASTION, Chinese variant for Type 59D
Warhead Type: 105-mm Shaped charge (HEAT)
Armor Penetration (mm CE): 650 (RHA)
Range (m): 5,200 (day only)

NOTES
GEC-Marconi Centaur fire control system is available. British Barr and Stroud thermal based FCS can be fitted.

Chinese Main Battle Tank Type 96 and Type 96G

Weapons & Ammunition Types	Typical Combat Load
125-mm smoothbore gun	(mix est) **42**
APFSDS-T	15
HEAT	6
Frag-HE	21
7.62-mm coax MG	**2,250**
12.7-mm cupola AAMG	**500**
ATGM in Type 96G SVIR/INVAR-type (swap for HEAT/Sabot)	**6**

SYSTEM
Alternative Designations: Early version was called Type 88C. AKA ZTZ 96. The main production Chinese tank is now Type 96G.
Date of Introduction: 1991, 1996 for Type 96G
Proliferation: At least 3 countries, 1 more considering Type 96G
Description:
Crew: 3
Combat Weight (mt): 41.5 without ERA, 46 Type 96G
Chassis Length Overall (m): 6.33
Height Overall (m): 2.30
Width Overall (m): 3.450
Ground Pressure (kg/cm^2): 0.771

Automotive Performance:
Engine Type: 1,000-hp Diesel
Cruising Range (km): 700/900 with external tanks
Speed (km/h):
Max Road: 57
Max Off-Road: 45
Average Cross-Country: 35
Max Swim: N/A
Fording Depths (m): 1.4 Unprepared, 5.0 with snorkel

Radio: INA

Protection:
Armor, Turret Front (mm): Type 96 comparable (est) to Challenger (pg 5-9). Type 96G is comparable to Improved T-72BM (pg 5-29).
Applique Armor (mm): Track skirts. Composite panels available.
Explosive Reactive Armor (mm): 2nd gen on Type 96G
Active Protective System: N/A
Mineclearing Equipment: Mine plows and roller-plow set
Self-Entrenching Blade: N/A
NBC Protection System: Yes
Smoke Equipment: 12x 81-mm smoke grenade launchers
Vehicle engine exhaust smoke system
Other Survivability Equipment: JD-3 ATGM IR jammer
Welded turret permits upgrade with improved armor. Bar armor stowage racks on turret sides and rear can support effort to pre-detonate ATGLs launched at those aspects.

ARMAMENT
Main Armament:
Caliber, Type, Name: 125-mm smoothbore gun 2A46M/ D-81TM
Rate of Fire (rd/min): 6/2 in manual mode
Loader Type: Autoloader (separate loading) and manual
Ready/Stowed Rounds: 22/20 (22 in carousel)
Elevation (°): -6 to +14
Fire on Move: Yes, up to 25 km/h. Depending on the road and distance to the target, most crews may halt before firing.

Auxiliary Weapon:
Caliber, Type, Name: 7.62-mm (7.62x 54R) Machine gun Type 59
Mount Type: Turret coax
Maximum Aimed Range (m): 1,800
Max Effective Range (m):
Day: 1,000
Night: 800
Fire on Move: Yes
Rate of Fire (rd/min): 250 practical, 600 cyclic, 2-10 rd bursts

Caliber, Type, Name: 12.7-mm (12.7x108) AA MG Type 54
Mount Type: Cupola
Maximum Aimed Range (m): 2,000
Max Effective Range (m):
Day: 1,500 ground/1600 for air targets (APDS)
Night: N/A
Fire on Move: Yes
Rate of Fire (rd/min): 80-100 practical, 600 air targets, 2-10 rd bursts

ATGM Launcher: For type 96G
Name: Tank main gun
Launch Method: Gun-launched, from tank auto-loader
Guidance: SACLOS laser-beam rider, Refleks missile launcher
Command Link: Encoded infrared laser beam
Rate of Launch: (missiles/min): 2-3, depending on range
Launcher Dismountable: No

FIRE CONTROL
FCS Name: ISFCS-212 (Image-Stabilized Fire Control System)
Main Gun Stabilization: 2-plane
Rangefinder: LRF
Infrared Searchlight: Yes
Sights w/Magnification:
Gunner:
Day: UI stabilized gunner sight
Field of View (°): INA
Acquisition Range (m): 5,500
Night: 2nd Generation II sights Type 96
1st gen thermal sight on Type 96G
Field of View (°): INA
Acquisition Range (m): 1,200 for Type 96 sight
2,600 for Type 96G

Commander Fire Main Gun: Yes

Chinese Main Battle Tank Type 96 and Type 96G continued

VARIANTS
These tanks have seen many minor improvements in manufacture and operations. Chassis was upgraded considerably from the original **Type 80/88** chassis. Heavier turret/chassis updates **Type 85**. Weight varies from 41 to 42 tons, depending on variant and improvements.

Type 85-IIAP: First significantly fielded tank of this class with 125-mm gun, autoloader, and a modern FCS. Early versions were assembled using parts from Type 59s, Type 69-IIs and upgrade kits for export, or produced in Pakistan under license. Those tanks displayed poor craftsmanship and reliability problems. Fabrication improvements corrected most of the problems. Pakistan is considering indigenous, Chinese, and other foreign upgrade programs to modernize those tanks. Pakistan now produces 125-mm ammo for these tanks, the more modern Al Khalid, and for export.

Type 85-III: Upgrade program was developed for export upgrades, e.g., Type 85-IIAP. It includes a 1,000-hp engine and composite armor panels, ERA (see photo), improved FCS with thermal sight, and a gun-launch ATGM option. Wt 42 mt 6.3m x 3.5m. It was applied to Type 88 series and Type 96 (some ERA application).

Type 85-III

Type 96: The original version (Type 88C) had a 730-hp engine. Many Type 85-III upgrades noted above are now incorporated. However, with transition to **Type 96G**, additional upgrades have been added.

Type 96G: The latest tank has conformal 2nd gen ERA of the same design as on the Type 99 tank. Other upgrades from the Type 99 include the gun, ammunition, and FCS. Export version also has a Shtora-type EO jammer system mounted on the turret sides. For description of turret and lethality capabilities, use Type 99 data (see page 5-46 and 47).

MAIN ARMAMENT AMMUNITION
Caliber, Type, Name:
125-mm APFSDS-T, BM-42M estimated, based on similar rounds
Maximum Aimed Range (m): 3,000
Max Effective Range (m):
Day: 2,000-3,000
Night: 850-1,300
Armor Penetration (mm KE): 590-630 at 2,000 meters

125-mm Frag-HE-T, OF-26 estimated, based on similar rounds
Maximum Aimed Range (m): 5,000
Max Effective Range (m):
Day: INA
Night: 850-1,300
Armor Penetration (mm): Can defeat IFV and APC

125-mm HEAT, BK-27 estimated, based on similar rounds
Maximum Aimed Range (m): 3,000
Max Effective Range (m):
Day: 2,000-3,000
Night: 850-1,300
Armor Penetration (mm CE): 700-800

125-mm HEAT-MP, BK-29M estimated, based on similar rounds
Maximum Aimed Range (m): 3,000
Max Effective Range (m):
Day: 2,000-3,000
Night: 850-1300
Armor Penetration (mm CE): 650-750

Other Ammunition Types: Giat 125G1 APFSDS-T, Russian BM-42 and BM-32 APFSDS-T. Note: The Russians may have a version of the BM-42M with a DU penetrator.

Antitank Guided Missiles: For type 96G
Name: INA
Warhead Type: Shaped charge (HEAT)
Armor Penetration (mm CE): 700+
Range (m): 5,000 day, 4,000 night

The more recent BK-27 HEAT round offers a triple-shaped charge warhead and increased penetration against conventional armors and ERA. The BK-29 round, with a hard penetrator in the nose is designed for use against reactive armor, and as an MP round has fragmentation effects. If the BK-29 HEAT-MP is used, it may substitute for Frag-HE (as with NATO countries) or complement Frag-HE.

NOTES
GEC-Marconi Centaur fire control system is available. British Barr and Stroud thermal based FCS can be fitted.

Chinese Main Battle Tank Type 99 and Type 99A2

Weapons & Ammunition Types	Typical Combat Load
125-mm smoothbore gun	(mix est) **42**
APFSDS-T	14
HEAT	2
Frag-HE	20
ATGM	6
7.62-mm coax and bow MGs	**2,250**
12.7-mm cupola AAMG	**500**

SYSTEM
Alternative Designations: ZTZ-99, Type 98 Gai, Type 98G.
See Type 99A2 at VARIANTS

Date of Introduction: 2001, 2003 improved configuration (above)
Proliferation: At least 1 country
Description:
Crew: 3
Combat Weight (mt): 52-54
Chassis Length Overall (m): 7.7
Height Overall (m): 2.25
Width Overall (m): 3.5
Ground Pressure (kg/cm^2): INA

Automotive Performance:
Engine Type: 1,500-hp Diesel (1,200 in first version – Type 98)
Cruising Range (km): 500
Speed (km/h):
Max Road: 80
Max Off-Road: 60
Average Cross-Country: 60
Max Swim: N/A
Fording Depths (m): 1.4 Unprepared, 5.0 with snorkel

Radio: INA

Protection:
Armor, Turret Front (mm): Welded turret with protection vs KE and CE comparable to T-90A (pg 5-35) and latest western tanks
Applique Armor (mm): Track skirts. Composite panels available.
Explosive Reactive Armor (mm): Conformal 2nd or 3rd gen ERA.
Active Protective System: No
Mineclearing Equipment: Mine plows and roller-plow set
Self-Entrenching Blade: No
NBC Protection System: Yes
Smoke Equipment: 12x 81-mm smoke grenade launchers
Vehicle engine exhaust smoke system
Other Survivability Equipment: Laser dazzler countermeasure System can temporarily blind enemy gunners at 5 km.
Laser warning receiver

ARMAMENT
Main Armament:
Caliber, Type, Name: 125-mm smoothbore gun
Rate of Fire (rd/min): 8/2 in manual mode
Loader Type: Autoloader (separate loading) and manual
Ready/Stowed Rounds: 22/20 (22 in carousel)
Elevation (°): INA
Fire on Move: Yes, depending on the road and distance to the target, most crews may halt before firing.

Auxiliary Weapon:
Caliber, Type, Name: 7.62-mm (7.62x 54R) Machine gun Type 59
Mount Type: Turret coax and bow
Maximum Aimed Range (m): 1,800
Max Effective Range (m):
Day: 1,000
Night: 800
Fire on Move: Yes
Rate of Fire (rd/min): 250 practical, 600 cyclic, 2-10 rd bursts

Caliber, Type, Name: 12.7-mm (12.7x108) AA MG W 85
Mount Type: Cupola
Maximum Aimed Range (m): 2,000, 3,000 with impact adjust fire
Max Effective Range (m):
Day: 2,000 ground/1500 for air targets (HE/APDS)
Night: N/A
Fire on Move: Yes
Rate of Fire (rd/min): 80-100 practical, 600 air targets, 2-10 rd bursts

ATGM Launcher:
Name: Tank main gun
Launch Method: Gun-launched, from tank auto-loader
Guidance: SACLOS laser-beam rider, Refleks missile launcher
Command Link: Encoded infrared laser beam
Rate of Launch: (missiles/min): 2-3, depending on range
Launcher Dismountable: No

FIRE CONTROL
FCS Name: ISFCS-212 (as on Type 96 above, probably), but with an auto-tracker (IR automatic target tracker)
Main Gun Stabilization: 2-plane
Rangefinder: LRF and laser target designator
Infrared Searchlight: Yes
Sights w/Magnification:
Gunner:
Day: UI stabilized gunner sight
Field of View (°): INA
Acquisition Range (m): 5,000-6,000
Night: 2nd gen thermal sight (improved version)
Field of View (°): INA
Acquisition Range (m): 4,500 (3,000-5,000)
Commander Fire Main Gun: Yes

Chinese Main Battle Tank Type 99 and Type 99A2 continued

VARIANTS
Type 98: Early version came with or without 1st gen ERA.

Type 99: Type 98 upgrade with advanced conformal ERA, 2nd gen thermal sight, countermeasure laser dazzler, and a more powerful engine. This is the latest fielded Chinese tank based on the third generation tank Type 90-II/P-90 chassis.

Type 99A2: Improved version with 3 gen Relikt type 3rd gen ERA, and a better gun. The ERA and composite armor will defeat virtually all modern vehicle fired KE rounds and missiles. The ATGM is a tandem-warhead type similar to Invar. An active protection system is employed on it. It is likely that the standard fielded version of Type 99 is Type 99A2, with previously produced Type 99s updated to this standard. It will be the representative Near Term tank.

MAIN ARMAMENT AMMUNITION
Caliber, Type, Name:
125-mm APFSDS-T, INA
Maximum Aimed Range (m): 3,000
Max Effective Range (m):
Day: 2,500
Night: 2,500
Armor Penetration (mm KE): 960 at 1,000 meters, 800+ at 2,000

125-mm APFSDS-T, Type II
Maximum Aimed Range (m): 3,000
Max Effective Range (m):
Day: 2,500
Night: 2,500
Armor Penetration (mm KE): 600 at 2,000 meters

125-mm Frag-HE-T, OF-19
Maximum Aimed Range (m): 3,000
Max Effective Range (m):
Day: 1,500
Night: 1,500
Armor Penetration (mm): Can defeat IFV and APC

125-mm HEAT, BK-27 estimated, based on similar rounds
Maximum Aimed Range (m): 3,000
Max Effective Range (m):
Day: 1,500
Night: 1,500
Armor Penetration (mm CE): 500

Other Ammunition Types: Tank can use Russian and other former Warsaw Pact ammunition, as well as the French Giat 125G1. Russian rounds include the BM-42M and BM-32 APFSDS-T. Note: The Russians may have a version of the BM-42M with a DU penetrator.

Other Russian rounds include HEAT and HEAT-Multipurpose rounds. The more recent BK-27 HEAT round offers a triple-shaped charge warhead and increased penetration against conventional armors and ERA. The BK-29 round, with a hard penetrator in the nose is designed for use against reactive armor, and as an MP round has fragmentation effects. If the BK-29 HEAT-MP is used, it may substitute for Frag-HE (as with NATO countries) or complement Frag-HE. The Russian OF-26 round is effective out to 5,000 m with area effects.

Antitank Guided Missiles:
Name: INA (similar to AT-11 Svir)
Warhead Type: Shaped charge (HEAT)
Armor Penetration (mm CE): 770, 270 behind ERA
Range (m): 5,000 day, 4,000 night

Name: INA (similar to AT-11B Invar)
Warhead Type: Tandem shaped charge (HEAT)
Armor Penetration (mm CE): 900, 850 behind ERA
Range (m): 5,000 day, 4,000 night

NOTES
The tank also uses an inertial/GNSS navigation system and battle management system.

Chapter 6
Antitank and Anti-armor

As armored combat vehicles added more protection and ascended in importance on the battlefield, so did systems designed to stop them gain importance. The umbrella term ***antitank*** (AT) originally denoted systems specifically designed to destroy tanks. Today it is more broadly constructed. Modern combat is combined arms combat. Mechanized forces include other armored combat vehicles, such as armored reconnaissance vehicles, infantry fighting vehicles, armored personnel carriers, etc. In order to address the whole spectrum of threats on the modern battlefield, new systems are being developed and older systems redesigned. Examples are ***heavy armament combat vehicles (HACVs)*** and ***heavy combat support vehicles*** on pg 6-34.

Tank armor protection continues to increase; but another way to defeat them is to defeat associated systems. Tanks cannot survive or achieve their tactical objectives without support from other armored systems. The more recent term ***anti-armor*** may supplant the current term; because antitank weapons which cannot penetrate tank armor can still be effective threats to defeat or damage more lightly armored fighting vehicles. With upgrades and innovative tactics, even older seemingly obsolete weapons can be used as OPFOR anti-armor weapons.

The OPFOR places a high priority on destroying enemy vehicles. It will use all available assets (organic and improvised) for the effort. The spectrum of AT and anti-armor weapons is noted on pages 5-3 to 5-4. They include aircraft, artillery, NBC assets, sniper rifles, and air defense systems. Many OPFOR countries employ antitank weapons for roles other than antitank, including AT guns against personnel and soft targets, and ATGMs against personnel and rotary-wing aircraft.

Critical factors for destroying vehicles are abilities to slow, canalize, and stop them to engage them with lethal fires and ambushes. Mines, explosives, IEDs, other obstacle systems, and terrain restrictions can be used in concert with AT weapons. Mines are found at Chapter 8, Engineer Systems. Discussion of IEDs can be noted at Chapter 16, Improvised Weapons.

Antitank guns (AT guns) include towed and self-propelled AT guns (aka ***SPAT*** or tank destroyers). A number of guns were designed as field guns, with multi-role capability as both artillery and antitank guns. The modern focus on maneuver warfare has brought a slight decline in development of uniquely antitank guns. Thus, the 85-mm D-44 gun, which can be used as artillery, is effective for use in an antitank role. Although recent systems have been developed, the number fielded has not kept pace with production of armored combat vehicles. Nevertheless, their effectiveness and selected armies' continued reliance on linear positional battles and protracted defenses have kept a large number of these systems in inventories. Based on numbers fielded and likelihood of their threat to US forces, only towed antitank guns were included.

Upgrades for towed guns are available. These include night sights, such as passive image intensifier sights and thermal sights for the Russian 100-mm MT-12. This is a robust antitank weapon, with a high rate of fire and rapid mobility. Note the Russian innovation in the MT-12R AT gun with a radar-directed all-weather fire control system. Improved ammunition is critical for continued effectiveness of antitank weapons. The MT-12 and its variants can fire a variety of modern ammunition, including the Russian gun-launched ATGMs, Kastet and Arkan.

The ***antitank guided missile*** (ATGM) is the singular greatest threat to tanks today. These systems are distinguished from other antitank weapons in that they are guided to the target. Most employ SACLOS guidance (see Glossary). An operator holds crosshairs on the target, and the missile tracker directs the missile to that point. There is a wide variety of countermeasures (such as smoke and counter-fire, due to long flight time and operator vulnerability) for use against ATGMs. Thus, a 90% probability of hit is a technical figure, and does not mean a 90% probability of success. On the other hand, there is a variety of counter-countermeasures which the ATGMs, launchers, and operators can use to increase the chance for success. Tactics, techniques and procedures in the antitank arena are critical to mission success.

Armor protection for many modern tanks has outpaced some older AT weapons. However, ATGMs offer improved size, range, and warhead configurations to destroy even the heaviest tanks. Notable trends include increased proliferation and variety of man-portable and portable ATGM launchers. These include shoulder-launched, short-range systems, such as the French Eryx, and copies of former Soviet systems, such as the AT-3/Malyutka ("Suitcase SAGGER). Some so-called portable launchers (AT-4/5, TOW, and HOT) have outgrown portability weight limits, and must be carried in vehicles and only dismounted short distances from carriers. But newer compact systems are being fielded, e.g., Spike-MR and Kornet-MR.

Although there are special-built ***ATGM launcher vehicles***, the most numerous launcher vehicles are common chassis adapted by adding a pintle mounted, manually loaded and launched ATGM (see pg 3-7). Adaptation is simple; so they are not described here. Nearly all ATGM launchers are high level threats to vehicles and rotary-winged aircraft in the US Army. They can also be used against personnel and materiel targets. The variety of launch platforms is increasing. UAVs are being adapted to launch ATGMs for responsive attacks against NLOS/BLOS targets.

Recent trends include new ATGM technologies for increased range and lethality. The most common type of lethality upgrade is addition of a nose precursor or tandem warhead. Recent options include missiles for wider battlefield lethality - BLOS/NLOS systems, and long-range ATGMs to attack targets previously considered invulnerable (pg 6-72). NLOS guidance technologies include fiber optics (to see thru the missile eye BLOS) and semi-active laser homing (for dismounted soldier/vehicle/aircraft/UAV-mounted laser target designators to select targets). Others have "fly-over, shoot-down" mode to fly behind a hill and fire an explosive-formed penetrator (EFP, in the shape of a cannon kinetic-energy penetrator round) downward through the relatively soft top of armored vehicles. Improvements include improved guidance, resistance to countermeasures, reduced smoke/noise signatures, and increased range. Night sights are common, including thermal sights. Many countries are looking at active protection system (APS) CM systems. Already, some ATGM have counter-countermeasures to defeat all APS.

The chapter has been reorganized, with systems in order of mobility and unit level, from dismounted infantry AT teams to ground/towed weapons, to vehicles. Lower level systems are more numerous and likely to be seen. Systems in this chapter are common systems, or those that represent likely threats against Army forces. Questions and comments should be addressed to:

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Antitank and Anti-armor Systems: Key Technology Trends

Military forces worldwide continue to field new anti-armor systems and upgrade legacy systems. Modern tanks can be fitted with increased armor protection, countermeasure systems, and survivability support systems. Thus new antitank systems and upgrades are being fielded to challenge those protection upgrades. Most weapons on the battlefield have some anti-armor capability. A variety of multi-role weapons have been fielded with lethal AT capability. Similarly, many AT weapons are used to defeat other targets.

System Category	Technology Trend	Reference Ch/Page	System Example	Ref Page
Recoilless Weapons	Electro-Optical LRF fire control system (FCS) with II/thermal sight	6-20	Simrad LP101	6-40
	Precision munitions and missiles for recoilless crewed weapons	6-59	M40 with LAHAT	6-59
	New munitions (tandem HEAT, longer range, multi-purpose use)	6-19	SPG-9M Rcllss gun	6-28
	Small light launch tubes and disposable canisters to extend length	6-19	RPG-29 Mtd ATGL	6-21
	Rapid disassembly into components for dismount team portability	--	M79 Rcllss gun	6-18
AT Guns	New FCS can include radar-directed fire control	1/6-1	MT-12R AT gun	6-27
	New munitions include homing round and gun-launched ATGMs	1/6-56	2S25 AT gun	6-43
	Auxiliary propulsion units for local moves	--	MT-12/MT-12R	6-27
	Increased protection for AT gun vehicles (see HACVs)	1/6-29	Type 63A light tank	6-43
	HACVs with similar weapons lethality to tanks	1/6-29	2S25 SPAT gun	6-31
ATGMs	EO/thermal FCS with LRF and encoded beacon to counter jammers	1/6-2	Konkurs-M (AT-5B)	6-19
	Missiles include thermobaric multi-use, improved tandem, top attack	1/6-2	AT-13	6-13
	New guidance modes extend range for missiles to BLOS and NLOS	1/6-2, -61	Spike-LR	6-14
	Back-blast reduction for use in confined spaces	--	Eryx	6-11
	KE missiles/rounds with short time-of-flight to defeat active protection	1/6-9	Starstreak	6-12
	Light man-portable medium-range high-lethality ATGMs	6-15	MILAN-ADT	6-15
	Remote add-on vehicle turrets with EO optics and multi-launchers	3-51	VBL-Kornet	5-20
Multi-role Weapons	Multi-role systems and munitions in other units to defeat armor	6-4	Strix IR Mortar rd	8-76
	Multi-role (AD/AT) missiles for air defense and anti-armor use	6-4	Starstreak	6-23
	Multi-role missile vehicles for AD, AT, and infantry units	3-53	BMP/Kliver	3-47
	Multi-role gun/missile systems and heavy combat support vehicles	3-56 3/5-9	BMPT	3-56
Other AT Weapons	Mines and IEDs include remote controlled and scatter mine systems	14-9	RPO-A grenade	13-11
	Flame weapons for use against armor and vehicle subsystems	13-1	Molotov Cocktail	14-2
	Improvised weapons for use against vehicles and personnel	14-5	PKM machinegun	2-18
	Wide variety of weapons to defeat wheels on armored vehicles	8-6	UMZ Mine scatter	8-28

Spectrum of Weapons and Munitions Effective Against Armored Vehicles

Military forces will use a wide variety of weapons to defeat armored systems and degrade their operations (see pg 6-1). The WEG describes multi-role (MR) weapons in various locations. Common weapons in combat units (e.g., machineguns and grenade launchers in Chapter 1) will engage various targets, including armored vehicles. With emphasis resulting from modern urban combat; demand for improved weapons and munitions against armored vehicles is increasing.

The challenge in defeating modern tanks is extremely difficult, with their high amount of armor protection and high mobility. Antitank subunits/units are found in infantry and armor battalions, brigades, and divisions, and in other combat units as needed. AT units are specially designed to support infantry, armor, and other units in combat, and are often task organized in combined arms groups. With limited armor protection and vulnerability to ground weapons, AT systems do not separate from supported maneuver units. AT unit weapons include the following:

- Crewed recoilless guns and launchers
- Towed AT guns
- HACVs (aka SPAT, etc, see pg 6-41)
- Man-portable and shoulder launch ATGMs
- Portable and ground mount ATGMs
- ATGM launcher vehicles, and
- NLOS ATGM launcher vehicles

The most prolific anti-armor and antitank systems are in units other than AT units. By number, most are found in infantry, mechanized infantry, tank units, and in special purpose forces units, but can also be in irregular and hybrid forces. They include the following assets.

Branch	System Type	Example	Reference (Vol, Page)	Lethality D/K if hit*	Remarks
Infantry, SOF, etc. (Also irregular or, hybrid forces)	ATGL	Pzf 3-IT600	1/2-37	Tk and LAV=K	Tandem HEAT, HE, Bunker-B
	ATDL	RPG-27	1/2-45	Tk and LAV=K	Tandem HEAT
	Shoulder ATGM	Eryx	1/6-22	Tk and LAV=K	Tandem HEAT, HE
	ATGL/IED remote fuze	SIRA sensor, Salamander	1/2-37	LAV=K, Tk=K	IR/seismic sensor, RF/wire cmd
Infantry Vehicles and other LAVs	IFV main gun and ATGM	AMX-10P/MILAN	1/3-28	LAV=K, Tk=K	APDS round, ATGM Tandem
	Infantry fire spt vehicle	BMP/Kliver	1/3-49, -56	LAV=K, Tk=K	Gun, ATGM, MANPADS
	Heavy IFV/IFSV	BMP-3M	1/3-47	LAV=K, Tk=K	See also HCSV, vol 1, pg 3-58
Tanks	Main Gun and ATGM	T-90S	1/5-37	LAV=K, Tk=K	Rounds and ATGM

Maneuver units receive support for various combat missions and phases. ATDLs are treated as ordnance stored with other ammunition, then disseminated as needed to infantry and other users depending on mission and battle conditions. Engineer assets and units will support maneuver units in the defense and conducting ambushes (by delivering or laying mines to slow or stop enemy forces, so that they can be engaged with AT/anti-armor weapons). Infantry companies and battalions may have organic weapons platoons for AT/anti-armor fire support. Combat units can call for AT unit support, anti-armor mortar/artillery fires, and aircraft strikes.

A shift to using more light armored vehicles has led to production and deployment of a wide array of anti-armor and multi-role weapon systems for use against LAVs. Threats to mobility are also greater with wheeled LAVs. The table on the next pages shows some of these.

Multi-role (MR) and Anti-armor Weapons and Munitions to Counter Armored Vehicles

Branch	System Type	Example	Reference (Vol, Page)	Lethality D/K if hit*	Remarks
Infantry, SOF, etc. (also irregular and hybrid forces)	Rifle, Machinegun	SVD with AP rd	1/2-11, 6-14	LAV=D, Tk=D	Vs tires, optics, engine, etc.
	Hand grenade	Molotov cocktail	1/13-1	LAV=K, Tk=K	Blind optics, secondary blast
	Grenade Launcher	QLZ-89 with DP	1/2-24	LAV=K	Penetrate/damage tires/wheels
	Anti-materiel rifle	Barrett M2A1A	1/2-14, 6-15	LAV=D, Tk=D	Calibers from .338 to 23 mm
	MR ATGL/ATDL	PF-89A	1/2-34, 13-9	LAV=K	HE or thermo with penetrator
	Flamethrower/FAE	Shmel-M reusable lchr	1/2-47, 13-11	LAV=K, Tk=D	RPO for napalm, RPO-A FAE
	Air-to-Surface rkt lchr	C-5K (S-5K hand lchr)	1/14-7	LAV=K	Improvised and shop-made
	Improvised explosives	IED, “sticky bombs”	1/14-2	LAV=K, Tk=D	Designs and fuzing vary widely
	Multi-role missile	Starstreak	1/6-23	Heli, LAV=K	Infantry Bn, also AT, AD units
Support Vehicles	AD/AT fire spt vehicle	Armored Starstreak	1/6-23	LAV=K	See also 1/2-51-54 and 2/5-31
	Combat recon vehicle	BRM-3K	1/4-11	LAV=K, Tk=K	Weapon priority - self-defense
	Flame unit spt vehicle	BMO-1 with 30 RPO-A	1/13-9, 13-11	LAV=K, Tk=D	Also BMO-T on tank chassis
	ASR launcher vehicle	BMD/Aviaagregat S5K	1/14-7	LAV=K, Tk=D	RS, 12x rkts, poss SAL PGM
Artillery/Mortars	Frag/HE round/rkt	152/155mm and others	1/7-64	LAV=K, Tk=K	Near miss or hit can destroy
	Flame/FAE rocket	9A152 FAE rocket	1/7-49, 13-10	LAV=K, Tk=K	More heavy MRLs have FAE.
	Dual-Purpose ICM	152/155 mm and others	1/7-64	LAV=K	Top atk, duds vs tracks/wheels
	SAL-homing rd/rkt	120-mm Kitolov-2	1/7-63, -76	LAV=K, Tk=K	Cannon, mortars, MRLs, others
	IR fuzed/homing rd/rkt	Motiv-3M/others	1/7-48, -77	LAV=K	120 mm mrtr, 122 mm MRL
	MMW-homing rd/rkt	Universal sub/others	1/7-67	LAV=K	120 mm mrtr122/220/300 MRL
	Scatter mine rockets/rds	122-mm 9M28K	1/7-72	LAV=K, Tk=D	For BM-21 MRL
	Jammer rockets/rds	122-mm 9M519	1/7-72	Effectiveness K	For BM-21 MRL
Engineers	Mines/IEDs	Controlled minefield esp.	1/8-3, 14-2	LAV=K, Tk=K	Large IED EFP, etc.
	Side-attack mine	TM-83 fuzed plate mine	1/8-24	LAV=K	Also TEMP-10 top attack
	Mine scatter vehicle	UMZ vehicle or pods	1/8-28	LAV=K, Tk=K	PKM for dismounts, 1/7-29
	Line-charge vehicle	MTK-2, ZRP-2 dismount	1/8-38, 7-37	LAV=K Tk=D	Cmd det, belly attack, esp whls
	Other obstacles	Concertina, trenches, etc.	1/14-3	Effectiveness K	To stop, slow, divert vehicles
Flame Weapons	Flame/FAE launch veh	TOS-1 with FAE rocket	1/13-10, 13-12	LAV=K, Tk=K	Stationary targets behind cover
	Incendiary rounds	API-T, thermobarics	1/13-9	LAV=K, Tk=K	Ignite fuel tanks, engine, etc.
	See Artillery/Mortars				
Aircraft	Cluster bomb DPICM	RBK-250/PTAB-2.5KO	2/2-26	LAV=K	Also RBK-500U/PTAB
	FAE/napalm bomb	ODAB-500PM FAE	2/2-26	LAV=K, Tk=K	Also ZAB-500 napalm
	SAL/TV guided bomb	KAB-500L, -500Kr	2/2-26	LAV=K, Tk=K	195 kg explosive area charge
	SAL rocket	S-13Cor 122 mm	2/2-23	LAV=K, Tk=K	Also 57/68/80/240/320 mm
	IR fuzed/cluster bomb	RBK-500U/SPBE-D	2/2-26	LAV=K, Tk=K	EFP top attack submunitions
	Air-launched missile	Kh-25 series	2/2-25	LAV=K, Tk=K	Guidance TV, SAL, IR
	Aircraft guns to 30-mm	Fixed, pod, and turret	2/2-22	LAV=K, Tk=D	Twin and Vulcan auto-cannon
	Mine scatter pod	KMGU	1/8-7, 2/2-9	LAV=K, Tk=D	Or mine ladders for TM-62
UAVs	Attack UAV	Harpy/CUTLASS	2/5-18	LAV=K, Tk=K	Can also be a cruise missile
	UCAV	Hermes 450S/Mikholit	2/4-14 and 15	LAV=K, Tk=K	Guns, grenades, and ATGMs
	UAVs for attack Spt	Camcopter S-100	2/4-10 and 15	LAV=K, Tk=K	LTD for gun rds, rkts, ATGMs
Theater Missiles	Theater ballistic missile	Iskander	2/5-6	LAV=K, Tk=K	ICM= large APAM with Frag
	Cruise missile	Harpy/CUTLASS	2/5-13	LAV=K, Tk=K	UAV camera or GPS guidance
Air Defense	AD guns and cannon	57-mm S-60	2/6-46	LAV=K, Tk=D	All can target ground vehicles.
	AD missile	Pantsir-S1-0 (SA-22)	2/6-62	LAV=K, Tk=D	2S6, Sosna, SA-11 FO also
	Multi-role missile	Starstreak/Starstreak II	1/6-23 2/6-58	LAV=K	Outfly/outshoot target, no CM
Others	Heavy multi-role missiles	Hermes-A	1/6-53	LAV=K, Tk=K	UAV designates, SAL, IR
	Naval gun rounds/rkts	AK-130 130-mm guns	3/2-17	LAV=K, Tk=K	Can fire SAL-H vs shore targets
	Coastal gun SAL-H	Firn-1 130-mm round	3/4-11	LAV=K, Tk=K	Bereg, also on ships (above)
	Underwater mines	KPDM-4 anti-landing sys	3/4-3	LAV=K, Tk=K	Magnetic fuzed wide area mine

Notes:

FAE (fuel-air-explosive) includes thermobaric HE, with high heat and overpressure effects similar to FAE.
ICM (improved conventional munitions are canistered submunitions. DPICM are ICM with AT shaped charge and Frag-HE effects.
SAL= semi-active laser-homing, guided round using a laser target designator operated by a dismount, or on a vehicle, RW, or UAV.
IR fuzed rounds hold sensor-fuzed submunitions which can disperse, each aiming at a vehicle, and firing EFPs into the vehicle tops.
IR homing munitions can lock onto vehicle hot areas to home in for top attack with a HEAT or large HE warhead.

Threats to Vehicle Mobility

Below is an unclassified listing of example organizations, weapons, and TTP which can be used to immobilize, disable, and destroy military vehicles. They can range from older, less effective systems, to modern Tier 1 or Near Term systems noted as upper range. Additional pertinent information is contained in other locations of the WEG, Ground Systems, Volume I:

- "APC and IFV Trends", pg. 3-4
- "Kinetic Energy Threats to Light Armored Vehicles," pg 6-14
- "Multi-role Weapons and Munitions Against Armored Vehicles," p. 6-4.
- "Emerging Technology Trends," pg 17-3

Enemy exploitation of tactical vehicle mobility limitations

The enemy will continue to capitalize on the single greatest vulnerability of most combat vehicles. That is limitations on their ability to transit terrain other than on hard-surfaces (like a parking lot or road) and on other improved surfaces. That vulnerability and its cascading effects cost lives. Technical decisions in vehicle design (weight, wheeled vs track, etc.) may dictate weapons operability (shoot on move ability and speed), off-road speed, water crossing capability, and even weather considerations in traversability. Tactical decisions in using vehicles with limited road, urban or off-road mobility can affect success and lives. A rational innovative enemy can be sufficiently informed to combine local knowledge with understanding of tactical and technical vulnerabilities for successful and lethal tactics, techniques, and procedures (TTP).

Contrary to accepted beliefs, the inability of the vehicles to protect their occupants is not the primary cause of these deaths. Any protection, including any amount of armor, can be breached, bypassed, neutralized, destroyed, or otherwise mitigated. The greatest vulnerability is the ability of an enemy to determine the exact route troops will travel, define when it will travel, how it will travel, how fast it will travel, etc. This ability to define who, what, why, and where to attack provides the enemy enormous tactical advantages and which are magnified in complex terrain. It not only allows an enemy to control the tempo and all aspects of attack, it allows them to attack at their own convenience. The analytical sophistication required to achieve this massive advantage is analogous to determining which route a train will take.

The primary purpose of a vehicle, any vehicle, is to transport something from point A to point B, when and where you need to. The primary purpose should never be to only protect. That's not the reason for having a vehicle—mobility is. Previously the term "tactical" or "combat" was used only to describe vehicles designed to and capable of operating off-road and transiting cross-terrain under combat conditions. Obviously neither term is appropriate for accurately describing the current class of vehicles used by many modern forces today.

Weapons

- Machinegun (12.7 mm and up will penetrate many light armored vehicles above, and below, wheel wells, 7.624R/51 mm below wheel wells and wheels)
- Machineguns can puncture vehicle tires (even those with run-flat) to immobilize or slow them. Most armored vehicles require repair with 2 or more tire hits per vehicle side.

- Anti-materiel weapons (12.7 – 20-mm HE), ballistic computers (w/laser rangefinder), advanced thermal optics, 1-shot 1-kill capability (12.7 mm range 2,500+ m, 14.5-mm and 20-mm range 2,000+m).
- Automatic Grenade Launchers 30/-35/40-mm. Ballistic computer, electronic fuzed air-burst munitions (ABM). Precise DP/HEAT fires out to 2500+ m. 35-mm Chinese QLZ-87 can penetrate 80 mm (3.2 inch) armor. HEAT round defeats 200+ mm armor. Delivers UGS, multi-spectral smoke, comms jamming grenades, robot option. Radar guidance linked (Fara-2 radar). Perfect weapon for neutralizing dismounted troops, which are especially vulnerable when dismounting from vehicles.
- Most anti-armor weapons can disable/destroy most light armored vehicles. In use by over 25 countries, standoff 100m+, penetration 950mm+, IR sensor activation and detonation.
- Off-route mines/Side-attack mines (AT or anti-vehicle). Panzerfaust-3T tandem, (penetrates 800mm+ at 400m+), w/SIRA sensor package w/fusing (acoustic/IR), Fire Salamander has 4 x Pzf-3 series launchers on tripod with remote controlled TV camera and other sensors, also auto-launch. Others TM-83, TEMP-30 sensor-fuzed mine.
- Ubiquitous shoulder-fired antitank grenade launcher /AT systems up to 125-mm, tandem-HEAT, Dual purpose, RPG-7V/Type 69, RPG-18/22/26/27/28/29/Hashim, CH PF-89/98, (from 300-mm to 1,100mm+ penetration-ranges from 200m - 800m),
- Antitank Grenade Launcher (Long Range), 125-mm tandem HEAT 1000 m, 1,300+armor penetration, TV/thermal sights, laser designator 5 km range, GPS corrected rounds.
- ATGM. Any antitank guided missile will destroy light armored vehicles - some from 8,000 meters out (AT-14 Kornet-E 5,500 to meters with 1,200-mm) and Starstreak II (dual-role MANPADS/anti-armor system with hypervelocity, laser beam-rider guidance, auto-tracker, very high Ph, armor penetration to 120-mm + for all LAVs, out to 8,000 meters). The other end of the spectrum is the (infantry) light-weight (14 kg) shoulder-fired ATGM Eryx with a range of 600 meters and penetration of 900 mm.
- Recoilless-rifles will destroy most light armored vehicles. Carl Gustaf M2/M3 84-mm, Type 65/65-1, M67 90-mm, B-10 82-mm, B-11 107-mm, Chinese PF-98 120-mm, M40 106-mm with tandem HEAT, ballistic computer sight, range to 2,000+ m, armor penetration 700+ mm, upgrades in progress. High PH/PK. R&D to add ATGM capability.
- Antitank Disposable Grenade Launchers 67 - 80mm HEAT to 300 m and 630 mm armor, HE anti-personnel effects. Some low signature, no smoke/flash, fire from enclosed spaces (rooms, sewers, etc). To 125-mm tandem HEAT 350m range, 1000+ mm tandem HEAT.
- Multi-purpose and/or bunker buster weapons will destroy most vehicles. PF-89A, SMAW HEPD, AT8 Bunker Buster, C90-CR-BM (M3), TBG-7V, BASTEG, Carl Gustaf.
- Any anti-tank hand-grenade has the capability to immobilize or destroy light armored vehicles. It is dependent of placement and angle of attack of the grenade.
- Improvised Multi-role Man-portable Rocket Launcher (AD/Anti-armor). Improvised 57-mm air-to-surface high velocity rockets (formerly aircraft rocket pods). Range 1,500m+ 400mm armor penetration, proximity fuze, and 20m lethal radius.
- Robotic weapons platforms and tracked grenade launchers and ATGM launchers
- Fixed- and rotary-wing aircraft
- CBRN attack. Some vehicles use collective protection, whereas others require masks.

- Thermobaric systems or warheads. Any hit by one of these warheads can disable or destroy a vehicle. The thermobaric warhead on RPO-A, RShG-2, WPF-89-1 and 2, Shmel-M, or TBG warhead on RPG-7V and RPG-29 have demolition effect equal to a round of 122-mm or higher HE artillery. The complex blast/ overpressure is particularly lethal in enclosed spaces such as building, tunnels, sewers, and even vehicles with hatch open (or other blast access), etc. The GM-94 is a smaller hand-held thermobaric launcher. Some mine-clearing systems (UR-77) use thermobarics for clearing lanes and are particularly effective in clearing streets (of enemy) in urban areas. The use of thermobaric warheads is proliferating and has expanded into rockets and artillery.
- Flame/napalm and other incendiaries. The trend is away from flame throwers to encapsulated weapons, bombs, bomblets, etc. RPO-Z, RPO. At a very minimum these weapons will disable sensors, optics etc externally mounted on the vehicle. Any flammable material, POL, packs, fuel lines, ammo on a vehicle exterior may cause it to catch fire. Field expedients are very easy to manufacture and use, such as fougasse.
- Lasers to blind/damage both vehicle (electronic optics, and sensors) and crews (eyes).
- Use of robotics and other remote-operated platforms proliferates significantly by 2015.
- Corrosive cloud or micro-fiber cloud munitions can corrupt and damage vehicle engines.

Obstacles

- The greatest obstacles remain natural and man-made terrain features. Their impact is also compounded by weather effects. Thus rain can turn a field impassible to wheeled vehicle units; and mud can immobilize tracked vehicles with high ground pressure.
- Conventional mines, controlled minefields, IEDs, and other explosive devices. They include mines, EFP, and sensor fuzes, also undetectable materials (e.g., plastic/alloys).
- Multi-spectral smoke/obscurants (e.g., Russian ZD-6 grenade), dust from HE fires, etc.
- Some examples of adaptive obstacles are:
  - Communications (or other electric) wire and concertina as an expedient obstacle. Both hinder or stop wheeled and tracked vehicles by wrapping around axles and tangling up tracks and road wheels. Det-cord is also very effective. Once it wraps around portions of the vehicle, it is then detonated.
  - Improvised obscurants (grass, trees, POL, buildings) smoke can screen the enemy and defeat or degrade vehicle sights.
  - Local population as civilian shields to hide infiltrators, attackers, or just to swarm U.S. units looking for water, medicine, or food, etc. and slow movement.
  - Improvised mobility obstacles. Rubble, civilians, holes, disabled vehicles.
  - Defilade and side slope restrictions as sites for front/rear vehicle attack, or to utilize non-lethal slippage measures (grease, oil residue or mud troughs), and ambush attack.
  - IED or body decoys to slow unit and conduct ambush.
  - Flooding or alter the flow of water (rivers, dams, etc.), open fire hydrants etc
  - Punji stakes (innovation--place punji stakes and/or det cord in a ditch. When the enemy arrives ambush them from the same side of the road/trail. The enemy will turn towards the fire and jump into the ditch to return fire. When they enter the ditch and land on the stakes, blow the det cord). Boulders rolled or blown into valleys.
  - Abatis (Fallen trees, telephone poles, wrecks, etc.)
  - Debris (vehicles, rubble)
  - Trenches, craters, or ditches (dug by hand or blown by demolitions)
  - Blow (or cut) a hole in a frozen river. Put tree logs in the water, cover with sticks and

tarp and camouflage (snow). The logs continually agitate the water to keep it from freezing. Armored vehicles drive across the frozen river and fall in the ice hole.
    - Prepare (and camouflage) the frozen river with demolitions prior to the arrival of the enemy armored column. Detonate when the armored vehicles are in mid stream. Artillery targeting with MRLs will have the same effect (or use both).
    - Induce avalanches in snow covered passes.
    - In extreme cold, put water on dangerous portions (or steep grades) of mountain roads.
- For information on conventional or generic obstacles see FM 90-7, "Combined Arms Obstacle Integration," http://www.globalsecurity.org/military/library/policy/army/fm/90-7/index.html and FM 90-7 (Army Field Manual), Combined Arms Obstacle Integration (10 Apr 2003) (Change 1) or http://www.everyspec.com/ARMY/FM+-+Field+Manual/FM_90-7_14502/

RISTA (UAV/UCAV, Robotic radars and camera, UGS, Manned FOs, and SOF)
- RISTA selects ambush/obstacle sites, target tracking and selection, priority target attack.
- Target acquisition and links to Integrated Fires Command, direct/indirect fires, ATGMs.
- SOF/UAV/FOs with NAI/TAIs and sensor-shooter links to artillery, mortars, ATGMs.
- Laser designators guide artillery, naval, aerial, ATGM, mortar rounds to moving targets.
- Direct attack by attack UAV/UCAV w/ATGM or precision homing submunitions.
- The ease of operation, size, and simple design of tactical UAVs lends itself to field expedient modification. Converting this UAV into a munitions delivery system (improvised attack UAV) is not difficult and offers several tactical advantages.
- Improvised (remote control aircraft-based) attack UAVs, with IED/munition attached.
- Robotic cameras locate close to mine/IED detonation points to precisely trigger them.

Information Warfare. For additional information see Chapter 10 and TC 7-100.2
- Information Attack. Alter or deny key information, Data manipulation (navigation, tracking, weapons, sensors, timing, etc). Disinformation.
- Computer Warfare: Disrupt, deny, or degrade the enemy's computer networks and information flow. Hacking, denial of service, malicious software (including adjusting clocks), etc. Insert viruses, spurious digital data, or hacking to manipulate computer information.
- Exploit reliance on extended communications and data links. Disrupt communications and data links (LIWA). Jamming communications connectivity (input and output).
- Electronic Warfare
    - Exploit, disrupt, deny, and degrade the enemy's use of the electromagnetic spectrum, especially C2 and RISTA. Wide area radar jammers.
    - GPS jamming. A 4-25 W power portable jammer has a 200-km radius. Can be delivered by artillery and/or mounted on UAV, civilian vehicles, or virtually anywhere including people, and/or farm animals.
    - Communications and data link jamming. Artillery and mortar rounds for local jamming. Wide area comms jammers.
    - Electronics vulnerable to "smart dust" which destroys electronic circuitry (computers, C2, sensors, navigations, etc.) by airborne penetration and short-circuiting the system. Delivered by rocket, UAV, other aircraft, possibly artillery. Access thru computer cooling system.

- Graphite Munitions and "blackout bombs." 400-500 kg cluster bombs/ warheads with graphite strands to short out transmission stations and power grids. Can be delivered by UAVs, aircraft, rockets, and cruise missiles.

EMP and High Power Microwave.

- Use EMP (esp non-nuclear) and High Energy High Radio Frequency Weapons (HERT) to target *circuit boards*. Circuit boards are the most vulnerable component of modern electronics.
- *EMP/HPM*. Missile, artillery, and UAV delivered EMP. This is will destroy all intravehicular electronics and battlefield digitization functionality in vehicular weapons. The specific target is circuit board systems, the internal connections of which require little EMP to disrupt and/or destroy. Electrical power is shared among propulsion, survivability, lethality, and auxiliary systems, along with multipurpose sensors, and all fusion and integration functions of each type of system.
- *Tactical EMP*. Enhanced warhead consisting of a hybrid EMP/HEAT warhead employed on ATGM, 70-mm rockets, and MRL rockets. This hybrid warhead will knock out a tank even if it does not penetrate armor, ignition, communications, or other electronics. Power output will be measured in hundreds of megawatts for microseconds. The e-warhead would also knock out other electronic systems. Applications may extend into infantry shoulder-fired rockets that could cause an electronic "soft kill" of armored vehicles.

Enemy tactics, techniques, and procedures. To degrade vehicle mobility, the enemy will:

- Always use (appropriate) portions of several basic principles. 1. Quick concentration (dispersed to avoid detection then come together for the attack, 2. Surprise, 3. Violent attack, often only three to four minutes, 4. Quick clearing and securing, 5. Quick withdrawal/dispersion, often disappearing back into the population from which they came.
- Attack with numerous hunter-killers teams (up to 10 per vehicle), approx 4-5 persons per team armed with 1 or more AT/Antiarmor weapons, sniper rifle, 7.62-mm GPMG, RPO-A/TBG-7V (thermobaric and/or flame weapons), AT grenades, assault rifles.
- Attack fixed sites prior and set ambushes (often complex) along the relief (quick reaction) force's likely avenues of approach.
- Attack units when they temporarily halt to refuel or conduct other activities. Attack tactical refueling operations whenever possible. The optimal attack occurs during transfer of fuel from tankers/refuelers to vehicles. This may set fire to both the tanker and the combat vehicle, also catching the combat crew outside their vehicle. Attack as units (squad and above) return to garrison, as they will be short of fuel and ammo, the troops lax, tired, and complacent after days or weeks of searching for, and not finding, the enemy.
- Use other "swarming" attacks (often involving civilians timed with complex attack).
- Halt or slow movement (obstacles, decoys, feints, remote weapon) to facilitate attacks.
- Use snipers to force crew members to operate "buttoned-up", instill tenacity, and impede mobility while dismounted.
- Whenever possible use complex attack composed of several synchronized elements. Example is anti-armor (ATGM and/or AT guns) ambush in conjunction with mines, artillery, and small arms fires.

- Converge attacks, probes; events from multiple directions, and possibly multiple dimensions, by numerous elements on a single target (and/or location or sensor) overwhelm the sensors ability to provide accurate data.
- Create conditions forcing vehicle troops to dismount prematurely, into infantry ambush.
- Attack vehicle beneath, above, or beyond weapons' platform ability to elevate or depress (high or close-in). CQ swarming effective and lethal.
- Exploit the high (elevation), low (close-in, depression), and rear "dead" spaces of the vehicle. These are areas that either cannot be observed, and/or, fired upon by the crew. Examples of the high dead space is the inability of the crew to view and/or bring fire on the higher floors of a building, or the enemy firing from the high sides of valley walls, enemy attacking from the rear of the vehicle.
- Focus light weapons attacks on most vulnerable areas of vehicle, rear, tires and very light armor below wheel wells and between tires, lightly armored top. Wheels are extremely vulnerable and easy to damage/disable. Without the wheels (especially the front steering wheels) the vehicle is disabled. External fuel tanks, flammables, ammo are vulnerable.
- Attack logistic supplies and support elements critical to operation of the vehicle (class IX parts, Fuel delivery means, vehicle mechanics and technicians, etc)
- Kill/attack contractors maintaining/servicing/fueling vehicles or disrupt their operations
- Target power generation systems supporting all C4I systems, forcing operations in a degraded mode, and challenging analog backup skills.
- Manufacture events, riots, or demonstrations staged to block or impede vehicles used in (medical) evacuation or redirect response forces.
- Capture vehicles to exploit situational awareness through tactical internet intrusion.
- Use night vision devices, flares, and IR screens to offset enemy night vision advantage.
- Utilize poor visibility (smoke, sand, weather) conditions to offset superior vehicle optics.
- Change the nature of the conflict. Prime example is from political to religious.
- Hug enemy forces to offset their indirect fire and precision strike advantage.
- Create shortages or overloads by continual attacks on convoys, LOCs, MEDVAC, etc and/or planting mines. All of these must then be secured by escorting units.
- Neutralize or destroy external antennas, optics, and sensors.
- Numerous synchronized attacks designed to overwhelm or over-saturate the enemy's ability to successfully deal with the attack.
- Prioritize targeting of low density specialty vehicles such as ambulances, mine- and/or route clearing and water/gap crossing (mobility/counter-mobility), POL vehicles fire support, etc. The elimination of these impacts the entire unit capability.
- Mimic Battlefield Combat Identification Systems to find, fix, close with, and destroy vehicles. Same with "friendly markings."
- Exploit the vehicle inability to traverse obstacles, roadblocks, rubble piles, holes, ditches, wrecked vehicles, and mines.
- Exploit vehicle inability to self-extract or to reposition other U.S. vehicles off the route.
- Exploit the large turning radius of the vehicle. This facilitates successful rear and rear-oblique attacks as well as trapping two or more vehicles together.
- Use multi-spectral smoke, especially in difficult terrain with poor road, surfaces, recognizable terrain, or in target rear areas during onset of attack.

Vehicle considerations which translate directly into either tactical strengths or weakness.

- Most considerations relate to mobility subsystems, apart from other subsystems. Mobility includes many specific automotive capabilities, e.g., road speed, cruising range, and swim capability. Stopping in high threat areas means increased P-hit, and likely troops dismount. One hit means more strikes follow; so mobility is critical, and speed is critical. Acceleration ability permits a vehicle to react to perceived threats, especially in close terrain (e.g., urban). High road speed can permit vehicles to emplace before threats appear.
- Navigation ability facilitates choice of fastest, most open, and safest route.
- Ability to operate in multiple differing physical combat environments. Turbine engine operates better in temperate-cold terrains. Diesel is better in temperate-hot. Turbine engine has problems with sand clogs, and requires more fuel. Diesel fuel is less flammable. Some engines are designed to accept varying grades and types of fuel.
- Military forces must be able to operate effectively in rivers, swamps, hilly terrain, snow, and coastal areas which fall into its area of operations. *Ground pressure* is less important on paved roads; but low ground pressure is critical for trafficability on wet, icy, or loose soil and uneven terrain. Tracks have lower ground pressure than wheels. More wheels mean less ground pressure (e.g., 10x10 vs 4x4). For tracked vehicles, six road wheels mean less than 5. Wider tracks reduce ground pressure. Some vehicles can lower auxiliary wheels (BRDM-2). Others can add rubber tracks for periods of off-road use.
- Wheeled vehicles with armor have higher ground pressure. They are limited in off-road capability and speed, and in soil composition usage. They are more subject to failure on tire loss, or in uneven terrain with ditches or bumps. They are more limited in soft soil, such as areas where vehicles have preceded them.
- Front/rear tire track too wide (wide track). While a wide tire track is efficient in desert and in other open terrain, it is not suitable in areas that are terraced for farming or have dikes, etc. For example, HUMVEEs do not work off-road in terrain such as South Korea/South East Asia/Philippines, agricultural regions, etc. The tire track is too wide causing the vehicle to slide off the side of the paddy path/road or to bottom out. These "wide "vehicles are virtually useless in some areas of the world such as some forests of Europe, jungles, and other close terrain areas.
- Factors such as side slope, gap crossing capability, etc. may seem esoteric; but those limitations cause accidents that kill and injure soldiers when moving off-road around hills and across ditches and rubble, trees, disabled vehicles, etc., and on roads as well. Limitations deny movement areas or slow movement and increase vulnerability time.
- Side-slope angle capability (reduces roll-over). This threat limits movement and may kill crew members. Factors for high slide slope capability include a low profile and low roll center (pivot point between the wheels), low center of mass (usually dictated by the height of the armor on the vehicle), wheel/track width of the vehicle, and tire characteristics. If the center of mass is much higher than the roll center, the vehicle can roll more easily if the vehicle slips to road shoulders, ditches, or holes. If the vehicle is wider, roll is less likely. Wheeled vehicles are generally higher than tracked counterparts, more limited in side-slope capability, and more subject to tipping or roll-over when off-road. Stiff, higher pressure, low profile tires offer roll resistance. Vehicles with heavy high turrets, like many western main battle tanks, have poorer side slope capability. Older low profile tanks have superior capability.
- Tracked vehicles, especially smaller ones, are more suitable on forest trails.

- Self-extraction, with winches facilitates greater use in areas with rubble and streams.
- Lighter vehicles are more deployable, for air insertion and water transport closer to their destination, limiting surface travel distance and the associated vulnerability to threats. Vehicle height and width are critical functions for moving rapidly and safely through urban areas, forests, jungles, and through tunnels. Dimensions and weight must be considered in crossing bridges, and for air deployability. Wheeled vehicles are generally higher than comparable tracked vehicles. They may have higher ground to hull clearance for mine resistance, and higher freeboard for swim capability. Also, wheeled vehicles may be lighter, which permits operability over bridges with weight restrictions.
- Tire vulnerability, especially steering tires, to small arms, ditches, det cord, etc. Avoid overloading with too much added armor, ammunition, etc, which reduces mobility.
- For fording operations, amphibious tracked vehicles are generally better-suited in conditions of high water speed and uneven surface. Some vehicles have high-ford design for deep-fording, even underwater. Some vehicles have winches to assist in fording.
- Wheeled vehicles with central tire inflation system (CTIS) operate better off-road. Vehicles with run-flat tires plus CTIS may puncture tires from inside when hitting bumps.
- Turning radius, (high radius requires backing). Tracked vehicles can pivot on one track, for vehicle-length turning radius, even in defilade areas.
- Wheeled vehicles may be able to swim in areas where tracked vehicles cannot. But they may be challenged in entering and exiting water, due to lack of traction in low water and wet/muddy shores. Vehicles with hydro-jets swim at higher speed. A few vehicles with bowplanes and hydrajets can hydroplane at high-speed in amphibious landings.
- 360 degree 3-dimensional visual and/or electronic (rear TV, etc) observation. Inability to see 360, especially rear view (for high speed backing/and threat) can challenge movement and limit situational awareness in. Optics must elevate declinate sufficiently close-in and distant awareness. They must also be able to operate in obscurant conditions.
- Reduced movement noise (especially engine and tracks) reduces warning time for threats. This factor is less significant in open terrain, more in closed (e.g., cities and defilade).
- Reduced visual/IR signature during movement (conformal nets, side skirts, screens, etc.), will reduce detectability and vulnerability to weapons in open terrain.
- Power/battery augmentation aids stops and moves. Solar or auxiliary power units add power for less noise and IR signature. Hybrid drive adds power and rapid acceleration.
- Weapons elevate and depress sufficiently to handle targets four stories high and very close-in enemy. If they cannot they may move behind infantry during movement.
- Communications compatibility (host country, digital vs. analog, frequency management).
- Collision and fratricide avoidance require IR marker lights and paint, and BCIS networks.
- CBRN protection system (Overpressure, vehicle mask system, or individual masks).
- Mine-clearing or neutralizing capability can cause speed reductions or stops enroute. Advance clearing requires electro-magnetic decoys, unmanned vehicles, and engineer assets.

Kinetic Energy Threats to Light Armored Vehicles

Summary: Military forces worldwide generally recognize that LAVs are increasingly being used not only as armored personnel carriers and infantry fighting vehicles, but as chassis for expensive and specialized systems critical to success of the mechanized ground force. Despite a variety of efforts to increase armor protection and adapt countermeasure systems for LAVs, most munitions considered to have anti-armor effects will continue to be able to defeat light armor. Recent developments in guns, munitions, and mounts add new weapons and upgrade capabilities of older weapons to challenge LAV protection.

LAV vulnerabilities. All armored vehicle designs, light or heavy, are compromises among competing requirements for mobility, survivability, and lethality. Designers of LAVs must accept armor protection limitations further than with heavy armored vehicles to meet additional requirements such as reduced cost, swim capability, and light weight for air deployability. From their inception, LAVs have been vulnerable to a wide array of munitions from antitank weapons to aerial munitions, artillery Frag-HE rounds, vehicle main gun/machineguns, mines, air defense munitions, and infantry munitions.

In the last decade, a variety of countries including the U.S. have redesigned LAV armor packages to resist shaped charge and high-explosive threats. But such measures exact a high cost in weight and at best only reduce the chances of penetration and vehicle system kill. These munitions (especially mines and improved shaped-charges) remain a threat to LAVs. The single munition type that is most effective against LAVs will continue to be High-Explosive (HE); because that term is generally shorthand for Fragmentation-High-Explosive (Frag-HE). Most Frag-HE and HE artillery, mortar, and heavy gun rounds have sufficient fragmentation to damage a tank or destroy most LAVs with a near miss. It is generally expected that in a Frag-HE near miss of an IFV, fragmentation effects will cause some type of kill (firepower, mobility, or catastrophic). That same near miss will usually destroy a lighter APC.

Energetic armors (such as ERA), and countermeasure systems have less effect against kinetic energy munitions. The best counter continues to be more armor, and the weight constraint limits protection. All LAVs have surfaces that can be penetrated by 12.7-mm rounds, and all have equipment vulnerable even to infantry small arms.

A general rule on the battlefield is that a stopped vehicle in close combat has a short lifespan. The greater the vehicle mobility, the better chance it has to escape a kill zone. Adversaries train to target armored vehicle engine locations. Well-aimed fires can damage the engine from side or rear, for a mobility kill, and initiate fires and secondary explosions.

A recent shift toward wheeled LAVs exposes the vulnerability of wheels. Tires of wheeled vehicles are vulnerable to all weapons, from rifles to fragmentation. Tires can be penetrated by any small arms. Rubble, abatis, and other loose materials can halt wheeled vehicles, as Russian BTR-80s experienced in Chechnya. Trenches, scattered nails, caltrops, spike strips, etc. can initiate KE tire blow-outs. Run-flat tires and added wheels (6x6, 8x8, and 10x10) can reduce but not eliminate mobility problems. Tires on steering wheels are critical; one or two penetrations can slow or stop the most modern vehicle, especially off-road. Rounds aimed at wheels can be effective even when they miss. Wheel well areas expose crews and passengers, and are rarely protected beyond 7.62-mm rounds.

Military forces worldwide recognize the difficulty in directly engaging heavy armored vehicles, and the risk in exposing themselves to obtain a catastrophic kill. An increasing variety of weapons for dismounted infantry and vehicles use KE munitions to penetrate the armor of LAVs. New specially designed weapons are being developed to attain lesser kills (mobility, firepower, communications, and function) to degrade effectiveness of the vehicle as a "system of systems". Due to limited room, much of the crew's gear may be stowed on the outside of the vehicle, and is vulnerable to fires. A favorite tactic is to attack sensors (sights, remote sensors, radar, or links to them). Remote weapons and external boxes are vulnerable to a variety of fires. Sniper fires and even rocks can damage sights to blind weapons of the most modern LAFVs.

Another vulnerable part of the LAV system is personnel. Personnel may ride outside of the vehicle, where they are exposed and vulnerable to all weapons. Drivers and personnel operating open weapons can be targeted, especially from higher angles. Concussion from munitions impacting on vehicles may not seriously damage the vehicle; but they can cause armor pieces or mounted equipment to rebound inside and kill or injure personnel. Blasts underneath vehicles can transfer shock through floor-bolted seats and break the backs of crew and passengers. Therefore, a critical part of vehicle design is in securing seats and materiel in vehicles. Also KE hits to ammo compartments and external tanks may not penetrate hull armor, but can start catastrophic fires. Hard jolts can injure soldiers inside. Thus, concealed trenches, slides from "non-lethal" road slimes, or deliberate collisions are kinetic energy threats to personnel in LAVs.

Weapons for dismounted infantry. They include sniper rifles and machine guns (7.62 mm and 12.7 mm). Machine guns and sniper rifles can be used with obstacles to slow the vehicles and deliver sufficient fires to vulnerable areas to obtain a kill (mobility, firepower, or catastrophic), or to kill crewmen and degrade its effectiveness. A variety of general-purpose machine guns can be dismounted and can penetrate some armors, tires, and exterior materials on LAVs. Mini-guns, such as 7.62-mm man-portable type, can swarm rounds at 1,200 rounds per minute. New ammunition includes sub-caliber sabot rounds for 7.62 and 12.7-mm weapons (such as the .50-cal SLAP), and improved armor-piercing rounds such as the Chinese tungsten alloy-core round. These traditional technologies defeat all current active protection systems.

Anti-materiel sniper rifles (12.7 mm or .50 cal). These rifles are integral to any modern battlefield. Although often categorized as sniper rifles (and capable of being used against personnel), they are generally employed as anti-materiel rifles. The most widely proliferated of these rifles are: the U.S. Barrett M82A1/M95 .50 cal semi-automatic rifle, the Croatian MACS M2-1/M3 (12.7-mm bolt action), and the Russian V-94 (12.7-mm semi-auto). The Barrett M82A1 is employed by all U.S. military forces as well as forces of 27 other countries, including Belgium, Chile, Denmark, Finland, France, Greece, Italy, Netherlands, Norway, Philippines, Portugal, Saudi Arabia, and UK. The Saboted Light Armor Penetrator (SLAP) round fired from the M82A1 can penetrate 19 mm (.75 in) of armor @ 1,500 m. It can also fire a multi-purpose round (See M82A1 data sheet). Approximately 25 variants of 12.7-mm sniper/anti-materiel rifles are available.

Larger-caliber Anti-materiel Rifles (14.5 to 20-mm). A trend in the past ten years has been towards larger-caliber anti-materiel rifles. The Croatian RT20 20-mm “hand cannon” is the most prevalent (range 1,800 m). It can chamber either an HE or API round. The RT20 was developed primarily to penetrate the armored casing around the thermal sight head on M84 tanks (a 20-mm round was the smallest caliber that could penetrate the casing). During the war in the former Yugoslavia, M84s were frequently deployed to detect Croatian infantry moving at night, so a method of removing their night-vision capability was found with this RT20 “hand cannon”.

Other anti-materiel rifles readily available are:
US M98 cal .338 Lapua Magnum (1,400 m and twice the penetration of 7.62-mm)
NTW 14.5-mm (range 2,300 m)
Hungarian Gepard M3 14.5-mm (range 1,000 m)
Austrian Steyr IWS 2000 15.2-mm (range 1,000 m, 19 gram tungsten carbide dart)
South African NTW 20-mm (range 1,500 m)
Finnish Helenius APH RK20 20-mm bolt-action gun

Guns for light vehicle applications (7.62 mm to 23 mm). Several countries mount guns on light carriers, such as motorcycles, fast-attack vehicles, and light utility vehicles such as HMMWVs, UAZ-467, and Land Rover. The Russians advertise the Gear-Up motorcycle with mounts for a variety of auto grenade launchers and machineguns. Several combat support vehicles for military security patrols have weapons mounted on light mounts, such as a pick-up truck or a possible towed or ground mount. Guns ranging to 14.5 mm (such as Russian Arzamas GAZ-53971 van for use of internal and other security forces) may also be mounted.

Recently China displayed a "dune buggy" with a 23-mm chain gun mounted to the overhead roll bar, for manual aiming and operation. The gun fires standard antiaircraft ammunition and recent APDS rounds, and has a thermal night sight. This gun could also mount on remote vehicle turrets, for use against air and ground targets. Oerlikon went one step farther with an infantry application for the KBB 25-mm auto-cannon. The break-apart mount actually permits infantry pack carry. It did not catch on. However, the very low profile weapon can also be towed, carried in an all-terrain vehicle, or off-loaded for ground mount. The profile is so low that the firer should dig a pit to operate it. This is a developed potential threat to all LAVs.

LAV main guns. Armored personnel carriers and combat support vehicles (7.62 mm to 30 mm). There is an increasing variety of APCs with 7.62-mm, 12.7-mm, and 14.5-mm guns, designed for the traditional "battle taxi" role. A parallel trend is for the increased use of wheels vs tracks. But on selected APCs and on combat support variants, many countries are replacing those guns with 20, 23, 25, or 30-mm guns; and the number of drop-in turrets available has exploded. Improved Oerlikon APDS and APFSDS ammunition has extended the life of 20-mm and 23-mm gun applications. The Vulcan mini-gun and modern auto-cannons in 20-mm can overwhelm a specific area of LAV armor at a high rate of fire. Multi-barrel 23-mm cannons can do the same thing. New cannon for 30-mm rounds (in several round designs) include the Ukrainian KBA-2, Russian 2A72, and Bushmaster II. Improved 30-mm rounds offer 100+ mm penetration at 1000 m (120 mm for 8-rd burst). Recently German Mauser displayed the RMK-30 recoilless gun. The light recoil gun permits accurate high-rate aimed fire to a range of 3,000 m, with a variety of ammunition including APDS and APFSDS on very light vehicle mounts.

Infantry fighting vehicles, Tanks, and fire support vehicles (20+ mm). Most IFVs feature auto-cannons in the 20-30 mm range, with a rate of fire of 500-700 rd/min, but a practical rate of fire of 100-250 rd/min. Aimed fire is generally confined to bursts, with a substantial dispersion. As armors have increased, the current trend is a shift in gun size toward 30-50 mm. A number of 35 mm guns, including the South African EMAK auto-cannon or Swiss Oerlikon 35/1000 revolver cannon (1,000+ rd/min rate of fire) have been offered for use in IFV upgrade turrets.

A 35-mm round doubles the penetration of 30-mm rounds. Swedish Hagglunds went a step farther with the 40-mm cannon on the CV9040 IFV. Italian Otobreda offers the T60/70A

60-mm gun turret for the Dardo IFV. The cannon features precision semi-automatic fires rather than automatic, but fires as rapidly as the target can be acquired. Penetration is well over 150 mm at 2000 m. The next trend (by around 2010) is cased-telescoped ammunition (CTA), which permits a 30-mm gun to achieve KE effects comparable to that of a 35-mm or 40-mm gun.

Tanks and heavy armored combat vehicles (HACVs). Any KE round of a 57+mm gun will damage and probably destroy a LAV. Canister and APERS (anti-personnel) rounds fired from tank guns, antitank guns, or HACVs guns can damage or destroy LAVs.

Other KE threats.

Mines and Improvised Explosive Devices (IEDs). Belly attack mines can include kinetic energy penetrator mines, which defeat even mine-resistant vehicles. Side-attack sensor-fuzed mines include Russian plate mines with aimed directional fragmentation. Other mines and IEDs have warheads which produce an explosively formed penetrator (EFP, shaped like a sabot penetrator), to defeat light to heavy armor, depending on design. Such mines include the Russian TM-83 and TEMP-30 sensor-fuzed mine. Other mines and IEDs (e.g., PD Mi-Pk) can produce multiple EFPs. Even blast effects from mines and IEDs can cause severe kinetic energy damage by flipping over vehicles, causing material to toss about inside and killing or injuring personnel.

Frangible rounds. The frangible armor-piercing discarding sabot (FAPDS) round design uses a brittle rod which can penetrate armor, then shatter after penetration, to spread varying sized fragments within the target. It flies with similar ballistics (including range and high velocity) to a KE round, but with effects of a Frag-HE round. Although most are currently designed for anti-aircraft use against thin armors, some are effective (with tailored brittleness, size, and design) for use against improved LAVs, such as IFVs.

Programmable fuze rounds. The Swiss Oerlikon 35-mm AHEAD round for use against aircraft uses an electronic fuze that is calibrated by a laser rangefinder, the fire control computer, and an electronic setter within the gun. At the pre-set time, the round fires a volley of KE sub projectiles forward (in the manner of 00 buckshot), with overall range to 5,000 m. Technology variants are being tested against ground vehicles. The AHEAD technology is available with other sizes of rounds, such as 30-mm PMC308. Russian HEF rounds for BMP-3M (100-mm) and T-80K tank (125 mm) employ the same technology, with range to more than 7,000 m. Russian rounds also permit an adjusted trajectory, in which they over-fly the vehicle and blast fragments outward and downward against the thin top armor of armored vehicles.

Artillery-delivered KE munitions. Artillery rounds include Russian 122-mm and 152-mm cannon rounds with top-attack flechettes, which can cover a wide area. They can damage and penetrate most LAVs. Sensor-fuzed artillery rounds, e.g., Russian Motiv-M, German SMART-155, and US SADARM can fire an EFP into the vehicle top for a sure penetration and kill.

Kinetic energy missiles. Prototype KE ATGMs are in various stages of development. High-velocity missiles (HVMs) offer a heavy armor overmatch against the heaviest armors with long range (5-7 km) and short flight times (4 km in 1-2 seconds). One HVM system that is a current threat to LAVs is, in fact, Starstreak (MANPADS and multi-role missile, page 5-52 below). Starstreak uses laser-beam rider (LBR) guidance and shoulder, vehicle, or helicopter

launch. Lethal mechanism is 3 darts - each a LBR Mach 4 HVM with high-penetration (125 mm) and HE blast. These can slam a helicopter target out to 7 km in 2-7 seconds, and have been successfully tested against light armored vehicle targets. A vehicle launcher version, Armored Starstreak, uses the Alvis Stormer LAV chassis and 8 launchers. Any Starstreak launcher is a threat to LAVs. The missile defeats almost all known countermeasures, including APS.

Future Developments in KE Attack. For the 40-mm CTA gun on the aborted US FSCS/ British TRACER programs, there was a proposal to modify the Starstreak dart into a KE missile round to fit in the autoloader, as an ATGM for use against LAVs and aircraft. The gun is fitted on the recently displayed Lancer proposed for reconnaissance vehicle and IFV and designs.

ATGMs exist with fly-over top-attack mode and EFP for target kill. The US Javelin is a successful fielded example. Other fly-over (Swedish Bill, Bill-2) ATGMs and top-attack (Israeli Spike/Gill) ATGMs with shaped-charge warheads have been fielded. The British fly-over sensor fuzed MBT-LAW ATGL employs a HEAT warhead. These designs are steps toward future soldier systems with fly-over EFP warheads for KE attack.

Attack UAVs and Micro-UAVs are being developed. A French proposal for Leclerc 2015 includes tank-launched attack micro-UAVs. The UAV kill mechanism is a top-attack EFP, which would easily penetrate LAV top armor.

Conclusions. Fighting vehicle developers have found a variety of upgrades to improve light armored vehicles. However, they are more useful in protecting the vehicle during travel to the combat zone. All of these innovations offer marginal increase in protection against modern anti-armor weapons in close combat. Even expensive high-technology approaches, such as active protection systems, will not protect against many KE munitions which threaten LAVs.

In close terrain, high defilade and urban areas, combat vehicles (including tanks and LAVs) are very vulnerable on their flanks and rear. Many modern IFVs have lost their firing ports and have limited awareness or firepower to address those directions.

Technical Implications: The vehicles need weapons and sensors to address all threats for 360°, and at high and low angles of fire. Remote weapon stations and periscopes for the dismountable infantry can be added. Additional protection can be added, for use against selected high lethality weapons, such as antitank grenade launchers. Other assets are gun shields for crewmen which are partially out of vehicles, or remote fire control systems which can be operated from the inside. Side skirts and better mine/wheel well protection are needed.

Tactical Implications: Technical AT considerations may force changes in tactics for mechanized infantry and crews of combat support systems. Tactics must exploit firepower, integration, and protection in the combined arms force as well as adaptive use of cover, concealment, and deception. Assaults across open areas against light forces can lead to disaster. Movement must employ speed, cover/concealment, and mutually supporting fires. Once a squad dismounts, it may have to precede the vehicle to protect it from anti-armor weapons, not follow and use it for protection. Although some tacticians differentiate IFVs from APCs, claiming that IFV squads can fight from the vehicle, that distinction is insignificant in close terrain, and in the face of modern AT weapons. These are only some of the responses to the spectrum of threats to light armored vehicles today. See Chapter 15, Upgrades, for additional responses.

Recoilless Weapons for Modern Warfare

In past decades, recoilless weapons were considered lethal and formidable antitank assets. Recoilless antitank grenade launchers (ATGLs) for squads have seen tremendous improvements (see Chapter 1). But, as tank armor has improved, most of the crewed systems for use by AT teams operating above squad level have seen fewer upgrades. Today, many of those crewed AT weapons are considered obsolescent. However, upgrades are available; and new weapons are now fielded. With more changes, crewed recoilless weapons can be effective.

One advantage of recoilless systems is their utility. They offer a variety of munitions, including HEAT, HE, flechette, and others, to service most battlefield targets. Some recoilless launchers (aka, recoilless guns or rifles, or mounted grenade launchers) are light enough for easy transport in light vehicles, with ability against infantry while outranging most infantry weapons. A well-proliferated example is the SPG-9/9M (pg 6-20), with HE range beyond 4,000 m.

Recoilless weapons are limited by certain design and operational considerations. The bore size limits size of rounds and their ability to penetrate modern tank armor. However, many offer sufficient penetration to defeat other armored and unarmored vehicles (which outnumber tanks on the battlefield). Those systems are best used to augment other forces in a fight.

A key value is in their general lethality. With a higher rate of fire than most antitank guided missile (ATGM) launchers at 5 or more rounds per minute, they are useful as a fire support asset that can augment fires of other weapons against various targets. Most lack the range of ATGMs. All lack the precision. But these multi-role systems can digest various rounds to defeat vehicles, then kill exiting personnel with large HE blast munitions. In a close fight or ambush, many of these weapons can kill any vehicle other than a main battle tank (MBT) from any aspect. Some can also damage or kill MBTs from the side or rear. As we have noted for infantry antitank grenade launchers (ATDLs), crewed weapons include new ones, and upgraded munitions with tandem HEAT warheads which can kill all tanks from the side or rear (see table).

A number of features have improved precision of these weapons. A variety of electro-optical sights can be mounted on these weapons. SPG-9M and SPG-29 Mounted can use the Russian 2Ts35 laser-rangefinder sight or a widely marketed lightweight ballistic computer sight such as the Simrad IS2000 (pg 6-40). Adaptable night sights include II sights like Simrad KN250F, and various compact thermal sights. A challenge to all grenades is their relatively slow velocity, which reduces hit probability (Ph) against moving vehicles. Some have high velocity (600 m/s for Italian Folgore, 700 for SPG-9) and flat trajectories to increase Ph vs movers.

A few manufacturers are looking for improved accuracy munitions. The ultimate solution is to add ATGM launch capability to recoilless launchers. Israeli IAI has offered to produce a version of the LAHAT (pg 6-28) for use in the 90 mm M40 recoilless rifle. Even the best recoilless round cannot kill a modern tank from the frontal aspect. Any ATGM exiting a bore of <150 mm has a low probability to defeat MBT front armor. But a top-attack tandem warhead missile, e.g., a 90 mm version of LAHAT for the M40 launcher offers probable major damage (or catastrophic kill) against an MBT turret or hull. Other vehicles would expect a catastrophic kill. Israeli IAI has offered development of the ATGM variant. In a beyond line-of-sight (BLOS) environment, ATGM capability dramatically increases effectiveness of this type of weapon.

Another limitation for recoilless weapons is their detectability. Most have high smoke and noise signatures in the backblast. Most are fairly tall and must be hand-loaded from a standing or kneeling position, which exposes the team to counter-fires. Older weapons are heavy enough to require breaking down and loading into vehicles for moves, limiting their ability to shoot and move quickly. One example of poor mobility is the old Russian B-10 (at 85 kg towed carriage, 72 without, pg 6-22). With an anti-armor range of 400-1,000 m, the first shot had better be accurate and lethal, or the crew is in serious trouble. Thus many users only employ these older weapons in combined arms defenses and ambushes, to augment other fires.

Some old launchers have been modified to reduce weight, plus break down into components for dismounted moves. The Chinese Type 65 is a lighter weight version of B-10, at 28 kg, and uses improved ammunition. The Serbian M79 variant also weighs less than 30 kg. With improved sights, it has an anti-armor range of 670-1,000 m. Better range aids survivability.

Several newer recoilless weapons have been designed for reduced weight, lower operating profile, and reduced move and setup times. Examples include RPG-29 Mounted (next page) and the Serbian M90. The best of the modern lightweight crewed launchers may be the Chinese 120-mm PF-98 (pg 2-34). Although it operationally resembles RPG-29, it is actually an amalgam of features from a variety of modern systems. Like the RPG-29, it comes in shoulder-launch version or tripod-mount crewed version. The launcher appears to be directly derived from the Montenegro/Serbian 120-mm M90. However, they followed the Russian design by adding a lightweight tripod, and a canistered grenade which attaches to the launcher to extend its length. The ammunition is another amalgam, with warheads which could be derived from recent Carl Gustaf rounds, and a rocket motor that resembles a scaled up RPG-29 motor. The sight is a modern EO/LRF ballistic computer sight. The result is a state-of-the-art launcher with 800/2,000 m range, 800+ mm penetration, light weight (<18 kg loaded), and competitive precision.

Rapid mobility, as noted earlier, is a critical factor for survivability and utility of these weapons. Since most legacy systems cannot be easily adapted for mobility, an alternative use is to mount them on vehicles. They offer good lethality to protect vehicles; and the vehicles facilitate launch-and-move operations, without downtime for disassembly. Examples include fire support versions of BTR-50 and Czech OT-21 APCs, and various weapons on the BTR-152 armored transporter (pg 3-64). They have also been fitted on a motorcycle and on boats.

A good weapon for ground and vehicle mounts is the Russian SPG-9 (pg 6-17), which has been seen pintle-mounted on a UAZ-469 TUV. The launcher is well proliferated, and seen several upgrades. On the SPG-9M upgrade, 2Ts35 or other more modern LRF ballistic sights are available. AT ranges are 1,300 m for improved HEAT, and 1,000 for tandem HEAT.

The best of these weapons for vehicle mount is the US M40 106 mm recoilless rifle (pg. 6-30). The Bofors Retrofit Kit updates it into a modern and effective fire support weapon. Sights include the CLASS laser sight, and others. Munitions include flechette, HEP-T, and tandem HEAT. Addition of the LAHAT ATGM (above) would greatly expand its lethality.

With these and other expected upgrades, and with new designs in production, we can expect to see recoilless weapons employed against U.S. forces for many more years.

Russian 105-mm Antitank Grenade Launcher RPG-29 Mounted _____

RPG-29 Mounted with the 2Ts35 sight.

Ammunition Types	Typical Combat Load
105-mm grenade	**3**
	Vehicle dismount 5
HEAT (tandem)	**Utility vehicle 10**
HE thermobaric	**AT Vehicle 44**

SYSTEM
Alternative Designations: Vampir. This is the pintle mount version of the launcher. When tripod-mounted version was first seen, and was known to be a replacement for SPG-9, it was incorrectly dubbed "SPG-10". For other versions, see Variants.
Date of Introduction: Late 1980s
Proliferation: At least 5 countries and several terrorist/insurgent groups. RPG-32/Hashim is currently produced for 2 countries. RPG-32 export negotiations are underway.
Description:
Crew: 2
Caliber (tube) (mm): 105
Weight (w/o sight) (kg): 11.5 (launch tube, sight, and canister)
20 on the tripod
Length (transport) (mm): 1,000 without rear section/canister
Length (firing) (mm): 1,850, with grenade canister attached
Life of Tube/barrel: 300
Rate of Fire (rd/min): 4-6 est
Fire From Inside Building: INA
Maximum Target Speed (km/h): INA
Emplacement/displacement time (min): <0.25
Deployment: The pintel permits the launcher to attach to a tripod ground mount or a vehicle mount. The RPG-29 Mounted breaks down into 3-4 parts for one soldier carry (launcher, grenade/ canister rear section, tripod, and perhaps, sight). It is ready to fire within a few seconds with quick connect couplings. A folding bipod on the canister can assist aiming during prone firing.
Fire means smoke and noise; but a low profile permits loading and firing while prone. Often it will be used in combined arms ambushes.

SIGHTS
Day sight:
Name: Simrad IS2000 or similar EO sight for RPG-29 Mounted
Type: LRF-based FCS with ballistic computer
Magnification: 1x/3.5x
Location: Left side
Sighting Range (m): 800

Name: KN250F or similar sight for RPG-29 Mounted
Type: 3 gen II clip-on sight designed to work with day sight
Magnification: 1 X
Location: Left side
Sighting Range (m): 600-800 for vehicle targets, 300+ man
Other sights: A variety can be used. 1st was the heavy 2Ts35 (3kg).

AMMUNITION
Name: PG-29V (in canister/launch tube extension)
Caliber (warhead): 105
Type: Tandem HEAT (shaped charge)
Effective range (m): 800
Penetration (mm CE):
Armor: 750 + behind ERA, 950 + conventional
Other: 1,500+ concrete and brick, 2,000 brick, 3,000 earth
Length (mm): INA, but it fits in the 850-mm long canister
Complete Round Weight (kg): 6.7
Muzzle Velocity (m/s): 280

Other: **TBG-29V** multipurpose HE thermobaric grenade.
Blast effects are the same as the TBG-7V (pg 2-37).
RPG-27, PG-7R grenade for RPG-7V, and RPG-32/Hashim use the same tandem warhead design.

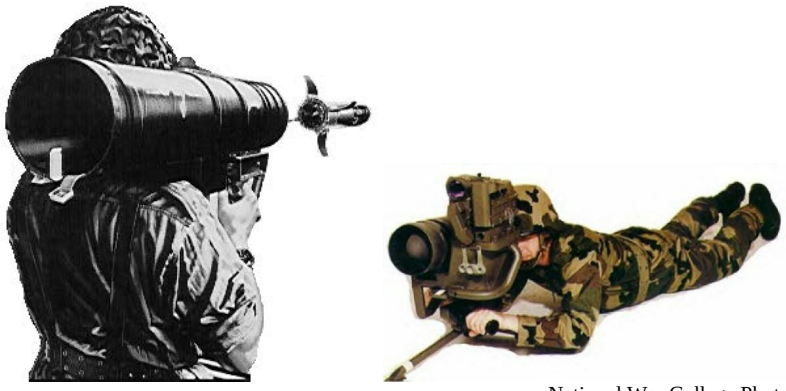
VARIANTS
The **RPG-29** comes in several versions.
RPG-29 Mounted: Mounted crew-served launcher variant, designed to replace SPG-9. It can fit on a vehicle with a pintle mount, or be dismounted to a tripod ground mount. The RPG-29 Mounted has a fire control system with an optical sight, laser rangefinder and ballistic data computer for increased range and precision. This increases the ***effective range of the mounted system to 800 m*** against a stationary target with a hit probability of 80%. The system can fire at all targets to maximum range (even moving, with reduced Ph). For Tier 1 and Tier 2 COE OPFOR, **RPG-29 Mounted** is the crew weapon in Weapons Squads and other supporting tactical units.

The shoulder launch version (**RPG-29** - see photo and pg 2-37) has an optical sight similar to RPG-7V. The RPG-29 could become a standard squad ATGL for maneuver squads; but weight and large size are problems. The launcher, even stripped down for shoulder launch, is almost 2 m long and considered to be fairly burdensome and ungainly for use with infantry attempting to move in close quarters or dense cover, and set up quickly to fire.

RPG-32/Hashim: Russian Bazalt and Jordanian KADDB squad launcher (see RPG-29, pg 2-37). They jointly developed a lighter 105 mm shoulder launcher, for infantry squad use. Loaded, it weighs 7 kg, with a length of 1.2 m. It can also launch a variety of smaller 72.5 mm grenades. There is also a vehicle remote weapons station with 7.62-mm MG, Hashim launcher, and thermal sight. An upgrade is due in 2010, to add "precision" for increased range and 80% P-hit.

NOTES
RPG-29 Mounted, like its predecessor, SPG-9, serves as all-purpose small unit artillery - to deliver supporting fires against the gamut of targets (including vehicles, personnel, buildings, and any other direct-fire targets within range - including helicopters).

French Man-portable ATGM Launcher Eryx



National War College Photo

Weapons & Ammunition Types	Typical Combat Load
ATGM Launcher	**1-5**
Eryx Tandem SC ATGM	
Crew of 1	1
Crew of 2	3
Crew of 2 from vehicle	5
Crew of 3	5

SYSTEM
Alternative Designations: Anti-Char Courtee Portee (ACCP)
Date of Introduction: 1991
Proliferation: At least 8 countries
Description:
Crew: 1-3 depending on required load or vehicle available
Primary mount: Ground mount on tripod or shoulder launch
Alternate mounts: Shoulder launch--standing, kneeling or prone
Weight Excluding Missile (kg): 3 with II night Sight
4 with added tripod
7.4 with tripod and Mirabel sight
Length Overall in Firing Position (m): 0.905
Height Overall In Firing Position (m): INA
Width Overall In Firing Position (m): INA tripod, 0.16 on shoulder

ARMAMENT
Launcher
Name: Eryx
Launch Method: Disposable launch canister
Elevation (°): INA, tripod; unlimited on shoulder launch
Rate of Launch: (missiles/min): 1 est
Reaction Time (sec): 20-30 (includes emplace time)
Emplacement Time (min): See Reaction Time (above)
Displacement Time (min): < 0.03
Ready/Stowed Missiles: 1/ 0

FIRE CONTROL
FCS Name: INA
Guidance: SACLOS
Command Link: Wire
Beacon Type: Infrared laser diode
Tracker Type: Charged couple device (CCD)
Susceptible To Countermeasures: EO jammers, smoke, counter-fire
Counter-countermeasures: Flight time less than 4 seconds

Rangefinder: INA
Sights w/Magnification:
Gunner:
Day: INA, 3x
Field of View (°): 3.4
Acquisition Range (m): INA
Night: French Mirabel thermal sight
Field of View (°): INA
Acquisition Range (m): 1,000

VARIANTS
Bumbar (Bumble Bee): Yugoslavian variant which appears similar to Eryx, also available for export. Penetration is claimed as 1,000 mm + ERA with a tandem warhead. Weight is said to be 17 kg with missile. Length is 1.2 m. A thermal night sight is available.

AMMUNITION
Antitank Guided Missile
Name: Eryx
Alternative Designations: ACCP
Missile Weight (kg): 11 (in tube)
Missile Diameter (mm): 136
Warhead Type: Tandem Shaped Charge (HEAT)
Armor Penetration (mm CE): 900
Minimum/Maximum Range (m): 50/600
Probability of Hit (%): 90
Average Velocity (m/s): 162
Time of Flight to Max Range (sec): 3.7

Other missiles: N/A

NOTES
The disposable canister/launch tube is attached to the reusable firing post (which includes sight systems).

Eryx employs a recoil reduction system with reduced back-blast, which permits launch from inside of buildings. A rest such as a ledge or sandbag is required for launches beyond 350 meters. Signature reduction includes noise and smoke reduction.

The original Sopelem 0B50 II night sight had a range of 600 m.
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British Air Defense/Anti-Armor (High Velocity) Missile System Starstreak _____

Starstreak Lightweight Multiple Launcher

Weapons & Ammunition Types	Typical Combat Load
Ready missiles	**Dismount 3** **Team in Vehicle 5**

SYSTEM
Alternative Designation: Man portable Shoulder- Launched (SL) Starstreak.
Date of Introduction: 1997 vehicle (SP HVM), 2000 man-portable (-SL)
Proliferation: 2-6 countries
Target: FW, heli, ground vehicles
Description: (SL configuration)
Crew: 2 with a loader (one possible)

ARMAMENT
Launcher
Name: Aiming Unit
System Dimensions: See Missile
System Weight (kg): 24.3 with missile
Reaction Time (sec): <6
Time Between Launches (sec): <30 sec
Reload Time (sec): <25 sec est
Fire on the Move: Yes, in short halt

Missile
Name: Starstreak
Range (m): 300-7,000 max (guided)
Altitude (m): 0-5,000
Dimensions (mm): 1400 length
127 diameter:
Weight (kg): 14.0
Max Missile Speed: 1,364 m/s, Mach 4
Propulsion: Canister launch booster, bus missile, and 3 darts (sub-missiles)
Flight Time to max range (sec): 5-7
Guidance: Laser beam rider SACLOS
Warhead Type: Three 25-mm darts- tungsten KE tip and case & HE fill
Penetration (mm KE): 120+ all LAVs (Equal to 3 x 40-mm APFSDS-T rds)
HE detonates after for frangible effects
Fuze Type: Contact with time delay.
Probability of Hit (Ph %): 60 FW, >95 heli (each dart 67% for heli).
Self-Destruct (sec): Yes, INA

Other Missiles
Starstreak II: Improved missile has 8-km range and better precision. Fielded 2010.

Lightweight Multi-role Missile/LMM: A multi-role missile option with a single 3-kg tandem (HEAT/HE) warhead and proximity fuze. At 13 kg, the lower-cost missile flies 8-km at 1.5 Mach. It is due in 2013, and was successfully launched by a Camcopter S-100 UCAV variant. Other projected upgrades are semi-active laser-homing and/or dual-mode (LBR/SAL-H).

FIRE CONTROL
Sights w/Magnification:
Day sight: Avimo stabilized optical sight with lead bias system
Field of View (º): INA
Acquisition Range (m): 7000+
Night sight: Thales clip-on thermal sight
Acquisition Range (km): 4-5 est

Other Acquisition Aides:
ADAD: British passive thermal IR scanners on remote tripod or vehicle mount with 240 º FOV automatic cueing.

Missile team employs an azimuth plotting board (e.g., Russian 1L15-1), for direction of approach on aerial targets (see pg 6-33).

VARIANTS
The most common launcher used is–SL.

Starburst: Javelin SAM launcher adapted for Starstreak LBR guidance- in production

Lightweight Multiple Launcher (LML): Pedestal launcher for three missiles (above). The launcher can also mount on a light vehicle, e.g., TUV. A demonstrator is LML on a Panhard tactical truck.

Starstreak II: Improved launcher uses Starstreak or Starstreak II missile. It has an auto-tracker for hands-free guidance. It was fielded in 2010.

Starstreak Lightweight Vehicle (LWV): Land Rover truck converted into an SP SAM system with a 6-canister launcher, ADAD auto-tracker, and TV/ thermal FCS. This launcher can be mounted on other vehicles.

Armored Starstreak or (SP HVM): Vehicle is a Stormer tracked APC chassis, with an 8-missile launcher. The passive IR fire control system uses ADAD, an auto-tracker and thermal sight. The launcher can be mounted on other vehicles.

Seastreak: Single-stage missile naval variant in a 12-missile launcher, with mm-wave radar FCS.

Optional Use: As a low-cost air defense/anti-armor (multi-role) system, Starstreak can be employed against ground targets, such as light armored vehicles, and snipers in bunkers or buildings. The missile and its darts, with a unique combination of penetrator and following Frag-HE, have been successfully tested against vehicle targets. With a missile cost of 1/2 to 1/3 of competing MANPADS, the system could be used as a fire support asset to complement ATGM launchers and vehicle weapons. See Vol 1, pgs 5-2 and 52 regarding anti-armor use.

Thor: British Multi-Mission Air Defense System is a RWS, with 4 missile launchers, TV, FLIR, and an auto-tracker. Weighing .5 mt, it mounts on trucks, vans, TUVs, APCs, etc., with a remote operator. Designed for Starstreak, launchers, it can also mount other MANPADS, and ATGMs, such as Ingwe, TOW, HELLFIRE, Mokopa, Spike, etc.

NOTES
Ground-based AD system optimized for use against armored helicopters and low flying fixed-wing aircraft. Missile employs smokeless propellant for minimal signature. Flight time (5-8 sec) and LBR guidance make it essentially immune to countermeasures. Because of the high velocity, the system exceeds the hit probability of competing systems against high -speed aircraft on receding flight paths.

The Starstreak's lower cost and capabilities as a multi-role missile system offers varied uses. Two considerations are the semi-automatic command line-of-sight (SACLOS) guidance and contact fuzes which make it less effective against agile fixed-wing aircraft from some aspects. Thus a more practical course would be to replace 33-50% of the MANPADS. With the lower cost of Starstreak and its multi-role capability, it could replace a portion of the expensive single-role MANPADS with Starstreaks. For instance, an 18-MANPADS battery could be reduced 33% to 12 MANPADS while adding 12 Starstreaks, with the latter used as a multi-role system. With 50% of the MANPADS replaced, the mix would be 9 MANPADS and 18 Starstreaks. Added anti-armor capability is a bonus. Substitution could vary with the expected adversary target mix.

Russian ATGM Launcher AT-7/AT-13

Launcher with AT-7 Missile

Weapons & Ammunition Types	Typical Combat Load
ATGM Launcher	**4**
AT-7 HEAT ATGM	
AT-13 HEAT ATGM	
AT-13 HE ATGM	
Crewed from vehicle	**5**

SYSTEM
Alternative Designations: 9P151Firing Post
Date of Introduction: 1978
Proliferation: At least 5 countries

Description:
Crew: 2
Primary mount: Ground mount on tripod
Alternate mounts: Shoulder for launch, UAZ-469 pintle mount
Weight Overall, Excluding Missile (kg): 10.2
Length Overall in Firing Position (m): 0.78 with AT-7/Metis
0.98 with AT-13/Metis-M
Height Overall In Firing Position (m): 0.72 with AT-7/Metis
Width Overall In Firing Position (m): INA

ARMAMENT
Launcher
Name: 9P151 Firing Post
Launch Method: Disposable launch canister
Elevation (°): -5/+10
Rate of Launch (missiles/min): 3-5, depending on range
Reaction Time (sec): INA
Emplacement Time (min): 0.20
Displacement Time (min): 0.33
Ready/Stowed Missiles: 4/0 (1 on launcher)

FIRE CONTROL
FCS Name: 9S816 Guidance system
Guidance: SACLOS
Command Link: Wire
Beacon Type: INA
Tracker Type: IR
Susceptible To Countermeasures: EO jammers, smoke, counter-fire
Counter-countermeasures: AT-13 defeats EO jammers.

Rangefinder: Available

Sights w/Magnification:
Gunner:
Day: INA
Field of View (°): INA
Acquisition Range (m): INA
Night: Russian 1PN86V/Mulat-115 thermal sight is available for launcher, with detection at 3,200 meters and recognition beyond the missile's 1,500 meter range. Field of view is 4.6°.

VARIANTS
Metis-M/AT-13: System with 9P151firing post adapted for and including the Metis-M missile, IOC 1992. The Mulat-115 thermal sight is likely to be used with the missile. This represents the Tier 3 OPFOR dismount ATGM system. The missile can be used on the AT-7 launcher, but cannot then defeat EO jammers.

Launcher with AT-13 missile and thermal sight

AMMUNITION
Antitank Guided Missiles
Name: AT-7/Saxhorn
Alternative Designations: Metis
Missile Weight (kg): 6.3 (in tube)
Warhead Type: Shaped Charge (HEAT)
Armor Penetration (mm CE): 460
Minimum/Maximum Range (m): 40/1,000
Probability of Hit (%): 90
Average Velocity (m/s): 180
Time of Flight to Max Range (sec): 6.2

Name: AT-13
Alternative Designations: Metis-M (often mislabeled Metis-2)
Missile Weight (kg): 13.8 (in tube)
Warhead Type: Tandem Shaped Charge (HEAT)
Armor Penetration (mm CE): 1,000/900 behind ERA
Minimum/Maximum Range (m): 80/1500
Probability of Hit (%): 90
Average Velocity (m/s): 287
Time of Flight to Max Range (sec): 8

Other missiles: Metis-M HE thermobaric
Metis-M1: New Russian variant of AT-13, weighing 1kg less, with 2,000 m range**.**

NOTES
The Russians used to characterize the AT-7 complex as man-portable (<21 kg), permitting long-distance carry by dismounted infantry. However, the AT-13 missile complex slightly exceeds 20 kg. With a 2-man crew, it is close enough to fit into the category.

Guidance elevation has a 15° span. Because the module is small and can be quickly corrected by shifting, elevation and field of view are operationally unlimited, and permit use against hovering or stationary helicopters.

Israeli/European Beyond-Line-of-Sight (BLOS) ATGM Launcher Spike _____

Weapons & Ammunition Types	Typical Combat Load
ATGM Launcher Total	**2-5**
Spike-MR/Gill ATGM	
Tandem HEAT	
HE	
Spike-LR ATGM	
Tandem HEAT	
HE	
Two-man crew	2
Three-man crew	4
Two-man crew from a vehicle	5

SYSTEM
Alternative Designations: To emphasize missile interchangeability using the launchers, Rafael changed missile names from Gill and Spike to Spike-MR and –LR. Later, Spike ER was fielded.
Date of Introduction: 1997-98
Proliferation: At least 15 countries in Europe, Asia, Africa, and the Americas. It is being considered in 3 more
Description:
Crew: 2 with 2 ATGMs, 3 with 4 ATGMs
Primary Mount: Tripod mount, sitting, crouching or prone
Alternate Mounts: IFV, APC, jeep, helicopter
Weight Overall (kg): 13/26 with missile
Length Overall in Firing Position (m): 1.2 with missile canister
Height and Width Overall In Firing Position (m): <.75 est

ARMAMENT
Launcher
Name: Spike Command Launch Unit (CLU), for Spike-MR and -LR
Launch Method: Disposable launch canister
Rate of Launch: (missiles/min): 2-3 depending on range
Reaction Time (sec): 1-2
Emplacement and Displacement Time (min): <0.5
Reload Time (min): <0.25
Ready/Stowed Missiles: 2 for 2-man crew, 4 for 3-man crew

FIRE CONTROL
FCS Name: INA
Guidance: Either for Spike-LR launcher, only IIR for Spike-MR.
(1) IIR-homing Seeker (fire-and-forget, lock-on before launch)─all 3
(2) CCD/IIR fiber-optic guided (LOBL or command)─Spike-LR/ER
Command Link: None for IIR-homing (1), Fiber-optic cable for (2)
Susceptible To Countermeasures: Smoke and cover (IIR only)
Countermeasures:
IIR seeker penetrates most smokes.
FOG allows varied controlled flight path.
IIR and CCD can be fuzed in dual mode to counter various CMs.
Spike-MR can launch from enclosed area and buildings
-LR FOG can launch from cover, over-fly defilade/obscuration
Rangefinder: Not included but available
Sights w/Magnification:
Launcher: Day, on Command Launch Unit (CLU)
Day: CCD imager displays image from missile seeker (CCD/ 3-5μm IIR), 10x magnification
Field of View (°): 5 IIR, 10 CCD
Acquisition Range (m): 2,500 CCD/IIR, Spike-MR, -LR
4,000 CCD/IIR FOG for -LR
Night: Thermal sight, 3.5x and 10x (removable for easier carry)
Field of View (°): wide and narrow
Acquisition Range (m): 3,000

VARIANTS
Gill SF: Lightweight Gill missile/canister for Special Forces.
Spike 2.5: Variant which will be produced by Eurospike consortium, with 2.5 km max range for both modes and high CM resistance. This version has a European made missile launcher and FCS, and has been accepted for fielding in a European country.

A variety of vehicle launchers and turrets have been developed.
RCWS-30: Remote Controlled Weapon Station with a 30-mm gun, MG and twin Spike launcher. It is used on the Czech Pandur IIs.
Mangosta: Helicopter Spike missile launcher with Topaz EO sensor turret, currently marketed for sales in Latin America.
Mantis: Spike-LR 6-missile launcher currently mounted on a Marvin ATV, with thermal sight, GPS nav and LRF.

Spike ER/Spike-Extended Range/Dandy: Initially for helicopters (4-missile launcher), it can be used on other launchers. A single-tube launcher can be mounted on light vehicles. The Light Combat Vehicle (LCV) remote launcher holds 2 missiles. The missile can launch in FOG mode and switch to IIR-homing for precise impact.

AMMUNITION:
Name: **Spike-MR** (or Gill ("Short Spike", NT-G)
Missile Weight (kg): 13 It fills Spike-MR and –LR launchers.
Warhead Type: Tandem Shaped Charge (HEAT)
Armor Penetration (mm CE): 800 top-attack
Min/Max Range (m): 200/2,500
Probability of Hit (%): 95

Name: **Spike-LR** (or Spike, NT-S).
Missile Weight (kg): 13 It will fit on all launchers.
Warhead Type: Tandem Shaped Charge (HEAT)
Armor Penetration (mm CE): 800 top-attack
Min/Max Range (m): 200/4,000
Probability of Hit (%): 95

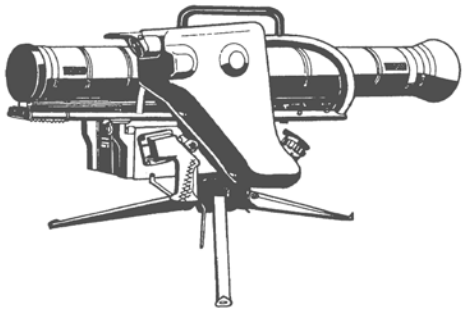
Name: **Spike-ER** (or Spike, Dandy, NT-D)
Armor Penetration (mm CE): 1,000+ top-attack
Missile Weight (kg): 32
Warhead Type: Tandem Shaped Charge (HEAT)
Armor Penetration (mm CE): 800 top-attack
Min/Max Range (m): 200/8,000
Probability of Hit (%): 95

Other Missiles: HE version of each missile. A multi-role Penetrator Blast-Frag (PBF) missile is offered for Spike-LR and others.

Rafael created the NLOS **Mini-Spike** system - EO guided missile (camera eye view RF links to the control display). With an HE warhead, it kills personnel and light vehicles. Other Spike launchers can launch the 4 kg, 1, 2 km missile.

NOTES
Use an equal mix of -MR and -LR. FOG-M guidance fits the category beyond-line-of-sight (BLOS), because it can launch from cover and hit targets behind cover. Missile has a dive or top-attack maneuver for high armor penetration. Lofted flight path permits use against helicopters. The weight (26 kg) fits categorization portable, and is quite man-portable with a 2-3 man team

European ATGM Launcher MILAN/MILAN 3/MILAN ADT



MILAN 2

Weapons & Ammunition Types	Typical Combat Load
ATGM Launcher Total	**1-5**
HEAT ATGM	
2-man crew	1
3-man crew	2
2-man crew and vehicle	5

SYSTEM
Alternative Designations: Missile d/Infantrie Leger Antichar
Date of Introduction: 1985 MILAN 2/1996 MILAN 3
Proliferation: At least 43 countries MILAN/MILAN 2/MILAN 3
Description:
Crew: 2, 3 with ammo bearer for second missile
Primary Mount: Ground mount on tripod, including operator prone
Alternate Mounts: IFV, ATGM Launcher Vehicle, jeep, helicopter
Weight Overall, Excluding Missile (kg): 16.5
Length Overall in Firing Position (m): 1.2 (missile canister)
Height Overall In Firing Position (m): 0.6
Width Overall In Firing Position (m): 0.42

ARMAMENT
Launcher
Name: MILAN 2/MILAN 3
Launch Method: Disposable launch canister
Elevation (°): INA
Rate of Launch: (missiles/min): 2-3, depending on range
Reaction Time (sec): INA
Emplacement Time (min): INA
Displacement Time (min): INA
Ready/Stowed Missiles:
2-man crew (1 on launcher), 0 stowed
3-man crew (1 on launcher), + 1 ready, 0 stowed

FIRE CONTROL
FCS Name:
Guidance: SACLOS
Command Link: Wire
Beacon Type: Pyrotechnic flare, MILAN 2/ xenon bulb, MILAN 3
Tracker Type: IR, 2.2 μm/ 0.9 μm MILAN 3
Susceptible To Countermeasures: Smoke, counter-fire, moving
Counter-countermeasures: Encoded tracker, counters EOIRCM
Rangefinder: INA
Sights w/Magnification:
Gunner:
Day: Name INA, 7x
Field of View (°): 4.3
Acquisition Range (m): INA
Night: MIRA Thermal sight available
Field of View (°): 3 x 6
Acquisition Range (m): 4,000 detection/ 2,000 recognition

VARIANTS
The missile launchers can be pintle-mounted for launch from vehicles, such as the Marder 1A3 IFV. Other recon vehicles, such as the French VBL, are fitted with MILAN launchers.

MILAN 2T: Improved ATGM with tandem warhead - not fielded
MILAN 3: New missile with a CCD tracker for the CM missile beacon. All MILAN missiles can be fired from all launchers; however, the EOIRCM will only work with MILAN 3 or ADT launcher and MILAN 3 missiles.
MILAN-ADT/ER: New firing post for **MILAN–ER** ATGM below. It can be operated remotely with video feed, with a thermal MILIS sight and 7,000 m detection range. With the remote feed, the missile can be used in NLOS mode (fly beyond the launcher line-of-sight).
MCT: Compact turret w/two launchers for Spartan and other APCs.
Sageh: Iranian version of the MILAN 2.
TRIGAN: New ATGM offered to replace MILAN with TRIGAT-MR tandem warhead. Range is 3,000 m, with penetration at 1,000-1,300 mm. With fielding of MILAN 3, sale of Trigan is less likely.
Flame-V: Indian adaptor for AT-4/5 launcher which permits use of MILAN missiles on the launcher.

AMMUNITION
Antitank Guided Missiles
Name: MILAN
Missile Weight (kg): 6.7
Warhead Type: Shaped Charge (HEAT)
Armor Penetration (mm CE): 600 (RHA)
Min/Max Range (m): 25/2,000
Probability of Hit (%): >90
Average Velocity (m/s): 160
Time of Flight to Max Range (sec): 12.5

Name: MILAN 2
Missile Weight (kg): 6.7
Warhead Type: Tandem Shaped Charge
Armor Penetration (mm CE): 800 (RHA)
Min/Max Range (m): 25/2,000
Probability of Hit (%): >90
Average Velocity (m/s): 160
Time of Flight to Max Range (sec): 12.5

Name: MILAN 3
Missile Weight (kg): 7.1
Warhead Type: Tandem Shaped Charge with precursor charge
Armor Penetration (mm CE): 880 (RHA)
Min/Max Range (m): 20/1,920
Probability of Hit (%): >90
Average Velocity (m/s): 160
Time of Flight to Max Range (sec): 12.5

Name: MILAN-ER (Missile can be used on earlier launchers.)
Armor Penetration (mm CE): 1,100 beyond ERA,
1300+ conventional armor
Max Range (m): 3,000 m

NOTES
Although the launcher is portable and has been labeled man-portable, it is too heavy for one-man carry with missile.
A kit is available for retrofit to earlier MILAN launchers, to permit firing the MILAN 3 ATGM using EOIRCM (jammer countermeasure).

Russian ATGM Launcher AT-3 and Malyutka-2

Chinese HJ-73 variant of AT-3

Slovenian 9M14P1B1 missile

Weapons & Ammunition Types	Typical Combat Load
ATGM Launcher	
AT-3 HEAT ATGM	**4/ 3 Polk Set**
Malyutka-2 Tandem	1 on launcher
AT-3 HE Thermobaric	

SYSTEM
Alternative Designations: Malyutka for missile and complex
Date of Introduction: 1963
Proliferation: At least 45 countries
Description:
Crew: 3
Primary Mount: Ground mount on "suitcase" launcher
Alternate Mounts: Rail on BMP-1, BMD-1, BRDM, BRDM-2 etc.
Weight Overall, Excluding Missile (kg): 30.5 launcher + guidance
Length Overall in Firing Position (m): 0.86, 1.02 with Malyutka-2

ARMAMENT
Launcher
Name: 9P111 Case launcher
Launch Method: Rail on case
Elevation (°): -5/ +10. It can be easily shifted (see NOTES)
Rate of Launch: (missiles/min): 2
Reaction Time (sec): < 30
Emplace/Displace Times (min): 1.7 POLK set/< 0.5
Ready/Stowed Missiles: 4/0, 3/0 POLK set

FIRE CONTROL
FCS Name: 9S415/9S415M/9S415M1 guidance panel
Guidance: MCLOS (9S415/-M panel), SACLOS for Malyutka-2
Command Link: Wire
Beacon Type: Incandescent infrared bulb (SACLOS)
Tracker Type: N/A for MCLOS, flare tracker for SACLOS
Susceptible To Countermeasures: EO jammers, smoke, counter-fire
Counter-countermeasures: Offset guidance panel, laser filters
Rangefinder: Any portable LRF can be used
Sights w/Magnification:
Gunner:
Day: 9Sh16, 8x
Field of View (°): 22.5 (see NOTES)
Acquisition Range (m): 4000
Night: Available. A Tier 3 upgrade has II.
A Tier 2 upgrade has Slovenian Iskra TS-M thermal sight: detection at 3,000 meters, recognition at 1,800.

VARIANTS
Copies include North Korean Susong-Po, Taiwanese Kun Wu, and Chinese **Red Arrow-73/HJ-73. HJ-73B** Chinese upgrade with indigenous SACLOS guidance and 500 mm penetration.
I-RAAD: Iranian upgrade SACLOS-guided with tandem warhead.
Malyutka-2/-2M: Upgrade missiles often linked to other upgrades.

9M14P1B1: Slovenian missile upgrade (new motor and propellant, lower smoke signature, nose probe, and 580 mm penetration).
POLK: Slovenian Portable Anti-armor Launching Set includes new launcher, guidance panel with binocular sight, and 3 ATGMs.
Malyutka 2000: Swiss/Bulgarian missile defeats 850 mm+ERA.
Malyutka M2T: Romanian missile with Milan 2T warhead. Similar to MILAN 3, it defeats is 850 mm +ERA, to 3,000m.

AMMUNITION
Antitank Guided Missiles
Name: AT-3, -3a, -3b/SAGGER
Alternative Designations: Malyutka, Malyutka-M
Missile Weight (kg): 10.9
Warhead Type: Shaped Charge (HEAT)
Armor Penetration (mm CE): 400
Minimum/Maximum Range (m): 500/3,000
Probability of Hit (%): 70 against moving tanks
Average Velocity (m/s): 115
Time of Flight to Max Range (sec): 26

Name: AT-3c/SAGGER
Alternative Designations: Malyutka-P
Missile Weight (kg): 11.4
Warhead Type: Shaped Charge (HEAT)
Armor Penetration (mm CE): 520
Minimum/Maximum Range (m): 500/3,000
Probability of Hit (%): 90 (SACLOS)
Average Velocity (m/s): 115
Time of Flight to Max Range (sec): 26

Name: Malyutka-2/AT-3e can be used with any Malyutka launcher
Alternative Designations: Malyutka (Modernized)
Missile Weight (kg): 12.5, 3.5 for warhead
Warhead Type: Shaped Charge (HEAT) with extendable probe
Armor Penetration (mm CE): 800
Minimum/Maximum Range (m): 500/3,000
Probability of Hit (%): 90 (SACLOS on Malyutka-2 launcher)
Average Velocity (m/s): 130
Time of Flight to Max Range (sec): 23

Other Missiles: Malyutka-2F thermobaric HE, AT-3c Imp, and above Malyutka M2T see Variants above. The HE-Blast ATGM is used for killing personnel and destroying bunkers and other fortifications.
Malyutka-2M: AT Tandem warhead missile with 4.5 kg warhead Penetration is 1000+, 800 behind ERA.

NOTES
AT-3 is classed by weight as portable (21+ kg with crew carry), rather than man-portable (<21 kg). However, with a 3-man crew and separated components, it can be carried like a man-portable system. The launcher is also a missile carry case, with missile body and warhead separated. They snap together in seconds. Missile upgrade time to Malyutka 2 is a few minutes. The guidance panel can be located up to 15 meters from the launcher, and can control up to four launchers. If target is <1,000 meters from launcher, the operator can joystick the missile to target without using optics. Because the module is small and can be shifted, elevation and field of view are operationally unlimited. Improved versions can be used on older launchers, but in the MCLOS mode. Any AT-3 can use the Malyutka-2M missile or be upgraded to it with replacement of warhead and or replacement of specific warhead and motor components.

Russian 73-mm Recoilless Gun SPG-9M

Ammunition Types	Typical Combat Load
73-mm recoilless gun	**INA**
HEAT	
HE	
Frag-HE	

SYSTEM
Alternative Designations: INA
Date of Introduction: 1970
Proliferation: Widespread

Description:
Crew: 3
Caliber (mm): 73
Weight (kg):
  Firing Position: 47.5
  Travel Position: 47.5
  Tripod: 12
Length (travel) (m): 2.11
Width (travel) (m): .99
Height (travel) (m): .80
Rifling: None
Breech Mechanism Type: Interrupted screw
Feed: Breech load
Traverse (°): 30 total
Elevation (°): -3 to +7
Rate of Fire (rd/min): 6
Emplacement/displacement time (min): 1
Fire From Inside Building: No

SIGHTS
Name:
Type: 2Ts35 Fire Control System with built in LRF for SPG-9M, also indirect fire sight for long range to 4,500 m
Sighting Range (m): 800, 1,000 est for 2Ts35
Magnification: INA
Weight (kg): .3
Location: Left side
Other Day Sights: PGP-9M the base day sight for SPG-9M.
Night Sights Available: 2 gen II for SPG-9M version

AMMUNITION
Name: PG-9VNT grenade used with SPG-9M
Caliber (mm): 73
Type: Tandem HEAT (shaped-charge) PG-9NT grenade
Range (m) Effective: 1,000
Penetration:
  Armor (mm CE): 550, 400 mm after ERA
  Reinforced Concrete (m): 1
  Brick (m): 1.
  Earth (m): 1.8
Muzzle Velocity (m/s): 400
Length (mm): INA
Weight (kg): INA

Name: PG-9VS grenade fired from earlier SPG-9
Caliber (mm): 73
Type: HEAT (shaped-charge)
Range (m):
  Effective: 1,300
Penetration:
  Armor (mm CE): 400 +
  Reinforced Concrete (m): 1 +
  Brick (m): 1.5 +
  Earth (m): 2 +
Muzzle Velocity (m/s): 435 (700 max)
Length (mm): INA
Weight (kg): 4.4

Name: OG-9VM1 grenade fired from SPG-9 or 9M
Caliber (mm): 73
Type: Frag-HE
Range (m):
  Effective: 4,500
Casualty Radius (Uncovered personnel) (m^2): 500
Muzzle Velocity (m/s): INA
Length (mm): INA
Weight (kg): 5.3

Other Ammunition
The SPG-9M can fire older ammunition for the SPG-9. A rocket assist can extend Frag-HE range to 6,000 m, but with increased error.

VARIANTS
SPG-9: Older version, with earlier PGO-9 day sight, 1 gen II night sight, and older ammunition. The SPG-9 can fire the newer ammunition without other improvements.

SPG-9D: Airborne version with detachable wheels

The SPG-9M is easily mounted on vehicles such as APCs or tactical utility vehicles using a pintle mount, as an improvised SP AT gun.

NOTES
The SPG-9/9M is a recoilless, smooth-bore, single-shot antitank weapon that fires both anti-armor and antipersonnel ammunition.
The SPG-9M is equipped with night sights. Several generations of night vision equipment (II and IR) are available for the SPG-9M and the older SPG-9. The gun is man-portable, but a truck or APC normally carries it. It must be dismounted and placed on its tripod for firing. Several variants have mounted wheels.

Yugoslavian 82-mm Recoilless Gun M79

Ammunition Types	Typical Combat Load
82-mm recoilless gun HEAT HE/Frag-HE	**36**

SYSTEM
Alternative Designations:
Date of Introduction: 1970s-1980s
Proliferation: At least 4 countries

Description:
Crew: 4 vehicle dismount, 2 pintle mount on vehicle
Caliber (mm): 82
Weight (kg): <30 with tripod
Length (travel) (m): 1.79
Mounts: Pintle mount, shoulder, or lightweight tripod
Rifling: Yes
Breech Mechanism Type: Horizontally hinged
Feed: Breech load
Rate of Fire (rd/min): 5-6
Emplacement/displacement time (min): 1/ 0.5
Fire From Inside Building: No

SIGHTS
Name: ON M72B
Type: Optical, panoramic and iron
Magnification: Optical 5.5x direct/2.5x indirect
Location: Left side
Sighting Range (m): 1,000 direct
2,700 indirect

Night Sights Available:
II sight direct fire, range 1,000 m vehicle/600 m man
Illuminated panoramic sight for indirect fire

VARIANTS
B-10: Russian towed system from which the M79 was derived.

Type 65: Chinese variant weighs 28.2 kg (with tripod but without wheels). The gun uses the Type 69 combination sight and fires a mix of ammunition including the Type 65 HEAT round.

Type 65-1: Chinese variant with a two-piece gun tube for long distance dismounted carry. Estimated weight is still 28.2 kg.

BST: Croatian version of M79 uses the CN-5 optical daysight.

AMMUNITION
Name: M79
Type: HEAT
Range (m):
Maximum Effective: 670
Maximum Aimed Range: 1,000 (direct)
Armor Penetration (mm CE): 350
Complete Round Weight (kg): 4.87 est
Muzzle Velocity (m/s): 322 est

Name: Type 65
Type: HEAT
Range (m):
Maximum Effective: 670
Armor Penetration (mm CE): 380
Muzzle Velocity (m/s): 340

Name: M81
Type: Frag-HE
Range (m):
Maximum Effective: 2,700 (indirect)
Maximum Aimed Range: 1,000 direct/2,700 indirect
Lethal radius (m): INA
Muzzle Velocity (m/s): 320

Other ammunition types: O-881 HE, BK-881/BK-881M HEAT.

NOTES
The M79 can be operated on a pintle mount.

Russian 9P135 ATGM Launcher for AT-4 and -4B/AT-5 and -5B

National War College Photo

Weapons & Ammunition Types	Typical Combat Load
ATGM Launcher Total	**4 - 8**
AT-4/AT-4B ATGM	(See NOTES)
AT-5/AT-5B ATGM	
Crew of 3	4
Crew of 3 from vehicle mixed AT-4/5	up to 8
Crew of 3 from vehicle AT-5 or 5B	5

SYSTEM
Alternative Designations: 9P135M Firing Post, Fagot/Fagot-M
Date of Introduction: 1973
Proliferation: At least 25 countries
Description:
Crew: 3
Primary Mount: Ground mount on folding tripod
Alternate Mounts: Pintle (post) on BMP-1P, BTR-D, UAZ-469, etc.
Weight Overall, Excluding Missile (kg): 22.5
Length Overall in Firing Position (m): 1.1/1.3 AT-4/5 tube

ARMAMENT
Launcher
Name: 9P135 (AT-4 only), 9P135M (AT-4/AT-5), -M1, -M2, -M3
Launch Method: Disposable launch canister
Elevation (°) (-/+): INA
Rate of Launch: (missiles/min): 2-3, depending on range
Reaction Time (sec): INA
Emplacement Time (min): INA
Displacement Time (min): INA
Ready/Stowed Missiles: 4/0 full dismount, 4/4 on or near vehicle

FIRE CONTROL
FCS Name: 9S451M1 Guidance control box
Guidance: SACLOS
Command Link: Wire
Beacon Type: Incandescent infrared bulb
Tracker Type: IR, 9S451M1
Susceptible To Countermeasures: EO jammers, smoke, counter-fire
Counter-countermeasures:
- Encoded pulse beacon. It counters EO ATGM jammers.
- Counter-dazzler adjustments to the 9S451M1 guidance box.
- Filters can be mounted in front of reticles.

Sights w/Magnification:
Gunner:
- Day: 9Sh119M1, 4x
  - Field of View (°): 4.5
  - Acquisition Range (m): 4,000+
- Night: 1PN86/Mulat thermal sight is likely for the AT-5B
  - Acquisition Range (m): 3,600+ detection

VARIANTS
P135M3: Konkurs-M Complex. Launcher with 1PN65 thermal sight and AT-5B/Konkurs-M missiles. Night range is 2,500m.

Tosan-1: Iranian variant of AT-5.

AMMUNITION
Antitank Guided Missiles
Name: Konkurs-M
- Alternative Designations: AT-5b/SPANDREL-B
- Missile Weight (kg): 26.5 (in tube)
- Warhead Type: Tandem Shaped Charge (HEAT)
- Armor Penetration (mm CE): 925
- Minimum/Maximum Range (m): 75/4,000
- Probability of Hit (%): 90
- Average Velocity (m/s): 208
- Time of Flight to Max Range (sec): 19

Name: Konkurs
- Alternative Designations: AT-5/SPANDREL-A
- Missile Weight (kg): 25.2 (in tube)
- Warhead Type: Shaped Charge (HEAT)
- Armor Penetration (mm CE): 650
- Minimum/Maximum Range (m): 75/4,000
- Probability of Hit (%): 90
- Average Velocity (m/s): 200
- Time of Flight to Max Range (sec): 20

Name: Factoria (aka Fagot-M)
- Alternative Designations: AT-4b/SPIGOT-B
- Missile Weight (kg): 12.9 (in tube)
- Warhead Type: Shaped Charge (HEAT)
- Armor Penetration (mm CE): 550
- Minimum/Maximum Range (m): 70/2,500
- Probability of Hit (%): 90
- Average Velocity (m/s): 180
- Time of Flight to Max Range (sec): 13.7

Name: Fagot
- Alternative Designations: AT-4/SPIGOT-A
- Missile Weight (kg): 13.0 (in tube)
- Warhead Type: Shaped Charge (HEAT)
- Armor Penetration (mm CE): 480
- Minimum/Maximum Range (m): 70/2,000
- Probability of Hit (%): 90
- Average Velocity (m/s): 186
- Time of Flight to Max Range (sec): 11

Other Missiles: Nag, AT-3E (see NOTES). The launcher can be modified to launch other missiles such as the Indian Nag (TV/IR/SAL-homing – due out in 2008), and the AT-3E/Malyutka-2.

NOTES
Because of its weight, the Russians categorize the AT-4/4b system as portable (21+ kg with crew carry), rather than man-portable. For dismounted carry load is divided among three packs. Due to the greater weight, AT-5/-5B fits into the "heavy" class (40+ kg), and should only be carried short distances from vehicles (<500 meters). TPVP/1PN65 thermal sight is available, with the range approximately 2,500 meters (see VARIANTS, above). Weight is 13 kg. Slovenian TS-F sight has a 3,600-meter detection range.

Russian ATGM Launcher Kornet-E and Kvartet Overhead Weapon Station _____

Kornet-E system with Kornet-LR

VBL ATGM launcher vehicle fitted with Kvartet

Weapons & Ammunition Types	Typical Combat Load
ATGM Launcher Total	**3-5**
HEAT ATGM	
HE ATGM	
2-man crew	3
3-man crew	5
2-man crew and vehicle	5
2-man crew w/Kvartet	8

SYSTEM
Alternative Designations: Kornet, AT-14, Kornet-LR and -MR
Date of Introduction: 1997-98
Proliferation: At least 3 countries
Description:
Crew: 3, 2 with Kornet-E lightweight launcher and vehicle
Primary Mount: Ground mount on tripod
Alternate Mounts: IFV, APC, ATGM launcher vehicle, jeep
Weight Overall, Excluding Missile (kg): 30 with thermal sight (11)
Length Overall in Firing Position (m): 1.21 (missile canister)

ARMAMENT
Launcher
Name: 9P163-1
Launch Method: Tube-launched from carrying canister
Elevation (°): INA
Rate of Launch: (missiles/min): 2-3, depending on range
Reaction Time (sec): 1-2
Emplacement Time (min): 1.0
Displacement Time (min): 1.0
Ready/Stowed Missiles: 2 for 2-man crew, 3-4 for 3-man crew

FIRE CONTROL
FCS Name: INA
Guidance: Laser beam rider
Command Link: N/A
Beacon Type: N/A
Tracker Type: N/A
Susceptible To Countermeasures: Smoke, counter-fire
Counter-countermeasures: Encoded laser beam
Rangefinder: Not included
Sights w/Magnification:
Gunner:
Day: 1P45-1 elbow sight
Field of View (°): INA
Acquisition Range (m): 5,500
Night: 1PN79 / Metis-2 thermal sight
Acquisition Range (m): 3,500 (ID range 2,500)
The new 1PN79M3 2nd gen sight ranges to 5,500 m.

VARIANTS
Kornet-E: Export version of the Kornet system includes a light-weight launcher tripod, thermal night sight, and Kornet-LR missile. A version is offered for hot climates.
9P163-1: Portable launcher with **Kornet -LR** missile (right). KBP suggests mounting the launcher on TUVs and other vehicles. A remote-operated version is available.

Kornet-MR: Missile for a man-portable version of the launcher. Range is km, with penetration 1,000 mm. It is unknown if the missile is currently fielded. See Notes, below.

Kornet-LR self-propelled/9P162: ATGM launcher vehicle system on BMP-3 chassis with twin launchers (see pg 6-64).

Kliver: IFV/FSV turret upgrade with Kornet (pg 3-47).
BMP-2M Berezhok: IFV upgrade with Kornet (pg 3-33).

KPB offers the **Kvartet/9P163-2** overhead weapon station for mount on light vehicles (e.g., HMMWVs currently in UAE) and VBL (aka: VBL Kvartet, Tier 1 representative ATGM launcher vehicle). It has a dual twin (4-tube) launcher and central module with TV/FLIR sights.

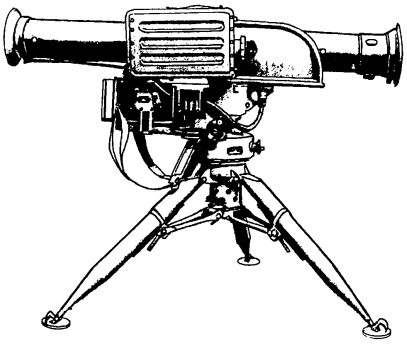
AMMUNITION
Antitank Guided Missiles
Name: Kornet-LR
Alternative Designation: 9M133
Missile Weight (kg): 27
Warhead Type: Tandem Shaped Charge (HEAT)
Armor Penetration (mm CE): 1,100
Min/Max Range (m): 100/5,500
Probability of Hit (%): 90
Average Velocity (m/s): 255
Time of Flight to Max Range (sec): 22

Other Missiles: Kornet-LR HE (thermobaric, 9M133F)
Kornet-MR Tandem HEAT and HE (thermobaric)

Kornet-EM: New ATGM launcher vehicle is based on a Russian TIGR armored 4x4 tactical utility vehicle. Two 4-missile modules jack thru the roof. An IR auto-tracker gives simultaneous dual-launch LBR ACLOS guidance. The night sight is 3rd gen thermal, for a range of 5+ km. **Kornet-EM** (Kornet-D) missiles range 8 km for HEAT, 10 for thermobaric-HE. The tandem HEAT defeats 1,300 mm of armor. The HE offers a proximity fuze for multi-role use (e.g., against helicopters).

NOTES
By weight, Kornet-MR can be broken down into a portable (30-50) 2-man system, or a man-portable system with fewer accessories. Kornet-LR is only portable (short-distance carry – See AT-3). MR and LR Kornet missiles are interchangeable on launchers.

Chinese ATGM Launcher Red Arrow-8



Weapons & Ammunition Types	Typical Combat Load
ATGM Launcher Total	
HEAT ATGM	**Ground 1-5**
3-man crew	1
4-man crew	3
3-man crew and vehicle	5
ATGM Launcher Vehicle	8-12
RA-8L Launcher Total	
2-man crew	1
3-man crew	2

SYSTEM
Alternative Designations: Hongjian-8, RA-8, HJ-8
Date of Introduction: 1986
Proliferation: At least 4 countries
Description:
Crew: 3-4
Primary Mount: Ground mount on tripod, including operator prone
Alternate Mounts: APC, ATGM Launcher Vehicle, jeep, helicopter
Weight Overall, Excluding Missile (kg): 63
Length Overall in Firing Position (m): 1.57 (missile canister)
Height Overall In Firing Position (m): INA
Width Overall In Firing Position (m): INA

ARMAMENT
Launcher
Name: Red Arrow 8
Launch Method: Disposable launch canister
Elevation (°) (-/+): -7 to +12
Rate of Launch: (missiles/min): 2-3, depending on range
Reaction Time (sec): INA
Emplacement Time (min): INA
Displacement Time (min): INA
Ready/Stowed Missiles: INA

FIRE CONTROL
FCS Name: INA
Guidance: SACLOS
Command Link: Wire
Beacon Type: Incandescent infrared bulb
Tracker Type: IR
Susceptible To Countermeasures: IR jammer, smoke, counter fire
Counter-countermeasures: Jamming CM (NFI)
Rangefinder: INA

Sights w/Magnification:
Gunner:
Day: Name INA, 12x
Field of View (°): INA
Acquisition Range (m): INA
Night: PTI-32 Thermal sight available (copy of Thorn EMI)
Field of View (°): INA
Acquisition Range (m): 4,000 detection/2,000 identification

VARIANTS
Red Arrow 8L: Compact lightweight (22.5 kg) launcher for man-portable use. Tracker system uses an encoded beacon to defeat IR jamming. A PTI-32 thermal night sight can be used.

Vehicle single tube launchers are on jeeps, such as Chinese BJ-212 and BJ 2020S, on a minibus, and on Chinese APCs such as WZ-551/ Type 90. A 4-tube launcher turret is used on many ATGM launcher vehicles, including YW 531, WZ-551, Type 89/YW 534 (ZDF 89) and Chilean Pandur. Helicopter mounts are WZ-9 and Z-9G gunships and the French Antelope.

Baktar Shikan: Pakistani variant, aka **Green Arrow**. Missile data is similar to Red Arrow-8A. One vehicle mount is on a Land Rover.

AMMUNITION
Antitank Guided Missiles
Name: Red Arrow-8A
Alternative Designation: HJ-8A
Missile Weight (kg): 24.5 (in tube), 22.5 ready for launch
Warhead Type: Shaped Charge (HEAT)
Armor Penetration (mm CE): 800
Min/Max Range (m): 100/3,000
Probability of Hit (%): 90
Average Velocity (m/s): 220
Time of Flight to Max Range (sec): 13.6

Name: Red Arrow-8E
Alternative Designation: HJ-8E
Missile Weight (kg): 24.5 (in tube), 22.5 ready for launch
Warhead Type: Tandem Shaped Charge (HEAT)
Armor Penetration (mm CE): 900
Min/Max Range (m): 100/4,000
Probability of Hit (%): 90
Average Velocity (m/s): 210
Time of Flight to Max Range (sec): 19

Name: Red Arrow-8F
Alternative Designation: HJ-8F
Missile Weight (kg): 25 (in tube)
Warhead Type: Tandem Shaped Charge (HEAT)
Armor Penetration (mm CE): 1,100 est
Min/Max Range (m): 100/4,000
Probability of Hit (%): 90
Average Velocity (m/s): 220
Time of Flight to Max Range (sec): 18

Other Missiles: There may be -8, -8B and -8C versions of the ATGM; however, the above are more likely for encounter.
The Red Arrow-8F (above) has an HE-Thermobaric warhead option. It is a multi-purpose warhead for bunkers, LAVs, dismounts, etc.

NOTES
The original launcher is too heavy to be considered portable. The -8L is truly portable when crewed by a 2-3 man team.

Russian 82-mm Recoilless Gun B-10

Ammunition Types	Typical Combat Load
82-mm recoilless gun	**36**
HEAT	12
HE/Frag-HE	24

SYSTEM
Alternative Designations: RG82
Date of Introduction: 1950s
Proliferation: At least 10 countries

Description:
Crew: 4 vehicle with dismount, 2 vehicle mount, 8 dismounted infantry
Caliber (mm): 82
Weight (kg):
Firing Position: 85.3, 71.7 without wheels
Travel Position: 85.3, 71.7 without wheels
Tripod: 6.5
Length (travel) (m): 1.85
Width (travel) (m): INA
Height (travel) (m): INA
Rifling: None
Breech Mechanism Type: Horizontally hinged
Feed: Breech load
Traverse (°): 250 each direction, 360 total
Elevation (°): -20/+35
Rate of Fire (rd/min): 5-7
Emplacement/displacement time (min): 1/ 0.5
Fire From Inside Building: No

SIGHTS
Name: PBO-2 combination, and iron
Type: Optical, panoramic and iron
Magnification: Optical 5.5x direct/2.5x indirect
Location: Left side
Sighting Range (m): 1,000 direct
4,500 indirect

Night Sights Available: Direct and indirect (illuminated), such as PN 5x80(J) II night sight from M79 (pg. 2-45) Also, a variety of strap-on II sights and sight with NVG can be used.

VARIANTS
Type 65: This Chinese variant weighs only 28.2 kg (with tripod but without wheels). The gun uses the Type 69 combination sight and fires a mix of ammunition including the Type 65 HEAT round.

Type 65-1: Chinese variant with a two-piece gun tube for long distance dismounted carry. Estimated weight is still 28.2 kg.

Type 78: Chinese upgrade with improved ammunition. Direct fire range for HEAT round is 500 m, 445 mm penetration (est).

M79: Yugoslavian lightweight variant (WEG pg 2-45).

AMMUNITION
Name: BK-881M
Type: HEAT
Range (m):
Maximum Effective: 400
Maximum Aimed Range: 1,000 (direct)
Maximum Range: 4,500
Armor Penetration (mm CE): 240
Complete Round Weight (kg): 4.87
Muzzle Velocity (m/s): 322

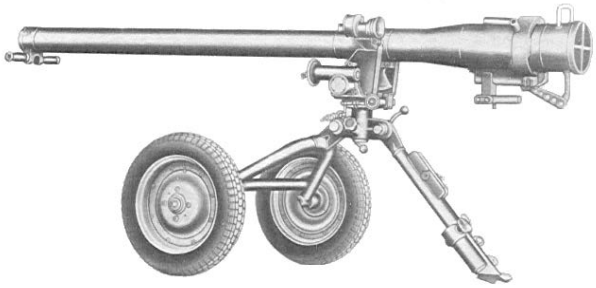
Name: Type 65
Type: HEAT
Range (m):
Maximum Effective: 450
Maximum Aimed Range: INA
Maximum Range: 3,750
Armor Penetration (mm CE): 356
Complete Round Weight (kg): 3.5
Muzzle Velocity (m/s): 240

Name: O-881A
Type: Frag-HE
Range (m):
Maximum Effective: 4,500 (indirect)
Maximum Aimed Range: 1,000 direct/4,500 indirect
Maximum Range: 7,300
Lethal radius (m): INA
Complete Round Weight (kg): 4.87
Muzzle Velocity (m/s): 320

Other ammunition types: O-881 HE and BK-881 HEAT.
Chinese Type 78 HEAT round, see VARIANTS (above).

NOTES
The B-10 can be mounted on a pintle, but is normally towed on a two-wheeled carriage with an under-slung tripod. The gun can be fired while on two wheels or on the tripod.

Former Yugoslavian 82-mm Recoilless Gun M60



Ammunition Types	Typical Combat Load
82-mm recoilless gun HEAT	**36**

SYSTEM
Alternative Designations: M60A
Date of Introduction: First sighted 1965
Proliferation: At least 2 countries
Description:
Crew: 5 dismounted, 2 on vehicle
Caliber (mm): 82
Weight (kg):
Firing Position: 122
Travel Position: 122
Tripod: INA
Length (travel) (m): 2.4 approximate
Width (travel) (m): 1.0 approximate, firing position
Height (travel) (m): 0.83 approximate, firing position
Rifling: Yes, 4 with left rotation
Breech Mechanism Type: Vertically hinged with flange rotate lock
Feed: Breech load
Traverse (°): 360
Elevation (°): -20 to +35
Rate of Fire (rd/min): 4
Emplacement/displacement time (min): 0.5/ 0.5
Fire From Inside Building: No

SIGHTS
Name: INA
Type: Optical telescopic
Magnification: INA
Location: Left side
Sighting Range (m): 1,500
Night Sights Available: INA

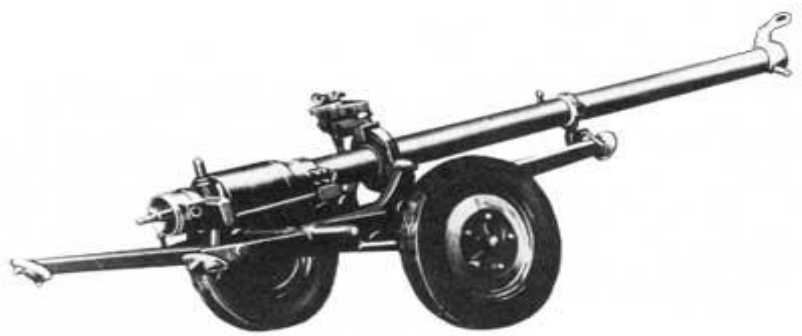
VARIANTS
Distinction between M60 and M60A is unknown.

AMMUNITION
Name: M60
Type: HEAT
Range (m):
Maximum Effective: 500
Maximum Aimed Range: 1,500 stationary target
1,000 moving target
Armor Penetration (mm CE): 200
Complete Round Weight (kg): 7.2
Muzzle Velocity (m/s): 388

Name: M72
Type: Rocket-assisted HEAT
Range (m):
Maximum Effective: 1,000
Maximum Aimed Range: 1,500 stationary/ 1,000 moving
Armor Penetration (mm CE): 220
Complete Round Weight (kg): INA
Muzzle Velocity (m/s): INA

NOTES
The M60 is mounted on a two-wheeled carriage with a trailing leg that is used as a tripod leg for firing, as well as a tow bar for towing the gun. The gun can be towed behind a variety of vehicles, and then moved into position by hand. Gun height is adjustable based on wheel and leg lock settings. The M60 can also be mounted on a pintle, such as the antitank version of the M-60PB APC, which features two guns. Back-blast safety area is 45 m deep by 25 m wide.

Russian 107-mm Recoilless Gun B-11



Ammunition Types	Typical Combat Load
107-mm recoilless gun	**30**
HEAT	10
HE	20

SYSTEM
Alternative Designations: RG107
Date of Introduction: 1950s
Proliferation: At least 5 countries
Description:
Crew: 5
Caliber (mm): 107
Weight (kg):
Firing Position: 304.8
Travel Position: 304.8
Length (m):
Firing Position: 3.54
Travel Position: 3,56
Width (travel) (m): 1.45
Height (m):
Firing Position: 1.19
Travel Position: 0.9
Rifling: None
Breech Mechanism Type: Interrupted screw
Feed: Breech load
Traverse (°): 35 each direction, 360 total with slight move
Elevation (°): -10 to +45
Rate of Fire (rd/min):
Emplacement/displacement time (min): 1/1
Fire From Inside Building: No

SIGHTS
Name: PBO-4 combination (direct/indirect) and iron
Type: Optical, panoramic and iron
Magnification: Optical 5.5x direct/2.5x indirect
Location: Left side
Sighting Range (m):
Direct: 1,800
Indirect: 6,650

Night Sights Available: Direct and indirect (illuminated)

AMMUNITION
Name: BK-883
Type: HEAT
Range (m):
Max Effective: 450
Max Aimed Range: 1,400 (est)
Armor Penetration (mm CE): 381 at 0°
Complete Round Weight (kg): 12.5
Muzzle Velocity (m/s): 400

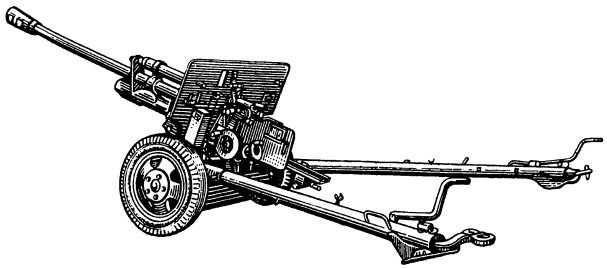
Name: O-883A
Type: Frag-HE
Range (m):
Max Effective: N/A
Max Aimed Range: 1,300 direct
6,650 indirect
Armor Penetration (mm): N/A
Complete Round Weight (kg): 13.5
Muzzle Velocity (m/s): 375

NOTES
The B-11 is towed on a two-wheeled carriage with an under-slung tripod. The gun can be fired while on two wheels; but due to recoil effect on accuracy, it is usually fired from the tripod.

The gun can easily be moved and repositioned by hand.

A unit of fire is 80 rounds.

Russian 76-mm Towed Antitank Gun ZIS-3



Weapons & Ammunition Types	Typical Combat Load
76-mm rifled gun	**INA**
HVAP-T	
HEAT	
APC-T	
Frag-HE	

SYSTEM
Alternative Designations: M1942
Date of Introduction: INA
Proliferation: At least 14 countries

Description:
Crew: 5-7
Combat Weight (mt): 1.12
Length Overall, Travel (m): 6.10
Height Overall, Travel (m): 1.3
Width Overall, Travel (m): 1.4

Mobility:
Mount: Two-wheeled carriage with twin trails
Prime mover: AT-P tractor, light trucks
Towed Speed (km/h):
Max Road: INA
Max Off-Road: INA
Average Cross-Country: INA
Fording Depth (m): N/A
Emplace Time (min): INA
Displace Time (min): INA
Radio: N/A
Protection: Gun shield

ARMAMENT
Main Armaments:
Caliber, Type, Name: 76-mm rifled gun
Rate of Fire (rd/min): 8-10 normal / 15-20 burst indirect fire
Loader Type: Manual
Ready/Stowed Rounds: N/A
Elevation (°): -5/+37
Fire on Move: No

FIRE CONTROL
FCS Name: N/A
Main Gun Stabilization: N/A
Rangefinder: N/A
Sights w/Magnification:
Gunner:
Day: INA
Field of View (°): INA
Acquisition Range (m): INA
Night: INA
Field of View (°): INA
Acquisition Range (m): INA

VARIANTS N/A

MAIN ARMAMENT AMMUNITION
Caliber, Type, Name:
76-mm HVAP-T, BR-354P
Maximum Aimed Range (m): INA
Max Effective Range (m):
Day: 1,000
Night: INA
Armor Penetration (mm KE): 58 at 1,000 meters
92 at 500 meters

76-mm APC-T , BR-350B
Maximum Aimed Range (m): INA
Max Effective Range (m): INA
Day: 1,000
Night: INA
Armor Penetration (mm KE): 61 at 1,000 meters

76-mm HEAT, BK-354M
Maximum Aimed Range (m): 1,000
Max Effective Range (m): INA
Day: 500
Night: INA
Armor Penetration (mm CE): 280 (RHA)

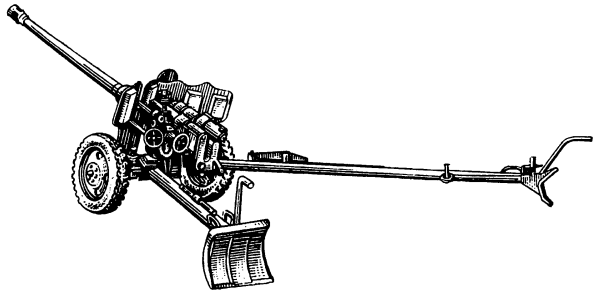
76-mm Frag-HE, OF-350A
Maximum Aimed Range (m): INA
Max Effective Range (m):
Day: INA
Night: INA
Armor Penetration (mm): INA

76-mm Frag-HE
Maximum Aimed Range (m): INA
Max Effective Range (m):
Day: 1,500
Night: INA
Armor Penetration (mm): INA

Other Ammunition Types: API-T BZR-350B, Smoke (WP)

NOTES
Although the ZIS-3 is categorized as an antitank gun, some OPFOR forces will employ it for general support, especially against light targets. Typical combat load is based on the prime mover; and a wide variety of systems can be used as prime movers.

Russian 85-mm Towed Gun D-44



Weapons & Ammunition Types	Typical Combat Load
85-mm rifled gun	**21**
HVAP-T	(est) 3
HEAT-FS	3
AP HE	3
Frag-HE	9
Smoke	3

SYSTEM
Alternative Designations: M1945
Date of Introduction: 1944
Proliferation: At least 16 countries
Description:
Crew: 8
Combat Weight (mt): 3.1
Length Overall, Travel (m): 8.34
Height Overall, Travel (m): 1.42
Width Overall, Travel (m): 1.73

Mobility:
Mount: Two-wheeled carriage with twin trails and coaster wheel
Prime mover: AT-P tractor, light trucks
Towed Speed (km/h):
Max Road: 60
Max Off-Road: 35
Average Cross-Country: INA
Fording Depth (m): INA
Emplace Time (min): 2
Displace Time (min): 2
Radio: N/A
Protection: Gun shield

ARMAMENT
Main Armaments:
Caliber, Type, Name: 85-mm rifled gun
Rate of Fire (rd/min): 8 normal / 15 burst Indirect Fire
Loader Type: Manual
Ready/Stowed Rounds: 0 / 140 on prime mover
Elevation (°): -7/+35
Fire on Move: No

FIRE CONTROL
FCS Name: N/A
Main Gun Stabilization: N/A
Rangefinder: N/A
Sights w/Magnification:
Gunner:
Day: OP-2-7 Direct Fire, 5.5x / PG-1M Indirect Fire
Field of View (°): INA
Acquisition Range (m): 1,500
Night: INA
Field of View (°): INA
Acquisition Range (m): INA
Indirect Fire: PG-1M, 4x (limited capability for direct fire)
Field of View (°): 10°
Range (m): 1,500-3,000+ day and night

VARIANTS
D-44-N: Variant with II night sight.

SD-44: Airborne version with auxiliary propulsion unit which permits self-propulsion for short distances at speeds of up to 25 km/h on the road, 5.5 km/h off road.

MAIN ARMAMENT AMMUNITION
Caliber, Type, Name:
85-mm HVAP-T, BR-365P/365PK
Maximum Aimed Range (m): 1,500
Max Effective Range (m):
Day: 1,150
Night: INA
Armor Penetration (mm KE): 180 (RHA) at 1,000 meters
113 (RHA, 30°) at 500 meters

85-mm HEAT-FS, BK-2M
Maximum Aimed Range (m): 1,500
Max Effective Range (m):
Day: 1,500
Night: INA
Armor Penetration (mm CE): 300

85-mm AP HE
Maximum Aimed Range (m): 1,500
Max Effective Range (m):
Day: 950
Night: INA
Armor Penetration (mm KE): 91 (30° angle) at 500 meters

85-mm Frag-HE, O-365K
Maximum Aimed Range (m): 1,500
Max Effective Range (m):
Day: 1,500
Night: INA
Armor Penetration (mm): Can defeat most IFVs on impact

Other Ammunition Types: HE, BR-365 and -365K AP-T and APC-T (obsolete)

NOTES
The gun is variously referred to as artillery, as a field gun or as an antitank gun. It can be used for all roles or specifically for artillery or antitank. Typical combat load is based on the prime mover; and a wide variety of systems can be used as prime movers.
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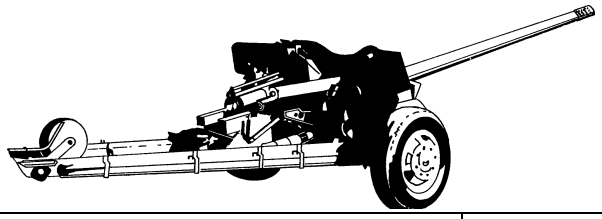
Russian 100-mm Towed Antitank Gun MT-12 and MT-12R



Weapons & Ammunition Types	Typical Combat Load
100-mm smoothbore gun	**20**
APFSDS-T	8
HEAT	4
Frag-HE	4
AT-10 ATGM	4

SYSTEM
Alternative Designations: T-12A, 2A29/Rapira for original system. Use MT-12R for Tier 2 version
Date of Introduction: 1972 original system
Proliferation: At least 12 countries
Description:
Crew: 6
Combat Weight (mt): 3.1
Length Overall, Travel (m): 9.65
Height Overall, Travel (m): 1.6
Width Overall, Travel (m): 2.3

Automotive Performance:
Mount: Two-wheeled carriage w/twin trails and coaster wheel
Prime mover: MT-LB-T, URAL-375D and other trucks
Towed Speed (km/h):
Max Road: 60
Max Off-Road: INA
Average Cross-Country: 25
Fording Depth (m): INA
Emplace/Displace Time (min): 2-3
Radio: N/A
Protection: Gun shield

ARMAMENT
Main Armaments:
Caliber, Type, Name: 100-mm smoothbore gun 2A29
Rate of Fire (rd/min): 6-8/up to 15 indirect fire
Loader Type: Manual
Ready/Stowed Rounds: 0/20
Elevation (°): -7/+20
Fire on Move: No

ATGM Launcher:
Launch Method: Gun-launched, 2A29 smoothbore gun
Guidance: Laser-beam rider
Command Link: Encoded laser-beam
Rate of Launch (missiles/min): 3-5 depending on range
Launcher Dismountable: No

FIRE CONTROL
FCS Name: N/A
Main Gun Stabilization: N/A
Rangefinder: 9S53 laser guidance (ATGM, observing). Radar
Sights w/Magnification:
Gunner:
Day: OP40M-40U direct fire, 5.5x / PG-1M indirect fire
Field of View (°): 11
Acquisition Range (m): 3,000, 5,500 with 9S53
Night: APN6-40 II sight, 6.8x
Field of View (°): 7
Acquisition Range (m): 2,000
MMW radar FCS: 3,000 m range. For surveillance, ranging, gun rd acquisition/fire control, and target tracking on MT-12R

VARIANTS
T-12: Original version of Russian gun. MT-12 has changes in carriage and obturator, which do not affect lethality performance.

MT-12R: Russian upgrade with radar-directed fire control system, for use at night and adverse weather.

Topaz: Former-Yugoslav variant of T-12, with the 2A19M gun mounted on a D-30 carriage. Some have AT FCS-1 (see NOTES).

MAIN ARMAMENT AMMUNITION
Caliber, Type, Name: 100-mm APFSDS-T, BM-412M, Romanian
Maximum Aimed Range (m): 2,500, 3,000 platoon volley
Max Effective Range (m):
Day: 2,500
Night: 2,500 with radar/2,000 II
Armor Penetration (mm KE): 418 at 2,000 m/380 at 3,000 m

Caliber, Type, Name: 100-mm APFSDS-T, M1000, Belgian
Maximum Aimed Range (m): 3,000/platoon volley INA
Max Effective Range (m):
Day: 3,000
Night: 3,000 with radar/2,000 II
Armor Penetration (mm): Triple heavy target at 4,000 meters

Caliber, Type, Name: 100-mm HEAT, BK-17
Maximum Aimed Range (m): 2,500, 3,000 platoon volley
Max Effective Range (m):
Day: 2,500
Night: 2,500 with radar/2,000 II
Armor Penetration (mm CE): 380
Look at BK-5M
Caliber, Type, Name: 100-mm Frag-HE, OF-15
Maximum Aimed Range (m): 3,000 direct-fire, 8,200 indirect fire
Max Effective Range (m):
Day: 5,500 using sight/radar. Adjust fire with 9S53 for area fire
Night: 3,000, direct-fire with radar, 2,000 with II sight
Armor Penetration (mm): Due to combined Frag-HE effects, round can defeat IFV/APC on impact. A near miss would damage those vehicles.
Note: Rate of fire for indirect fire (Frag-HE) is 8-15 rd/min.

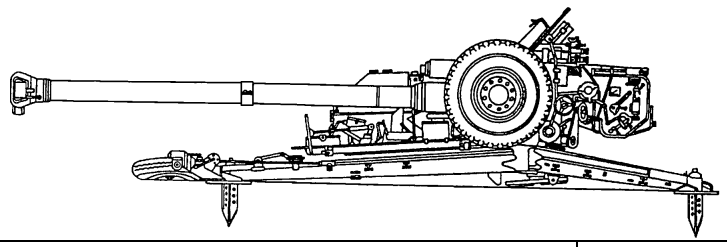
Other Ammunition Types: BM-2/-20/-25 APFSDS-T; BK-5M HEAT-FS

Antitank Guided Missiles:
Name: AT-10/Kastet
Warhead Type: Shaped charge (HEAT)
Armor Penetration (mm CE): 650 (RHA)/150 behind ERA
Range (m): 5,000 day only

Name: AT-10B/Kan
Warhead Type: Tandem Shaped charge (HEAT)
Armor Penetration (mm CE): 750 (RHA)/700 behind ERA
Range (m): 5,500 day only

NOTES
The Serb Iskra AT FCS-1 computerized laser rangefinder FCS is on is offered for sale. Range for FCS-1 is 0-3,000 meters. Russian 2nd generation II sights are available. The day sight can be used at night if the target is illuminated. Thermal sights for the ATGM launcher, such as the 1PN79 (with 3,500 m range) are available.

Russian 125-mm Towed Antitank Gun 2A45M



Weapons & Ammunition Types	Typical Combat Load
125-mm smoothbore gun	***60**
APFSDS-T	28
HEAT	4
Frag-HE	20
Invar/Svir ATGM	8
	* Mix estimate

SYSTEM
Alternative Designations: SPRUT-B (Octopus-B)
Date of Introduction: 1980s
Proliferation: At least 1 country
Description:
Crew: 7
Combat Weight (mt): 6.5
Length Overall, Travel (m): 7.12
Height Overall, Travel (m): 2.09, 2.35 with APU (0.90 firing)
Width Overall, Travel (m): 2.3

Automotive Performance:
Mount: Two-wheeled carriage with three trails and coaster wheel
Prime mover: MT-LB, URAL-4320, and other trucks
Towed Speed (km/h):
Max Road: 80
Max Off-Road: INA
Average Cross-Country: 25
Emplace/Displace Time (min): 1.5/2.0
Auxiliary Propulsion Unit. Gasoline engine enables the gun to travel at a speed of up to 14 km/hour, to a distance of 50 km.

Radio: On the prime mover
Protection: Gun shield

ARMAMENT
Main Armaments:
Caliber, Type, Name: 125-mm smoothbore gun 2A45M
Rate of Fire (rd/min): 6-8
Loader Type: Manual, separate-loading
Ready/Stowed Rounds: 6 onboard/60 on prime mover
Elevation (°): -6 to +25
Fire on Move: No

ATGM Launcher:
Launch Method: Gun-launched
Guidance: Laser-beam rider, with 9S53 guidance device
Command Link: Encoded laser-beam
Rate of launch (missiles/min): 3-5, depending on range
Launcher Dismountable: No

FIRE CONTROL
FCS Name: N/A
Main Gun Stabilization: N/A
Rangefinder: 9S53 laser guidance unit. Also use radar for ranging.
Sights w/Magnification:
Gunner:
Day: OP4M-48A, 5x, direct fire, 5.5x / 2Ts33 iron
PG-1M, 4x, indirect fire.
Field of View (°): 11 on OP4M-48A, 10 on PG-1M
Acquisition Range (m): 4,000/8,200 indirect fire
ATGM night sight: 1PN79 thermal sight
Acquisition Range Day/Night (m): 3,500 (ID range 2,500)

VARIANTS
Original **2A45** had only 1PN53-10 II night sight, range 800-1,300m.
2A45M: Upgrade adds an APU (see Automotive Performance, left).
2A45MR: For Tier 1 add MMW radar FCS used on MT-12R**.** It can be used day and night for surveillance, target tracking, and precise gun direct fire to a range of 3,000 m.

MAIN ARMAMENT AMMUNITION
Caliber, Type, Name: 125-mm APFSDS-T, BM-42M
Max Aimed Range (m): 3,000
Max Effective Range (m):
Day: 3,000
Night: 3,000 with radar
Armor Penetration (mm KE): 590-630 at 2,000 meters

Caliber, Type, Name: 125-mm HEAT, BK-27
Max Aimed Range (m): 4,000
Max Effective Range (m):
Day: 3,000-4,000
Night: 3,000 radar/1,300 II sight
Armor Penetration (mm CE): 700-800

Caliber, Type, Name: 125-mm HEAT-MP, BK-29M
Max Aimed Range (m): 4,000
Max Effective Range (m):
Day: 4,000
Night: 3,000 radar/1,300 II sight
Armor Penetration (mm): 650-750. It also has HE effects

Caliber, Type, Name: 125-mm Frag-HE-T, OF-26
Max Aimed Range (m): 5,000
Max Effective Range (m):
Day: 5,000 use radar/day sight, adjust with ATGM sight
Night: 3,500 radar, adjust with ATGM night sight/1,300 II
Armor Penetration (mm): Due to combined Frag-HE effects, rd can defeat IFV/APC on impact. A near miss will damage vehicles.

Other Ammunition Types: Giat 125G1, and BM-42 and BM-32 APFSDS-T. The Russians may have a BM-42M with DU penetrator.

Antitank Guided Missiles:
Name: AT-11B/INVAR
Warhead Type: Tandem shaped charge
Armor Penetration (mm CE): 900/850 behind ERA
Range (m): 5,000/3,500 night

NOTES
The day sight can be used at night if the target is illuminated.

The Sokol-1 guided antitank round uses semi-active laser-homing or IR-homing for a 5-km effective range. A laser target designator (LTD) can be positioned next to the gun. The direct-fire round can be used without an LTD under some circumstances. The round is less expensive than ATGMs, and offers a fast response (1-5 sec) to defeat target vehicles before they can employ their weapons. With a HEAT warhead and 700 mm penetration, lethality is sufficient for a mobility or firepower kill against tanks and a catastrophic kill against other targets.

Heavy Armament Combat Vehicles (HACVs)

All combat vehicles lighter than MBTs are too vulnerable to lead tactical assaults. For infantry units, the best solution is in task organization - adding tanks to the mechanized infantry formation. But at times, that solution is simply not available. The tanks are being used, not road-mobile enough, or cannot operate in areas where the mech formation must go. Therefore, some forces turn to ***HACVs***. This category combines all vehicles on chassis lighter than main battle tank chassis, but mounting heavy guns (at least 60 mm), including those characteristic of tanks.

Many countries produce armored combat vehicles which can execute a variety of other combat missions, such as anti-tank fires, fire support, combat reconnaissance, etc. Recent analysts have tried to differentiate them as "medium armored vehicles". However, the term has not yet been widely accepted because of two reasons: (1) There is no clear agreement on the weight or armor protection distinctions between medium and light, and (2) Most modern AT weapons will defeat any vehicles other than MBTs. In recent years, the term ***HACVs*** was coined to characterize all of those systems. The term seems contradictory, in that they are usually not as heavy as tanks, and may not be as heavy as ***heavy infantry fighting vehicles (HIFVs)***, or ***heavy armored personnel carriers (HAPCs)***; but it is based on the heavy gun, versus the chassis.

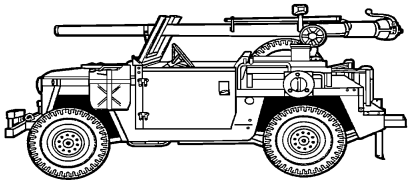
Other terms are still used for these systems. Most are based on the original mission for which the system was developed. The term ***tank destroyer*** has been used to describe antitank vehicles with the role of killing tanks with guns and/or missiles. The ***self-propelled anti-tank gun*** (SPATG) referred to a vehicle with a heavy gun and designed to operate in antitank units to destroy tanks and other armored vehicles. Others have been called ***assault guns*** (ASU-85), ***heavy combat reconnaissance vehicles*** (Scorpion), ***light tanks*** (AMX-13), or ***fire support vehicles*** (AMX-10 PAC 90). Despite their original design role, user countries may use them for various combat and combat support roles to provide direct fire support, and even indirect fire support. For instance, the OPFOR can use the 2S25 in amphibious and airborne units for light tank, fire support, as well as in antitank roles.

The most critical role for these systems in modern forces as the fire support vehicle which is mobile enough to accompany highly mobile infantry forces and provide immediate direct fire (and possibly indirect fire) support. Although many have guns which are inadequate for challenging MBTs, they could participate in combined arms ambushes and deliver lethal anti-armor fires against other armored vehicles accompanying tanks. The HACVs could be misused as assault vehicles, but that mission is too hazardous for use by a thinking OPFOR.

Another kind of vehicle which is receiving some attention is the ***heavy combat support vehicle***. This vehicle is used in a combined arms team or unit with tanks and other vehicles to provide supporting fires, and to protect the tanks from close-in antitank weapons, including other tanks. For discussion of this vehicle, see page 3-40.

Forces continue to demonstrate requirements for these vehicles. China recently fielded a new amphibious light tank, ZBD2000 (with 105-mm ATGM firing gun and surface-skimming ability), and a new SPAT (PTL02 with a 100-mm ATGM firing gun on wheeled Type 92 chassis (pg 3-25). Russia began production on a new design 2S25 SPAT (pg 6-42). South Africa is upgrading AMX-RCs (pg 6-45). New modular heavy gun turrets are offered for LAV upgrades.

United States 106-mm Recoilless Rifle M40



Ammunition Types	Typical Combat Load
106-mm recoilless gun HEAT HEAT-T HEP-T APERS-T HEAP	**INA**

SYSTEM
Alternative Designations: BAT (Battalion Antitank), and VARIANTS
Date of Introduction: 1953
Proliferation: At least 50 countries
Description:
Crew: 4 vehicle with dismount, 2 vehicle mount, 8 dismounted infantry
Caliber (mm): 106
Weight (kg): 130, 113 without the spotting rifle
Length (m): 3.4, with a 2.85 m barrel
Width (on M79 mount) (m): .8, 1.524 with the legs spread
Height (on M79 mount) (m): 1.3

ARMAMENT
Main Armament: 106-mm Recoilless rifle.
Bore: Rifled 36 grooves, rh. The actual bore size is 105 mm; but is referred to as 106 mm to avoid confusion with the failed 105-mm M27 gun system.
Breech Type: Interrupted thread , hand-operated
Recoil System: Vented breech
Feed: Manual
Traverse (°): 360
Elevation (°) (M79 Mount): -17/+65
Rate of Fire (rd/min): 5
Emplacement/displacement time (min): INA
Fire From Inside Building: No
Complete Round Weight (kg): 13
Muzzle Velocity (m/s): 570

Spotting Rifle: .50 cal M-8C, magazine-fed. It uses a .50 cal semi-auto spotting rifle mounted along the axis of the barrel to determine proper elevation for the 106-mm rifle. The round matched to M40 round flight ballistics, and holds a 20-round magazine.

SIGHTS
Name: Bofors Modernization Package
Daysight:
Name: Simrad LP101 laser day sight (in place of the ranging gun)
Others available: Computerized LASer Sight (CLASS)
Upgraded systems may have the Simrad laser sight in lieu of the ranging (spotting) gun.

Night Sights:
Name: NVL-11 Mk IV II sight with computer LRF
Range: 990 m.
Others available: Simrad KN250 II sight, other II and thermal sights

VARIANTS
M40A1: Initial fielded version of the rifle which was commonly exported, with the M-8C spotting rifle.
M40A2: Upgrade with an M79 mount.
M40A4: The latest fielded version, with the M27 tripod.
Other countries have produced the rifle, under license, and mounted it on various chassis.
Bofors Retrofit Program: Upgrade program, with the Simrad sights and the 3A-HEAT-T round.
The weapon can be porteed, carried on a vehicle pintel mount, then transferred to a ground semi-mobile tripod mount.

M79 Mount: Tripod, ground, or vehicle
M50 Ontos: Six-barrel mount on small tracked vehicle
PAK-66: Austrian M40 on two-wheel carriage

AMMUNITION
Name: M344A1
Type: HEAT
Range (m):
Maximum Effective: 1,350
Maximum Range: 2,745
Armor Penetration (mm CE): INA
Complete Round Weight (kg): 16.8
Muzzle Velocity (m/s): 503

Name: 3A-HEAT-T (Bofors upgrade)
Type: HEAT-Tracer
Maximum Effective Range (m): 2,000
Armor Penetration (mm CE): 700 +
Complete Round Weight (kg): 14.5
Muzzle Velocity (m/s): 570

Name: M346A1
Type: HEP-T (HE plastic-tracer)
Maximum Range (m): 6,870
Complete Round Weight (kg): 16.95
Muzzle Velocity (m/s): 498

Name: M581
Type: APERS-T (antipersonnel-tracer) (flechette)
Fill (.5 g ea): 10,000 flechettes
Maximum Effective Range (m): 300
Complete Round Weight (kg): 18.73
Muzzle Velocity (m/s): 438

Name: HEAP M-DN
Type: HE antipersonnel (steel pellets)
Fill: 1,000 steel pellets
Maximum Effective Range (m): 1,500
Lethal Radius: 40
Complete Round Weight (kg): 16.4
Muzzle Velocity (m/s): 560

NOTES
The producer of the LAHAT gun-launch ATGM (pg 6-58) offers to produce a version for use in the M40 launcher. The tandem ATGM is a viable threat to all modern armored vehicles. Use requires a tripod-mounted laser guidance unit, as used with MT-12 and 2A45M AT guns.
The rifle produces a massive amount of noise and smoke which reveals its location. Thus a first round hit is critical.

Russian Self-Propelled Antitank Gun 2S25

2S25 with improved hull design

Weapons & Ammunition Types	Typical Combat Load
125-mm smoothbore gun	**40**
BM-42M APFSDS-T	(mix est) 15
BK-27 HEAT	3
OF-26 Frag-HE	16
Invar ATGM	6
7.62-mm coax MG	**2,000**
*125-mm Sokol-1 IR Homing/SAL round for Near Term	(next page)

SYSTEM
Alternative Designations: Sprut-SD
Date of Introduction: 1993 for prototype, 2009 with new design
Proliferation: In production for fielding of ground forces with the BMD-4M type hull design.
Description:
Crew: 3
Chassis: BMD-3, modified with 7 road wheels
Combat Weight (mt): 18.0
Length Overall (m): 6.98
Height Overall (m): 2.45 Height varies due to hydro-pneumatic suspension (see NOTES).
Width Overall (m): 3.13 est
Ground Pressure (kg/cm^2): 0.36 (wide track) / .53 (standard track)

Automotive Performance:
Engine Type: 500-hp UTD-29 Diesel
Cruising Range (km): 500
Speed (km/h):
- Max Road: 71
- Max Off-Road: 45 est
- Average Cross-Country: INA
- Max Swim: 10

Fording Depth (m): Amphibious to sea state 3 with no preparation

Radio: R-173

Protection:
Armor, Turret Front (mm): Against 12.7 mm machinegun
The recent front hull adds an improved angle on the hull glacis and a hull front compartment for more bow protection.
Applique Armor (mm): N/A
Explosive Reactive Armor (mm): French SNPE and others available
For amphibious use, additional armor application is unlikely.
Active Protective System: Available
Mineclearing Equipment: N/A
Self-Entrenching Blade: N/A
NBC Protection System: Collective
Smoke Equipment: Smoke grenade launchers, 6 on turret rear

ARMAMENT
Main Armament:
Caliber, Type, Name: 125-mm smoothbore gun 2A75
Rate of Fire (rd/min): 6-8 with autoloader
Loader Type: Autoloader (separate loading) and manual
Ready/Stowed Rounds: 22/18
Elevation (°): -5 to +15
Fire on Move: Yes

Auxiliary Weapon:
Caliber, Type, Name: 7.62-mm (7.62 x 54R) machinegun, PKT
Mount Type: Turret coax
Maximum Aimed Range (m): 2,000Max Effective Range (m):
- Day: 1,000
- Night: 1,000

Fire on Move: Yes
Rate of Fire (rd/min): 250 practical / 650 cyclic, 2-10 round bursts

ATGM Launcher:
Name: 2A75
Launch Method: Gun-launched
Guidance: SACLOS, Laser beam rider
Command Link: Encoded infrared laser beam
Rate of launch (missiles/min): 2-3, depending on range
Launcher Dismountable: No

FIRE CONTROL
FCS Name: INA
Main Gun Stabilization: 2E42-2, 2-plane
Rangefinder: TPD-K1M or similar laser rangefinder
Infrared Searchlight: Yes
Sights w/Magnification:
Gunner:
- Day: Computer LRF, 2-plane stabilized sight
  - Field of View (°): INA
  - Acquisition Range (m): 3,000 with LRF, 5,000 without
- Night: Sanoet-2 Thermal sight or similar capability
  - Field of View (°): INA
  - Acquisition Range (m): 2,600

Commander Fire Main Gun: Yes

VARIANTS
The earlier design employed the BMD-3 chassis, but expanded with seven road wheels. This version was fielded in limited numbers. After budget delays and retooling for the new design, production will resume.

Russian Self-Propelled Anti-tank Gun 2S25 continued

The new version includes improvements comparable to those on the amphibious IFV BMD-4 (see pg 3-42). The new BMD-4M features a new larger and better-armored hull. The 2S25 will shift to a similar hull front design in the 2009 production versions.

MAIN ARMAMENT AMMUNITION
Caliber, Type, Name:
125-mm APFSDS-T, BM-42M
Maximum Aimed Range (m): 4,000
Max Effective Range (m):
Day: 3,000-4,000
Night: 2,600
Armor Penetration (mm KE): 590-630 at 2,000 meters

125-mm Frag-HE-T, OF-26
Maximum Aimed Range (m): 5,000
Max Effective Range (m):
Day: 5,000
Night: 2,600
Armor Penetration (mm): Due to combined HE and fragmentation effects, this round can defeat an IFV or APC on impact. A near miss would damage those vehicles.
125-mm HEAT-MP, BK-29M
Maximum Aimed Range (m): 4,000
Max Effective Range (m):
Day: 4,000
Night: 2,600
Armor Penetration (mm CE): 650-750, plus HE effects.

125-mm HEAT, BK-27
Maximum Aimed Range (m): 4,000
Max Effective Range (m):
Day: 3,000
Night: 2,600
Armor Penetration (mm CE): 700-800

Other Ammunition Types: Giat 125G1 APFSDS-T, Russian BM-42 and BM-32 APFSDS-T. Note: The Russians may have a version of the BM-42M with a DU penetrator.

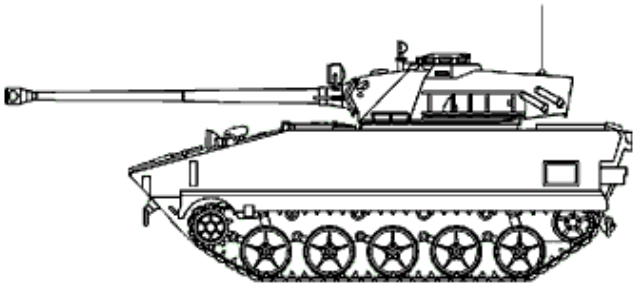
*The Sokol-1 guided antitank round uses semi-active laser-homing or IR-homing for a 0.1-5-km effective range. A laser target designator (LTD) can be added to the vehicle fire control system. The direct-fire round can be used without an LTD under some circumstances. The round is less expensive than ATGMs, and offers a fast response (1-5 sec) to defeat target vehicles before they can employ their weapons. With a HEAT warhead and 700 mm penetration, lethality is sufficient for a mobility or firepower kill against tanks and a catastrophic kill against other targets. In the Near Term, three (est) will replace APFSDS-T rounds in the onboard load.

Antitank Guided Missiles:
Name: AT-11C/Invar-M
Warhead Type: Tandem Shaped charge (HEAT)
Armor Penetration (mm CE): 900/ 850 behind ERA
Range (m): 100-7,000

NOTES
Hydro-pneumatic suspension is used to vary height immediately, lowering profile to reduce signature, improve cross-country mobility, reduce swimming profile, and increase stability during firing. Since the vehicle can also fit aboard aircraft, a lowered profile facilitates loading.
The below photo shows an early design 2S25 swimming. The new design offers a higher front bow, for more bow clearance.

Available options are improved ammunition and FCS, spall liners, air conditioning, and a more powerful engine. These could include stabilized fire control similar to that on T-90A, with autoloader and improved thermal night sight. Improved FCS could permit use of the Ainet HE-Shrapnel Focused Fragmentation round. For airborne and amphibious forces, the round would supplement the limited air defense capabilities.

French Fire Support Vehicle AMX-10 PAC 90



Weapons & Ammunition Types	Typical Combat Load
90-mm rifled gun	**50**
APFSDS	15
HEAT	15
HE/HE-ER	15
Canister	5
7.62-mm coax MG	**3,200**
12.7-mm AA MG	**500**

SYSTEM
Alternative Designations: AMX-10PAC90 Marines (Indonesia)
Date of Introduction: Early 1980s
Proliferation: At least 3 countries
Description:
Crew: 3
Platform: AMX-10P hull with TS-90 turret
Combat Weight (mt): 16.5 est
Chassis Length Overall (m): 5.9
Height Overall (m): INA
Width Overall (m): 2.78
Ground Pressure (kg/cm^2): 0.60

Automotive Performance:
Engine Type: 300-hp Diesel
Cruising Range (km): 600
Speed (km/h):
- Max Road: 65
- Max Off-Road: INA
- Average Cross-Country: INA
- Max Swim: 7

Fording Depth (m): Amphibious

Radio: INA

Protection:
Armor, Turret Front (mm): 12.7-mm frontal
Applique Armor (mm): No
Explosive Reactive Armor (mm): No
Active Protective System: No
Mineclearing Equipment: No
Self-Entrenching Blade: No
NBC Protection System: Collective, optional
Smoke Equipment: 4 smoke grenade launchers

ARMAMENT
Main Armaments:
Caliber, Type, Name: 90-mm rifled gun CN-90-F4 Super 90
Rate of Fire (rd/min): INA
Loader Type: Autoloader and manual est
Ready/Stowed Rounds: 20/30
Elevation (°): -8 to +15
Fire on Move: No

Auxiliary Weapon:
Caliber, Type, Name: 7.62-mm (7.62 x 51) MG, AAT 52 NF1
Mount Type: Turret coax
Maximum Aimed Range (m): 1,000+
Max Effective Range (m):
- Day: 800
- Night: 800

Fire on Move: Yes
Rate of Fire (rd/min): 700

Caliber, Type, Name: .50-cal (12.7 x 99), heavy MG, M2HB
Mount Type: Turret cupola mount
Maximum Aimed Range (m): 2,000
Max Effective Range (m):
- Day: 1,000 Ball/2,000 SLAP (sabot)
- Night: 1000/1,650

Fire on Move: Yes
Rate of Fire (rd/min): 450-550 cyclic, in 5-10 rd bursts

FIRE CONTROL
FCS Name: Soptac computer-based fire control system upgrade
Main Gun Stabilization: None
Rangefinder: Laser in FCS
Infrared Searchlight: Yes
Sights w/Magnification:
Gunner: Soptac Day/night
- Day: Telescopic sight
  - Field of View (°): INA
  - Acquisition Range (m): 3,000
- Night: II night channel
  - Field of View (°): INA
  - Acquisition Range (m): 1,500-2,000

Commander Fire Main Gun: No

VARIANTS: None

MAIN ARMAMENT AMMUNITION
Caliber, Type, Name:
90-mm APFSDS
- Maximum Aimed Range (m): 2,000
- Max Effective Range (m):
  - Day: 2,000
  - Night: 1,650
- Armor penetration (mm KE): INA

90-mm HEAT
- Maximum Aimed Range (m): 2,000
- Max Effective Range (m):
  - Day: 1,100
  - Night: 1,100
- Armor Penetration (mm CE): 160 (RHA) at 60° impact angle

90-mm HE-ER
- Maximum Aimed Range (m): 3,000
- Max Effective Range (m):
  - Day: 925
  - Night: 925
- Armor Penetration (mm): Can defeat most IFVs on impact

Other Ammunition Types: Canister, HE, Smoke (WP)

NOTES
Original system lacks 12.7-mm AA MG. Original FCS is M563 telescopic sight. French Thompson Canasta FCS with LLLTV is available.

French Armored Reconnaissance Vehicle AMX-10RC

National War College Photo

Weapons & Ammunition Types	Typical Combat Load
105-mm rifled gun	**38**
APFSDS-T	(est) 10
HEAT-T	9
HE-T	19
7.62-mm coax MG	**4,000**

SYSTEM
Alternative Designations: INA
Date of Introduction: 1979
Proliferation: At least 3 countries
Description:
Crew: 4
Troop Capacity: None
Combat Weight (mt): 15.8
Chassis Length Overall (m): 6.35
Height Overall (m): 2.29
Width Overall (m): 2.95
Drive Formula: 6 x 6

Automotive Performance:
Engine Type: 260-hp Diesel
Cruising Range (km): 1,000
Speed (km/h):
Max Road: 85
Max Off-Road: INA
Average Cross-Country: INA
Max Swim (km/h): 4.5/7.2 with 2 hydrojets
Fording Depth (m): INA

Radio: INA

Protection:
Armor, Turret Front (mm): INA
Applique Armor (mm): Available, Desert Storm version
Explosive Reactive Armor (mm): N/A Active Protective System:
KCBM ATGM IRCM decoy device
Mineclearing Equipment: N/A
Self-Entrenching Blade: N/A
NBC Protection System: Yes
Smoke Equipment: 2x2 smoke grenade launchers (16 grenades)

ARMAMENT
Main Armament:
Caliber, Type, Name: 105-mm (48 Cal) rifled gun, CN-105-F2
Rate of Fire (rd/min): INA
Loader Type: Manual
Ready/Stowed Rounds: 12/26
Elevation (°): -8 to +20
Fire on Move: No

Auxiliary Weapons:
Caliber, Type, Name: 7.62-mm MG, INA
Mount Type: Coax
Maximum Aimed Range (m): 2,000
Max Effective Range (m):
Day: INA
Night: INA
Fire on Move: Yes
Rate of Fire (rd/min): INA
ATGM Launcher: N/A
Firing Ports: N/A

FIRE CONTROL
FCS Name: COTAC M401
Main Gun Stabilization: No
Rangefinder: Cilas APX M550 laser
Infrared Searchlight: No
Sights w/Magnification:
Gunner:
Day: APX M504-04, 10x
Field of View (°): INA
Acquisition Range (m): INA
Night: DIVT 13 LLLTV
Field of View (°): INA
Acquisition Range (m): INA
Commander Fire Main Gun: No

VARIANTS
Desert Storm version: Vehicles have applique armor, an ATGM IRCM decoy device, and a DIVT 16 thermal sight, range 4,000 m.

MAIN ARMAMENT AMMUNITION
Caliber, Type, Name:
105-mm APFSDS-T, OFL 105 Mle F3, Giat
Maximum Aimed Range (m): 2,000
Max Effective Range (m):
Day: 1,500
Night: INA
Armor Penetration (mm KE): Single heavy tank target at 1,000 m

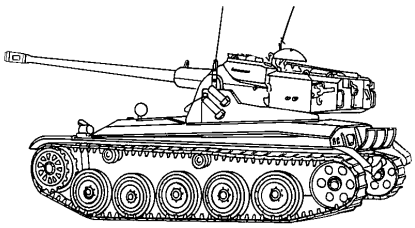
105-mm HEAT-T, OCC 105 F3, French Giat
Maximum Aimed Range (m): 1,300
Max Effective Range (m):
Day: 1,250
Night: INA
Armor Penetration (mm CE): 100 at 70°

105-mm HE, OE 105 Mle F3
Maximum Aimed Range (m): 2,500
Max Effective Range (m):
Day: 1,000
Night: INA
Armor Penetration (mm): Due to combined HE and fragmentation effects, this round can defeat an IFV or APC on impact. A near miss would damage those vehicles.

Other Ammunition Types: Smoke

NOTES
The Alis modular thermal sight can be used on AMX-10RC. A 280-hp Baudouin engine replaced the original engine in some upgrades. In 1997 the French army demonstrated a version of the Leclerc Battlefield Management System on the AMX-10RC.

French Light Tank AMX-13



AMX-13 Model 51/75 mm Gun

Weapons & Ammunition Types	Typical Combat Load
90-mm rifled gun	
APFSDS-T	**34**
HEAT	
HE	
Canister	
7.62-mm coax MG	**3,600**

SYSTEM
Alternative Designations: AMX-13/90
Date of Introduction: 1966
Proliferation: At least 15 countries
Description:
Crew: 3
Combat Weight (mt): 15.0
Chassis Length Overall (m): 4.88
Height Overall (m): 2.28
Width Overall (m): 2.51
Ground Pressure (kg/cm^2): 0.74

Automotive Performance:
Engine Type: 250-hp Gasoline
Cruising Range (km): 350
Speed (km/h):
Max Road: 60
Max Off-Road: INA
Average Cross-Country: INA
Max Swim: N/A
Fording Depths (m): 0.6 unprepared, 2.1 with snorkel

Radio: TR-VP118 and intercom

Protection:
Armor, Turret Front (mm): 25 at 45° impact angle
Applique Armor (mm): N/A
Explosive Reactive Armor (mm): N/A
Active Protective System: N/A
Mineclearing Equipment: N/A
Self-Entrenching Blade: N/A
NBC Protection System: N/A
Smoke Equipment: 2 smoke grenade launchers each side of turret

ARMAMENT
Main Armaments:
Caliber, Type, Name: 90-mm rifled gun CN-90-F3
Rate of Fire (rd/min): INA
Loader Type: Autoloader and manual
Ready/Stowed Rounds: 10 in autoloader, 11/13 in hull
Elevation (°): -5.5/+12.5
Fire on Move: N/A

Auxiliary Weapon:
Caliber, Type, Name: 7.62-mm (7.62x51) MG, AA52
Mount Type: Turret coax
Maximum Aimed Range (m): INA
Max Effective Range (m):
Day: INA
Night: INA
Fire on Move: Yes
Rate of Fire (rd/min): INA

FIRE CONTROL
FCS Name: INA
Main Gun Stabilization: N/A
Rangefinder: N/A
Infrared Searchlight: Yes
Sights w/Magnification:
Gunner:
Day: L862, 7.5x and 8x
Field of View (°): INA
Acquisition Range (m): INA
Night: OB-11-A, 5x. EL-OP thermal sights available
Field of View (°): INA
Acquisition Range (m): 800-1,000
Commander Fire Main Gun: No

VARIANTS
AMX-13 Model 51: Original tank destroyer/recon vehicle, Model 51, w/75-mm gun. Many variants and upgrades have diesel engines and a 7.62-mm AA MG. Two versions were fitted with 2 x SS-11 or 3 x HOT ATGM launchers
AMX-13/90: This is the variant portrayed on this data sheet.
AMX-13/105: Variant with a GIAT 105G1 105-mm gun.
AMX-13 CD Model 55: Armored recovery variant.
AMX-13 DCA: Air defense variant with twin 30-mm guns.
AMX-13 with LAR: Multiple Rocket Launcher System.
AMX 105-mm Mk 61: Self-propelled howitzer variant.
AMX F3: 155-mm self-propelled gun.
AMX-VCI: Variant used as an APC.

MAIN ARMAMENT AMMUNITION
Caliber, Type, Name:
90-mm APFSDS, OFL 90 F1
Maximum Aimed Range (m): 2,000
Max Effective Range (m):
Day: 1,660
Night: 1,000
Armor Penetration (mm KE): NATO Triple target (10/25/60) at 60° and 1,500 m/120 at 60° and 2,000 m

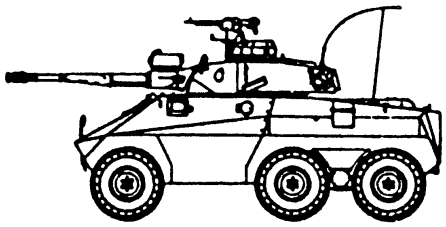
90-mm HEAT, NFI
Maximum Aimed Range (m): INA
Max Effective Range (m):
Day: 1,000
Night: 1,000
Armor Penetration (mm CE): 160 (RHA) at 60° impact angle 300-320 at 0°

90-mm HEAT, OCC 90-62
Maximum Aimed Range (m): 1,800
Max Effective Range (m):
Day: 1,000
Night: 1,000
Armor Penetration (mm CE): 120 (RHA) at 60°/320 at 0°

Other Ammunition Types: Canister, Smoke. Note: HE round can defeat most IFVs on impact

NOTES N/A

Brazilian Armored Reconnaissance Vehicle EE-9



Weapons & Ammunition Types	Typical Combat Load
90-mm cannon	**44**
APFSDS-T	(est) 11
HEAT-T, HESH	11
HE-T	22
7.62-mm coax MG	**2,000**
.50 cal AA MG	**500**

SYSTEM
Alternative Designations: Cascavel IV
Date of Introduction: 1977
Proliferation: At least 18 countries (all variants)
Description:
Crew: 3
Troop Capacity: None
Combat Weight (mt): 13.4
Chassis Length Overall (m): 5.19
Height Overall (m): 2.36
Width Overall (m): 2.66
Drive Formula: 6 x 6

Automotive Performance:
Engine Type: 212-hp Diesel
Cruising Range (km): 880
Speed (km/h):
Max Road: 100
Max Off-Road: INA
Average Cross-Country: INA
Max Swim: N/A
Fording Depth (m): 1.0 unprepared

Radio: INA

Protection:
Armor, Turret Front (mm): 16
Applique Armor (mm): N/A
Explosive Reactive Armor (mm): N/A
Active Protective System: N/A
Mineclearing Equipment: N/A
Self-Entrenching Blade: N/A
NBC Protection System: N/A
Smoke Equipment: 6 smoke grenade launchers

ARMAMENT
Main Armament:
Caliber, Type, Name: 90-mm gun, Engesa EC-90 (Cockerill-type)
Rate of Fire (rd/min): INA
Loader Type: Manual
Ready/Stowed Rounds: 24/ 20
Elevation (°): -8/+15
Fire on Move: INA

Auxiliary Weapons:
Caliber, Type, Name: 7.62-mm MG, INA
Mount Type: Coax
Maximum Aimed Range (m): 2,000
Max Effective Range (m):
Day: INA
Night: INA
Fire on Move: Yes
Rate of Fire (rd/min): INA

Caliber, Type, Name: .50 Cal M2 HB MG
Mount Type: Cupola
Maximum Aimed Range (m): 2,000
Max Effective Range (m):
Day: 2,000
Night: INA
Fire on Move: Yes
Rate of Fire (rd/min): INA

ATGM Launcher: N/A
Firing Ports: N/A

FIRE CONTROL
FCS Name: INA
Main Gun Stabilization: N/A
Rangefinder: LV3 laser rangefinder
Infrared Searchlight: N/A
Sights w/Magnification:
Gunner:
Day: SS-123, 10x
Field of View (°): INA
Acquisition Range (m): INA
Night: SS-122 II channel, 5.6x
Field of View (°): INA
Acquisition Range (m): INA
Commander Fire Main Gun: No

VARIANTS
Cascavel I: Original vehicle had a US M36 37-mm gun turret.
Cascavel II: Variant with a French 90-mm gun from AML-90.
Cascavel III: Uses the 90-mmCockerill gun and new transmission.
Cascavel IV: Has a new engine and transmission, improved day and night optics with laser rangefinder, and .a 50 cal antiaircraft MG.

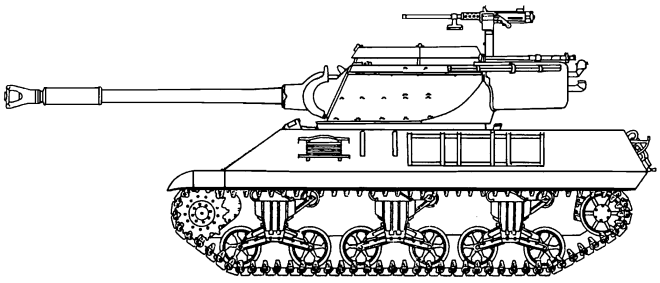
MAIN ARMAMENT AMMUNITION
Caliber, Type, Name:
90-mm APFSDS-T, Engequimica-produced
Maximum Aimed Range (m): INA
Max Effective Range (m):
Day: 2,000+
Night: 800-1,300
Armor Penetration (mm KE): INA

90-mm HE-T, Engequimica-produced
Maximum Aimed Range (m): INA
Max Effective Range (m):
Day: 2,200
Night: 800-1,300
Armor Penetration (mm): INA

Other Ammunition Types: HEAT-T, HESH-T, Smoke, Canister
Maximum effective ranges are (m): HEAT-T - 1,500, HESH-T - 800.

NOTES N/A

U.S. Self-Propelled Antitank Gun M36



M36B2

Weapons & Ammunition Types	Typical Combat Load
90-mm gun APFSDS-T, HVAP, HEAT-T or APC HE	**47**
12.7-mm bustle MG API, API-T, APDS-T	**1,000**

SYSTEM
Alternative Designations: INA
Date of Introduction: 1944
Proliferation: At least 5 countries
Description:
Crew: 5
Combat Weight (mt): 27.7/30.8 for M36B1/29.9 for M36B2
Chassis Length Overall (m): 5.98
Height Overall (m): 3.19
Width Overall (m): 3.05
Ground Pressure (kg/cm^2): 0.95/0.86 M36B2

Automotive Performance:
Engine Type: 500-hp Gasoline/375-hp Diesel for M36B2
Chassis: M-10 tank destroyer
Cruising Range (km): 177
Speed (km/h):
- Max Road: 42/40 M36B2
- Max Off-Road: INA
- Average Cross-Country: 29
- Max Swim: N/A

Fording Depth (m): 0.91/1.07 M36B2

Radio: INA

Protection:
Armor, Turret Front (mm): 76
Applique Armor (mm): N/A
Explosive Reactive Armor (mm): N/A
Active Protective System: N/A
Mineclearing Equipment: N/A
Self-Entrenching Blade: N/A
NBC Protection System: No
Smoke Equipment: No

ARMAMENT
Main Armament:
Caliber, Type, Name: 90-mm (50 Cal) rifled gun, M3
Rate of Fire (rd/min): 8 est
Loader Type: Manual
Ready/Stowed Rounds: INA
Elevation (°): -10 to +20
Fire on Move: No

Auxiliary Weapon:
Caliber, Type, Name: 12.7-mm machinegun, M2HB
Mount Type: Turret bustle
Maximum Aimed Range (m): 2,000
Max Effective Range (m):
- Day: 2,000
- Night: N/A

Fire on Move: Yes
Rate of Fire (rd/min): 550

ATGM Launcher: None

FIRE CONTROL
FCS Name: INA
Main Gun Stabilization: No
Rangefinder: No
Infrared Searchlight: No
Sights w/Magnification:
Gunner:
- Day: INA
- Night: No

Commander Fire Main Gun: No

VARIANTS
M36B1: Variant uses an M4A3/Sherman tank chassis.
M36B2: Variant uses an M10 chassis with plate canopy protection.

MAIN ARMAMENT AMMUNITION
Caliber, Type, Name:
90-mm HVAP, INA
- Maximum Aimed Range (m): INA
- Max Effective Range (m):
  - Day: 1,000
  - Night: N/A
- Armor Penetration (mm KE): 195 at 1,000 m

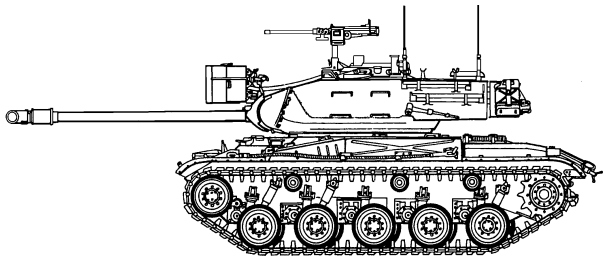
90-mm APFSDS-T, Mecar 90
- Maximum Aimed Range (m): 1,000-2,000
- Max Effective Range (m):
  - Day: 1,000+
  - Night: N/A
- Armor Penetration (mm KE): INA, can defeat APC/IFV

90-mm HEAT-T, Yugoslavian M74
- Maximum Aimed Range (m): INA
- Max Effective Range (m):
  - Day: 1,000
  - Night: N/A
- Armor Penetration (mm CE): 150 (30° impact) at 1,000 m

Other Ammunition Types: HE M71, APC-T M82. Note: HE round can defeat most IFVs on impact

NOTES
This type vehicle is historically referred to as a "tank destroyer". The above label is more modern. The baseline vehicle has an open-top turret.

US Light Tank M41A3



Weapons & Ammunition Types	Typical Combat Load
76-mm rifled gun M32	**65**
APDS-T/APFSDS-T	20
HEAT -T	20
Frag-HE	20
Canister	5
7.62-mm coax MG	**5,000**
12.7-mm AA MG	**2,175**

SYSTEM
Alternative Designations: Walker Tank, Walker Bulldog
Date of Introduction: 1951
Proliferation: At least 18 countries
Description:
Crew: 4
Combat Weight (mt): 23.5
Chassis Length Overall (m): 5.82
Height Overall (m): 2.73
Width Overall (m): 3.20
Ground Pressure (kg/cm^2): 0.72

Automotive Performance:
Engine Type: 500-hp Gasoline
Cruising Range (km): 161
Speed (km/h):
- Max Road: 72
- Max Off-Road: 48
- Average Cross-Country: 40
- Max Swim: N/A

Fording Depths (m): 1.0 Unprepared, 2.4 prepared

Radio: INA

Protection:
Armor, Turret Front (mm): 38
Applique Armor (mm): Available
Explosive Reactive Armor (mm): N/A
Active Protective System: N/A
Mineclearing Equipment: N/A
Self-Entrenching Blade: N/A
NBC Protection System: N/A
Smoke Equipment: N/A

ARMAMENT
Main Armament:
Caliber, Type, Name: 76-mm rifled gun M32
Rate of Fire (rd/min): INA
Loader Type: Manual
Ready/Stowed Rounds: INA
Elevation (°): -9.75/ +19.75
Fire on Move: No

Auxiliary Weapon:
Caliber, Type, Name: 7.62-mm (7.62x51) MG, M9194E1
Mount Type: Turret coax
Maximum Aimed Range (m):
Max Effective Range (m):
- Day: INA
- Night: N/A

Fire on Move: Yes
Rate of Fire: INA

Caliber, Type, Name: .50 (12.7 x 99) AA machinegun, M2HB
Mount Type: Cupola AA mount
Maximum Aimed Range (m): INA
Max Effective Range (m):
- Day: 2,000
- Night: INA

Fire on Move: Yes
Rate of Fire (rd/min): 450-550

FIRE CONTROL
FCS Name: INA
Main Gun Stabilization: N/A
Rangefinder: N/A
Infrared Searchlight: Available
Sights w/Magnification:
Gunner:
- Day: M97A1 and M20A1
  - Field of View (°): INA
  - Acquisition Range (m): INA
- Night: Available

Commander Fire Main Gun: No

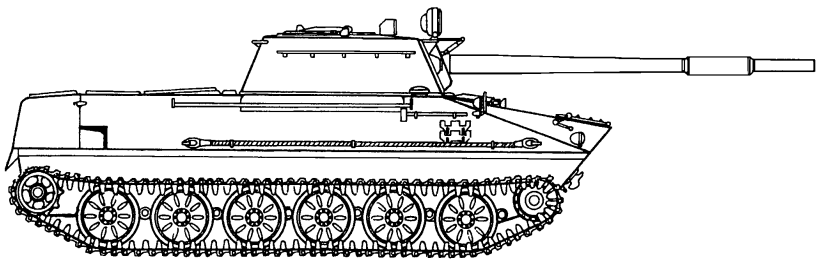
VARIANTS
M41 DK-1: Danish variant with diesel engine and LRF-based fire control. Other upgrades are side skirts, thermal sights, NBC protection, smoke grenade launchers and 7.62-mm AA MG.
Brazilian M41: Upgrades are similar to DK-1 except for AA MG and change to 90-mm gun using Cockerill Mk III ammunition.
Uruguayan M41: M41A3 fitted with Cockerill Mk III gun.
YUNG HU: Taiwanese upgrade with diesel engine.
M42/Duster: Air defense gun system with twin 40-mm AA cannon.

MAIN ARMAMENT AMMUNITION
Caliber, Type, Name:
76-mm APFSDS-T, AAI M464
- Maximum Aimed Range (m): INA
- Max Effective Range (m): INA
- Armor Penetration (mm KE): NATO triple heavy (57°), 1000 m

Other Ammunition Types: M33A1 and A2 APDS-T, M319 and M339 AP-T, M496 HEAT-T, HE, Smoke (WP), M363 canister.
Note: HE round can defeat most IFVs on impact

NOTES
German Atlas offers the MOLF 1-plane stabilized laser rangefinder fire control system and retrofit kit. The FCS includes a thermal night sight. Israeli EL-OP offers a FCS for the system. Maximum range for the canister round is 155 meters.

North Korean Light Tank M1985



Weapons & Ammunition Types	Typical Combat load
85-mm rifled gun	**47***
APC-T/HVAP-T	
HEAT-FS	
AP HE	
Frag-HE, HE	
ATGM Launcher	**4***
AT-3-type ATGM	
12.7-mm AAMG	**500***
7.62-mm coax MG	*(est) **1,000***

SYSTEM
Alternative Designations: Often called PT-85
Date of Introduction: 1985
Proliferation: At least 1 country
Description:
Crew: 3-4
Combat Weight (mt): 19.0
Chassis Length Overall (m): 7.0
Height Overall (m): 2.6
Width Overall (m): 3.2
Ground Pressure (kg/cm^2): INA

Automotive Performance:
Engine Type: 320-hp Diesel
Cruising Range (km): 500
Speed (km/h):
Max Road: 60
Max Off-Road: INA
Average Cross-Country: INA
Max Swim: 10
Fording Depths (m): Amphibious

Radio: INA
Protection:
Armor, Turret Front (mm): 30 (est.)
Applique Armor (mm): N/A
Explosive Reactive Armor (mm): N/A
Mineclearing Equipment: N/A
Self-Entrenching Blade: N/A
Active Protective System: No
NBC Protection System: INA
Smoke Equipment: INA

ARMAMENT
Main Armament: 85-mm rifled gun, resembles CH Type 62 and 63
Rate of Fire (rd/min): 8
Loader Type: Manual
Ready/Stowed Rounds: INA
Elevation (°): -5 to + 18
Fire on Move: No (est.)

Auxiliary Weapons:
Caliber, Type, Name: 12.7-mm (12.7 x 108), Type 54/DShKM
Mount Type: Cupola
Max Aimed Range (m): 2,000
Max Effective Range (m):
Day: 1,600 unarmored ground / 800 armored (est)
Night: INA
Tactical AA Range: 1,600 (est.)
Armor Penetration (mm): 21 at 500 m, 13 at 1,000 m

Caliber, Type, Name: 7.62-mm Machine gun PKT
Mount Type: Turret coax
Max Effective Range (m):
Day: 1,000 (400-500 on the move)
Night: 800
Fire on Move: Yes
Rate of Fire (rd/min):
Practical: 250
Cyclic: 650, in 2-10 round bursts

ATGM Launcher:
Name: Similar to 9P111
Launch Method: Rail-launched
Guidance: MCLOS
Command Link: Wire
Rate of launch (missiles/min): 2
Launcher Dismountable: Yes

FIRE CONTROL
FCS Name: INA
Main Gun Stabilization: None
Rangefinder: None
Infrared Searchlight: Yes
Sights w/Magnification:
Gunner:
Day: INA
Field of View (°): INA
Acquisition Range (m): 1,500-3,000 (est)
Night: IR, INA
Field of View (°): INA
Acquisition Range (m): 800 (est.)

Commander Fire Main Gun: INA

VARIANTS: N/A
The M1985 chassis is derived from the North Korean VTT-323, and is similar to the Russian PT-76 amphibious tank. The turret on the M1985 is an indigenous design.

MAIN ARMAMENT AMMUNITION
Caliber, Type, Name: 85-mm HVAP-T, BR-365PK
Max Aimed Range (m): 1,500 (est)
Max Effective Range (m):
Day: 1,150 (direct fire range)
Night: 800
Armor Penetration (mm KE): 130 (0°) at 1,000 m

North Korean Light Tank M1985 continued

Caliber, Type, Name: 85-mm APC-T, Type 367
Max Aimed Range (m): 1,500 (est)
Max Effective Range (m):
Day: 1,150 (est)
Night: 800
Armor Penetration (mm KE): 120 (0°) at 1,000 m

Caliber, Type, Name: 85-mm HEAT-FS (variant of BK-2M)
Max Aimed Range (m): 1,500 (est)
Max Effective Range (m):
Day: 1,500/970 direct fire range
Night: 800
Armor Penetration (mm CE): 100 at 65°, 300-400 at 0° all ranges

Caliber, Type, Name: 85-mm, AP HE,
Max Aimed Range (m): 2,000-3,000 (est.)
Max Effective Range (m):
Day: 1,500/950 direct-fire range
Night: 800
Armor Penetration (mm KE): 102 (0°) at 1,000 m

Caliber, Type, Name: 85-mm Frag-HE, INA (Copy of O-365K)
Max Aimed Range (m): 4,000 (est)
Max Effective Range (m):
Day: 1,500 (est)
Night: 800
Armor Penetration (mm): Can defeat most IFVs on impact

Other Ammunition Types: Chinese Smoke, AP HE. Russian BR-365P HVAP-T, BK-2M HEAT-FS

Antitank Guided Missiles:
Name: AT-3, -3A, -B
Warhead Type: Tandem HEAT
Armor Penetration (mm CE): 410 RHA
Range (m): 3,000

Name: AT-3C
Warhead Type: Tandem HEAT
Armor Penetration (mm CE): 520 RHA
Range (m): 3,000

Name: AT-3C Imp/ Polk (Slovenian)
Warhead Type: Precursor with HEAT
Armor Penetration (mm CE): 580 RHA
Range (m): 3,000

Name: Red Arrow-73A (Chinese)
Warhead Type: HEAT
Armor Penetration (mm CE): 500 RHA
Range (m): 3,000

Name: Red Arrow-73B/C (Chinese)
Warhead Type: HEAT
Armor Penetration (mm CE): 600 RHA
Range (m): 3,000

Name: Malyutka-2
Warhead Type: Tandem HEAT
Armor Penetration (mm CE): 800 RHA
Range (m): 3,000

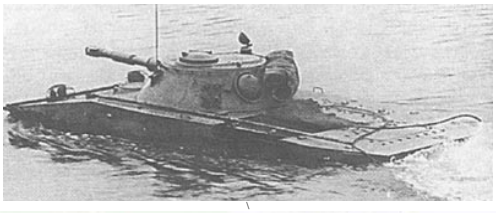
Name: Malyutka-2 HE
Warhead Type: Frag-HE
Armor Penetration (mm CE): N/A
Range (m): 3,000

NOTES
Chassis is derived from North Korean stretched VTT-323 APC chassis.

Main gun is of the family which includes Chinese Type 62 and 63 tank guns, Chinese Type 56/ FSU D-44 field guns, and the T-34/85 tank. Therefore, ammunition options include the variety of ammunition available for these guns.

The AT-3 type ATGM can be upgraded by an operator with a new warhead in minutes. Low-mid level maintenance can upgrade the missile motor. The HE-Blast ATGM is used for killing personnel and destroying bunkers and other fortifications.

Russian Amphibious Tank PT-76B



National War College Photo

Weapons & Ammunition Types	Typical Combat Load
76-mm rifled gun D-56	**40**
HVAP, AP-T/API-T	10
HEAT	10
Frag-HE	20
7.62-mm coax MG	1,**000**

SYSTEM
Alternative Designations: INA
Date of Introduction: 1952
Proliferation: At least 21 countries
Description:
Crew: 3
Combat Weight (mt): 14.0
Chassis Length Overall (m): 6.91
Height Overall (m): 2.26
Width Overall (m): 3.14
Ground Pressure (kg/cm^2): 0.46

Automotive Performance:
Engine Type: 240-hp Diesel
Cruising Range (km): 260
Speed (km/h):
Max Road: 44
Max Off-Road: INA
Average Cross-Country: 25
Max Swim: 10
Fording Depth (m): Amphibious

Radio: R-123
Protection:
Armor, Turret Front (mm): 20
Mineclearing equipment, self-entrenching blade, and NBC Protection System: N/A
Smoke Equipment: VEESS

ARMAMENT
Main Armament:
Caliber, Type, Name: 76-mm rifled gun D-56B
Rate of Fire (rd/min): 6-8
Loader Type: Manual
Ready/Stowed Rounds: INA
Elevation (°): -4/+30
Fire on Move: Yes

Auxiliary Weapon:
Caliber, Type, Name: 7.62-mm (7.62x54R) machinegun PKT
Mount Type: Coax
Maximum Aimed Range (m): 1,500
Max Effective Range (m):
Day: 1,000/400-500 on the move
Night: 600
Fire on Move: Yes
Rate of Fire (rd/min): 250 practical / 650 cyclic, 2-10 round bursts

FIRE CONTROL
Main Gun Stabilization: 2-plane **Rangefinder:** N/A
Infrared Searchlight: Available
Sights w/Magnification:
Gunner:
Day: TShK-66
Acquisition Range (m): 4,000
Night: TVN-28 IR Available
Acquisition Range (m): 600
Commander Fire Main Gun: No

VARIANTS
The chassis was derived from the BTR-50 APC chassis.
M1985: North Korean variant light tank.
Polish PT-76: Variant with a commander's hatch and 12.7-mm MG.
Type 63: Chinese variant with a new turret, 85-mm gun, and 12.7-mm AA MG.

PT-76E: Recent upgrade program features a stabilized version of the 57-mm S-60 automatic AA gun (70 rds/min), with computer fire control system and a thermal sight. Other features are a more powerful engine and improved tracks.

MAIN ARMAMENT AMMUNITION
Caliber, Type, Name:
76-mm HVAP-T, BM-354P
Maximum Aimed Range (m): 1,060
Max Effective Range (m):
Day: 650
Night: 600
Armor Penetration (mm KE): 127 at muzzle, 50 at 1,000 m

76-mm HEAT, BK-350M
Maximum Aimed Range (m): 1,000
Max Effective Range (m):
Day: 650
Night: 600
Armor Penetration (mm CE): 280 to max range

76-mm, Frag-HE, OF-350
Maximum Aimed Range (m): 4,000
Max Effective Range (m):
Day: INA
Night: 600
Armor Penetration (mm): Can defeat most IFVs on impact

Other Ammunition Types: 76-mm APC-T, BR-350 API-T

NOTES
Original PT-76 was produced in limited numbers with a non-stabilized main gun. Some PT-76s are augmented with 12.7-mm AA MGs. Israel offers an upgrade package with a 90-mm gun, LRF fire control and a 300-hp engine. API round can defeat all LAVs, and most HACVs.

British Combat Reconnaissance Vehicle, Tracked Scorpion_____

National War College Photo

Weapons & Ammunition Types	Typical Combat Load
76-mm rifled gun	**40**
HESH	
HE	
Canister	
7.62-mm coax MG	**3,600**

SYSTEM
Alternative Designations: FV101
Date of Introduction: 1972
Proliferation: At least 18 countries
Description:
Crew: 3
Combat Weight (mt): 8.07
Chassis Length Overall (m): 4.79
Height Overall (m): 2.10
Width Overall (m): 2.24
Ground Pressure (kg/cm^2): 0.36

Automotive Performance:
Engine Type: 190-hp Gasoline
Cruising Range (km): 650
Speed (km/h):
- Max Road: 80
- Max Off-Road: INA
- Average Cross-Country: INA
- Max Swim: 4/6 with propeller

Fording Depth (m): 1.07, amphibious

Radio: INA

Protection:
Armor, Turret Front (mm): Against 14.5-mm projectiles
Applique Armor (mm): N/A
Explosive Reactive Armor (mm): N/A
Active Protective System: N/A
Mineclearing Equipment: N/A
Self-Entrenching Blade: N/A
NBC Protection System: Yes
Smoke Equipment: 4 smoke grenade launchers each side of turret

ARMAMENT
Main Armament:
Caliber, Type, Name: 76-mm rifled gun L23A1
Rate of Fire (rd/min): 6
Loader Type: INA
Ready/Stowed Rounds: INA
Elevation (°): -10/ +35
Fire on Move: N/A

Auxiliary Weapon:
Caliber, Type, Name: 7.62-mm (7.62x51) MG, L8A1
Mount Type: Turret coax
Maximum Aimed Range (m): INA
Max Effective Range (m): INA
Fire on Move: Yes
Rate of Fire (rd/min): INA

FIRE CONTROL
FCS Name: INA
Main Gun Stabilization: N/A
Rangefinder: Laser rangefinder
Infrared Searchlight: Yes
Sights w/Magnification:
Gunner:
- Day: Barr and Stroud Tank Laser Sight, 10x
  - Field of View (°): INA
  - Acquisition Range (m): 2,200
- Night: GEC Sensors SS100, II, x5.8/1.6
  - Field of View (°): 8/28
  - Acquisition Range (m): INA

Commander Fire Main Gun: No

VARIANTS
Scorpion 90: Variant with a 90-mm Cockerill Mk III gun.

A number of vehicles use the same Alvis chassis. They include the **Scimitar** armored reconnaissance vehicle, **Striker** armored ATGM launcher vehicle, **Spartan** armored personnel carrier or Milan ATGM launcher, **Stormer** modernized APC, **Samaritan** armored ambulance, and **Saber** modernized reconnaissance vehicle.

MAIN ARMAMENT AMMUNITION
Caliber, Type, Name:
76-mm HESH, L29
- Maximum Aimed Range (m): 2,200
- Max Effective Range (m): INA
- Armor Penetration (mm): INA

Other Ammunition Types: L24A1/2 HE (max effective range--indirect fire: 5,000 meters), L33A1 Canister (max effective range: 100 meters), L32A5 Smoke (BE), L42 Illumination. Note: HE round can defeat most IFVs on impact

NOTES
As a reflection of the vehicle's suitability for a variety of roles, in recent times it is referred to as an armored reconnaissance vehicle or combat vehicle reconnaissance (tracked)--CVR (T).

A British upgrade program includes a diesel engine, thermal sights, and secure communications. The Tank Laser Sight and Avimo LV10 Day/Night LRF sight can accept a thermal channel. Thermal sights are available for use on the tank.

Chinese Amphibious Light Tank Type 63A Modernized

Weapons & Ammunition Types	Typical Combat Load
105-mm rifled gun	**57**
New CH APFSDS-T	20
M456 HEAT	4
L35 HESH	27
AT-10/Imp ATGM	6
7.62-mm coax MG	**2,000**
12.7-mm AA MG	**500**

SYSTEM
Alternative Designations: Type 99, Type ZTS 63A
Date of Introduction: 1999
Proliferation: At least 1 country
Description:
Crew: 3
Combat Weight (mt): INA
Chassis Length Overall (m): 8.15
Height Overall (m): INA
Width Overall (m): 3.20
Ground Pressure (kg/cm^2): INA

Automotive Performance:
Engine Type: 580-hp Diesel, or 1,000-hp engine upgrade due on upgrade version
Cruising Range (km): 370
Speed (km/h):
Max Road: 64
Max Off-Road: 28
Average Cross-Country: 28
Max Swim: 7, can swim in 1.3-m waves with wave board
Fording Depth (m): Amphibious

Radio: A-220A

Protection:
Armor, Turret Front (mm): Against 35-mm AP round at 300 m
Applique Armor (mm): Added armor defeats 35-mm at 0 m
Explosive Reactive Armor (mm): Available - degrades swim ability
Active Protective System: N/A
Mineclearing Equipment: N/A
Self-Entrenching Blade: N/A
NBC Protection System: Probable
Smoke Equipment: 8 x smoke grenade launchers

ARMAMENT
Main Armaments:
Caliber, Type, Name: 105-mm rifled gun, similar to German design
Rate of Fire (rd/min): 8
Loader Type: Manual
Ready/Stowed Rounds: INA
Elevation (°): -4 to +22
Fire on Move: Probable

Auxiliary Weapon:
Caliber, Type, Name: 7.62-mm (7.62x 54R) Machine gun
Mount Type: Turret coax
Maximum Aimed Range (m): 2,000
Max Effective Range (m):
Day: 1,000
Night: 800
Fire on Move: Yes
Rate of Fire (rd/min): 250 practical, 600 cyclic in 2-10 round bursts

Caliber, Type, Name: 12.7-mm (12.7x108) W 85
Mount Type: Turret cupola
Maximum Aimed Range (m): 2.000
Max Effective Range (m):
Day: 1,500 ground/1,600 for air targets (APDS)
Night: N/A, II sights available
Fire on Move: Yes
Rate of Fire (rd/min): 80-100 practical, 600 air targets 2-10 rd bursts

ATGM Launcher:
Name: 105-mm main gun
Launch Method: Gun-launched
Guidance: SACLOS, laser-beam rider
Command Link: Encoded infrared laser-beam
Rate of launch (missiles/min): 2-3, depending on range
Launcher Dismountable: No

FIRE CONTROL
FCS Name: INA
Main Gun Stabilization: Probable
Rangefinder: LRF
Infrared Searchlight: Yes
Sights w/Magnification: For upgrade version
Gunner: Modern stabilized sights with ballistic computer
Day: INA
Field of View (°): INA
Acquisition Range (m): 5,500
Night: Thermal night sight in upgraded system
Field of View (°): INA
Acquisition Range (m): 5,000, 4,000 ATGM
Commander Fire Main Gun: No

VARIANTS:
Type 63: Original amphibious tank with 85-mm gun.

National War College Photo

The **Type 63A Modernized** tank is lengthened with boat-shaped hull for improved swim effects, improved lethality and protection, and a welded turret.

Chinese Amphibious Light Tank Type 63A Modernized continued

Type 63A Modernized Upgrade version: Since first fielding, Norinco has added missile-firing capability. It also has a 1,000-hp engine available for use.

MAIN ARMAMENT AMMUNITION
Caliber, Type, Name:
105-mm New CH (Chinese) APFSDS-T
Maximum Aimed Range (m): 3,000
Max Effective Range (m):
Day: 3,000 (est)
Night: 3,000
Armor Penetration (mm KE): 460 at 2,000 m

105-mm APFSDS, H6/62
Maximum Aimed Range (m): 3,000
Max Effective Range (m):
Day: 3,000 (est)
Night: 3,000
Armor Penetration (mm KE): INA

105-mm HESH, L35 (UK)
Maximum Aimed Range (m): 5,000
Max Effective Range (m):
Day: 3,000 (est)
Night: 3,000
Armor Penetration (mm): NATO single heavy target. Due to combined HE and fragmentation effects, this round can defeat an IFV or APC on impact. A near miss would damage those vehicles.

105-mm HEAT, M456 (multinational)
Maximum Aimed Range (m): 3,000
Max Effective Range (m):
Day: 3,000 (est)
Night: 3,000
Armor Penetration (mm CE): 432, NATO single heavy target
Other Ammunition Types: Chinese Type 83/ UK L64/ US M735 APFSDS, UK L52 APDS, multinational M393 HEP-T, French OE 105-F1 HE, L39 Smoke, canister

Antitank Guided Missile
Name: Arkan/AT-10B
Warhead Type: Tandem shaped charge
Armor Penetration (mm CE): 750 (RHA)/ 700 behind ERA
Range (m): 5,500, 4,000 night
Launcher Dismountable: No

NOTES
Next upgrade mentioned in articles is addition of a "35 mm shell launcher" (probably a QLZ-87 35-mm automatic grenade launcher similar to a W-87).

China has a more recent amphibious light tank known as **ZBD2000**. It shares the more modern and more sea-worthy chassis of the Type 90 APC and an IFV variant. Expected ship launch distance is 10 km from shore. With two powerful water jets and large bow and stern flaps, the vehicle can plane across water at a speed of 47 km/h. The 105 guns are like those of Type 63A, with and capability to launch ATGMs while afloat. The vehicle also has GPS navigation.

Gun-launched Antitank Guided Missiles and Guided Antitank Rounds

A critical element of modern warfare is the use of "high-precision weapons" to extend the lethal range of ground forces. Maneuver forces can add gun-launched missiles to tanks, IFVs, HACVs, and antitank (AT) guns to increase accuracy and range. These missiles offer a higher missile speed than most other ATGMs for intercepting moving targets, and out-flying enemy missiles during combat. Thus they can engage a wider range of targets (such as fast-moving helicopters or vehicles) at longer ranges in the modern operational environment.

A gun-launched ATGM must be matched to a stub case with an eject charge, which expels the missile from the gun. For the more common laser beam-riding ATGMs, another requirement is a laser guidance unit/designator in its sight. Application to antitank (AT) guns is even simpler and more cost-effective, with a tripod-mounted laser guidance unit. For semi-active laser homing ATGMs, a laser designator is not required on the vehicle, as long as one is coordinated with the gun to start designating, and is within designation range of the target.

There are attractive advantages to the ATGM upgrade. Few countries are producing or buying significant numbers of modern tanks. Many, however, are upgrading current inventories to approach the lethality (including range, rate of fire, precision, and penetration) of newer tanks. Gun-launched ATGMs provide an easy upgrade for older tanks with addition of the missile and its related FCS. Applications are available for tanks, assault guns, infantry fighting vehicles, and AT guns in any known gun caliber of 100-125 mm. Current estimate is that 10-20% of 140,000 potential OPFOR tanks (about 21,000) are missile-capable. Nearly all operational Russian-made tanks, and close to 1,000 BMP-3 IFVs are either equipped with or can be retrofitted with gun-launched ATGMs.

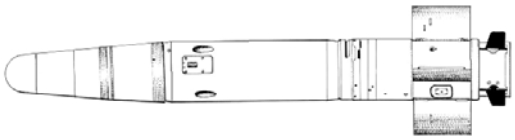
With upgrade kits available for low-level depot conversion, the task of distinguishing missile-capable vehicles is much more difficult. The most common upgrade uses a 1K13 sight, which replaces the vehicle night sight. Other more capable laser projectors and fire controls are available. Because laser guidance units for AT guns are man-portable units, which can be concealed and easily transported, the number of ATGM-launch AT guns cannot be determined.

There are benefits and downsides to this technology. The cost of upgrading a tank to launch six missiles will run $120,000-$300,000 (subject to varying negotiable costs). Many modern canister-launch ATGMs currently enjoy a lethality overmatch against certain aspects of even the heaviest tanks. Because gun-launched ATGMs offer penetration inferior to some ATGMs, they may be overlooked in the budget-constrained military markets of today. NOTE: The lethality is limited by gun caliber, which can be expanded using a different attack trajectory (i.e., dive- or top-attack.) As with other ATGMs, range advantage may be of limited utility in selected battlefield environments, such as many cluttered, forested, or uneven terrains of Europe and Asia. However, for many applications in the battlefield environment, such as in urban combat, a gunner can use the increased precision for applications, such as placing the round through the top-left pane of the third window on the right of that fourth floor apartment. Units lacking employment discipline could quickly expend their missile allocation and find themselves out-ranged by enemy guns. For many environments, however, such as in European terrain, limited numbers of missiles could be used to control line-of-sight in open areas. Once the enemy approaches within his effective range, flight time (versus KE round) and the limited penetration

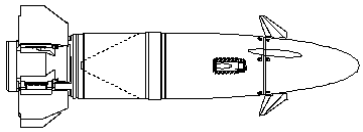
of a bore diameter HEAT warhead can place the firer at risk. Night use and fire-on-the move limitations can reduce opportunities for use of most gun-launched ATGMs.

Ground forces may employ moderate use by balancing selective gun-launched ATGM upgrades with acquisition of newer more conventional ATGMs. Countries with limited budgets might select high-priority units for the gun-launched ATGMs. Others can designate special-assigned maneuver units for use with the upgrade. Another selective approach would be to configure units with one vehicle per platoon equipped for employing gun-launch ATGMs. Another critical consideration is missile availability. Under shifting wartime conditions, a force may not be able to shift missile-launch units, missiles and laser units to support the main effort.

The first successful gun-launched ATGM application was the 125-mm Kobra (aka AT-8/ SONGSTER) radio frequency (RF) guided ATGM, fired from the T-64B Russian tank. Later, Kobra was adopted for the widely fielded T-80B tank, and is still used today.



Kobra

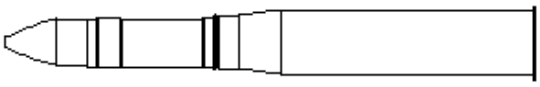


Svir

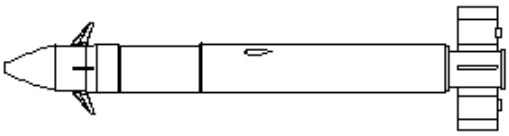
The Russian SVIR (AT-11/SNIPER), for the T-72B tank and other applications has a configuration which permits it to be handled by the autoloader like conventional separate-loading ammunition, with the missile loaded in the first stroke, and a second stroke for the stub case. SVIR uses laser beam-rider (LBR) guidance, which means that the gunner must use the 1K13 sight rather than the day sight. On the earlier tanks, launcher design limited range to 4 km. But by simply switching out the laser timer for one with longer radiation time, most launchers can extend missile range to 5-6 km. It is likely that this simple modification has been made. The T-80U and later tanks use Refleks fire control system, in which the laser guidance unit is in the day sight versus night sight. With this sight the missile is called Refleks, and has a range of 5,000 m.

Russian makers updated the missiles with a tandem warhead version, INVAR. A new Ukrainian ATGM, Kombat, is an indigenous design missile produced for use with their T-84 tanks, and for tanks with compatible FCS.

The Russian BASTION or AT-10 missile family fits a variety of 100-115 mm guns. It is a single-piece round combining missile and eject charge configured similarly to a unitary round. Designed to fit different chamber configurations and bore diameters, different launcher application have different missile configurations and corresponding missile names. As noted for tanks, timer switch-out permits the launchers noted below to extend range missile to 5-6 km.



Bastion Round Configuration



Bastion Flight Configuration

Past and Current Gun-launched ATGMs

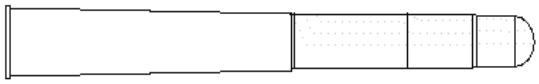
Designator/Name (Producer Country)	Number Users/ Status	Bore (mm)	Launcher Platform (Tank unless noted)	Range (km)	Shift to Gun Rd (km)*	Type Warhead /Penetration (mm CE)**	Guidance/ P-Hit (%)
US Shillelagh (Obsolete)	At least 1	152	M60A2 M551 recon vehicle	3	1-1.5	HEAT 500/0	SACLOS Wire/<80
Russian AT-8/Kobra	At least 2	125	T-64B T-80B	4	2-2.5	HEAT 700/200	SACLOS RF/80
Russian AT-10 series						HEAT	
Bastion	At least 4	100	T-55AM, T-55AM2V	4	.5-2.5	650/150	LBR/80-90
Sheksna		115	T-62D, T-62M	4	.5-2.5	750/250	80-90
Basnya		100	BMP-3 IFV	4	.5	650/150	80 on move 90 stopped
Kastet		100	MT-12, MT-12R	5	.5-2.5	650/150	90
Russian AT-10B series					.	Tandem HEAT	LBR/90
Bastion-M	At least 1	100	T-55AM	6	.5-2.5	750/700	90
Kan	At least 1	100	MT-12, MT-12R	5.5	.5-2.5	750/700	90
9M117M2	At least 1	115	T-62D, T-62M	6	.5-2.5	800/750	90
Arkan	At least 1	100	BMP-3 IFV, etc	5.5	.5	750/700	80, 90 stopped
Russian AT-11 series						HEAT	
Svir	At least 2	125	T-72B/S, 2A45M	4	2-2.5	770/270	LBR/80-90
Refleks	At least 5		T-80U, T-84, T-90	5	2-3	770/270	80-90
			2A45M AT Gun	5	2-3		80-90
Russian AT-11B	At least 1	125	T-72B, T-72S	4	2-2.5	Tandem HEAT	LBR/80-90
Invar or			T-80U, T-84, T-90	5	2-3	900/850	80-90
Refleks-M			2A45M AT Gun	5	2-3		80-90
AT-11C/Invar-M	At least 1	125	All above	7	2-3	900/850	80-90
Ukrainian Combat	At least 1	125	T-84, T-80U, T-90,	5	2-3	Tandem HEAT	LBR/80-90
(aka: Kombat)			Ch Type 98, 2A45M	5	2-3	800/750	80-90
Israeli LAHAT	At least 1	105	Merkava 4, other	8	1.5-2.5	Tandem HEAT	SAL-Hmg
		120	tank, M40 recoilless		.5-1.5	=1000+/1000+	80-90
		106	gun, LAFVs, helis,	13 heli	--	Due to Top-Atk	

NOTES:
* Shift point from ATGM to gun round may be gun round effective range, but includes other factors (Next page).
** When there are two figures, first figure is against armor without ERA/second figure is penetration behind ERA

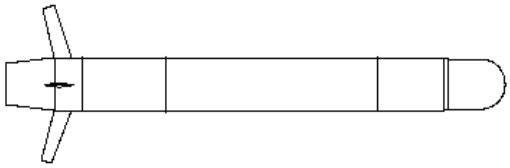
Improved AT-10B ATGMs feature tandem warheads and 5-6 km range. Arkan has control surfaces adapted from SVIR. It is now marketed for all variants. Note that some versions differ in penetration. These missiles inspired several other gun-launched ATGMs. A German/ Russian R&D effort yielded the 105-mm SPEAR, (perhaps later 120-mm) for NATO guns.

Recently Marketed And Future Gun-Launched ATGMs and Guided Antitank Rounds

Designator/Name (Producer Country)	Number Users/ Status	Bore (mm)	Launcher Platform/ # Missiles	Range (km)	Shift to Gun Rd (km)*	Type Warhead/ Penetration (mm CE)	Guidance/P-Hit (%)
Russian/German Spear	Near fielding	105 120	Leopard 1 and other NATO type	5.5+	1.4-2	TH (Tandem HEAT)/ 750/700	LBR 90
Ukrainian Artemis (aka: R-211)	Marketed	120 125	Tanks with gun and LBR FCS	5	2-3	Tandem HEAT/ (est) 1050+/1000	LBR 80-90
Ukrainian Falah-2	In R&D	100	BMP-3/3M, Ch 2G	5.5	.5	TH/ 550+/500	LBR
Ukr R-111/Stugna		100	T-55AM, MT-12	5	.5	TH/ 550+/500	LBR
Israeli Excalibur	In R&D	120	Merkava 4 or NATO type	INA	.5-2.5	INA	Terminal Homing
Russian Sokol-1 guided AT round	In R&D	125	T-90A, other tanks, AT guns	5	2 .5	HEAT 700/200	SAL + IR /80-90



LAHAT ATGM/Round Configuration



LAHAT Missile Flight Configuration

A modern ATGM with different guidance is the Israeli LAHAT (see pg 6-58). LAHAT's semi-active laser-homing guidance means that the ATGM can be designated with the vehicle's designator or launched at a target beyond the line-of-sight and homed to target by a down-range designator. Indirect fire SAL-H guidance with LAHAT enables launcher systems to extend their lethal range, while reducing the enemy's opportunity to detect them and trigger deadly counter-fires. Thus tanks and other users can operate from covered or concealed positions and launch the missiles; relying on concealed infantry or airborne assets to guide the missiles to target. This method lends itself to urban, forested, or uneven terrain, where maneuver forces are restricted by limited lines of sight. LAHAT was initially marketed in 105 and 120 mm for NATO-standard cannon, including the Merkava tank. A 4-missile canister launcher was developed for use on helicopters, ships, and vehicles (one or two canisters per system). The LAHAT can be adapted for use with the M40 106-mm recoilless rifle, to extend the usefulness of that well-proliferated weapon. With its high velocity, LAHAT is a threat to helicopters. A new multi-purpose missile is offered against other targets. A sensor-operated 6-missile ground launcher was unveiled.

A Russian firm offers a new kind of round, the Sokol-1 SAL-H ***guided antitank round***. Without a motor, it is not a missile and is less costly. Flight time to 5 km is about 5 seconds. Fins provide in-flight guidance. A laser target designator (LTD) is normally needed, and can be added into a tank FCS. A separate or even remote LTD can be positioned to guide the round to the target. Rounds are fired direct-fire, using the tank’s precise fire control system. Accurate aim would normally generate a hit near-miss anyway; but guidance increases accuracy, even in difficult conditions. Vehicles have detectible hot spots that are visible to the round’s IR seeker. Thus even if the LTD is not used or if the firer is disabled, in most cases, the seeker can detect and home on a target’s heat-generated infrared light emissions. Although hit probability (Ph) is less in that mode, it is still more than for a standard tank round. This round permits a tank to be able to fire rounds at more than 6 per minute against moving targets up to 5 km away with a high probability of a hit (90%), and kill or damage enemy vehicles beyond its normal weapons range.

Technical capabilities and limitations affect use of gun-launched munitions. Missiles can be launched at moving targets; but hit probability is highest if the target is stopped or moving slowly. Smoke and dust can degrade the laser beam and the associated optics. However, effects of obscurants on ATGM seeker sensitivity have in some cases been shown to improve the hit performance of certain LBR missiles. Launch rate varies from 2-3 per minute, depending on target range. As target units approach within the gun's maximum effective range (see Glossary), the system should cease launching ATGMs and shift to gun rounds. Given the lethality of modern kinetic energy main gun rounds at 3,000 meters, an ATGM-launch vehicle may not want to risk a missile's 8-second flight time against a 2-second KE round. Determination of the point of shift from ATGM to cannon round is primarily dependent on accuracy of the vehicle's gun sight, and capabilities of specific rounds onboard. For instance, improved KE rounds can range out to 3 km; but most have a max effective range of no more than 2.5 km. The BMP-3 ATGM is the IFV's only true AT round, and can be employed to its minimum range.

Missile proliferation cannot be determined, because ammunition packaged for transport is difficult to track. Basic load is 5-8 rounds per vehicle, with another basic load at battalion re-supply, and a half basic load at division. In a gun basic load, the ATGMs substitute for Frag-HE rounds (used beyond KE round range) and a portion of the HEAT round allocation.

Some gun-launched ATGM fire control systems do not have a night channel, which permits observation for launch at night. A few that do are limited by the range (800-1,300 meters) of their infrared sensors. However, with proper battlefield illumination, engagements can take place using its full range. They just need a lot of well-positioned and well-timed illumination. Several recently fielded combat vehicles have fire control with thermal (FLIR) channels permitting launch at night. There is still wide variation in range based on the capability of the FLIR to detect, recognize, and track targets for launch on the move. Recent fire control systems with 2nd generation thermal sights have longer range comparable to the missiles. Near-term night sights will be able to support the full range capabilities of the longest range ATGMs.

Laser beam guidance ATGMs have not received as much attention for countermeasures as have semi-active command line-of-sight (SACLOS) systems. Those ATGMs using LBR guidance are not susceptible to interference from EO countermeasures. Electro-optical jammers operating on the same wavelengths as the laser are ineffective because the missile optical receiver is looking back towards its launch point rather than at the target. Laser decoy devices used against SAL-homing munitions are also ineffective. The ATGM rider laser beam, however, can trigger laser-warning receivers. Operator counter-tactics can reduce warning time. Conventional reactions against ATGMs, such as obscuration of optics, can degrade performance of gun-launch missiles. But the longer target range and shorter flight time can reduce a target's awareness and time window in which to react. Explosive reactive armor, stand-off plates, and hard-kill active protection systems can significantly reduce penetration by HEAT (or shaped-charge) warheads, characteristic kill mechanisms on most ATGMs.

Considerations such as tactics, specific deployment, and technology of each gun and upgrade impact on their effectiveness (See Chapter 15). These upgrades could apply to OPFOR portrayal of numerous systems in this document, especially in chapters for: infantry weapons (Chapter 2), infantry vehicles (Ch 3), tanks (Ch 5), also towed guns and HACVs (Ch 6).

Russian ATGM Launcher Vehicle 9P148

Weapons & Ammunition Types	Typical Combat Load
Launcher	**15-20**
AT-5/AT-5B ATGM	15
Mixed (see NOTES)	
AT-4/AT-4B ATGM	10
AT-5/AT-5B ATGM	10

SYSTEM
Alternative Designations: BRDM-2/AT-5
Date of Introduction: 1977
Proliferation: At least 6 countries
Description:
Crew: 2
Platform: BRDM-2M/GAZ-41-08
Combat Weight (mt): 7.0
Chassis Length Overall (m): 5.73
Height (m):
Overall: 2.31
In Firing Position: INA
Width Overall (m): 2.26
Drive Formula: 4 x 4 (+ 4 auxiliary wheels)

Automotive Performance:
Engine Type: 140-hp Gasoline
Cruising Range (km): 750
Speed (km/h):
Max Road: 100
Max Off-Road: INA
Average Cross-Country: INA
Max Swim: 10
Fording Depth (m): Amphibious
Self-Entrenching Blade: N/A

Radio: R-123

Protection:
Armor, Turret Front (mm): 10
Applique Armor (mm): N/A
Explosive Reactive Armor (mm): N/A
Active Protective System: N/A
NBC Protection System: Collective
Smoke Equipment: N/A

ARMAMENT
Antitank Guided Missile Launcher
Name: 9P135M3 (recent upgrade)
Launch Method: Disposable launch canister
Number of missiles on launcher: 5
Elevation (°): INA
Rate of Launch: (missiles/min): 3-4, depending on range
Reaction Time (sec): INA
Emplacement Time (min): INA
Displacement Time (min): INA
Can Launch Missiles Simultaneously: NA
Ready/Stowed Missiles: 15 (launcher + autoloader)/ 0-5 by mix
Loader Type: Automated
Launcher dismountable: No
Auxiliary Launcher: Yes
Fire on the Move: No

FIRE CONTROL
FCS Name: N/A
Guidance: SACLOS
Command Link: Wire
Beacon Type: Incandescent bulb
Tracker Type: IR, 9S451M1
Susceptible To Countermeasures: EO jammers, smoke, counterfire
Counter-countermeasures: Electro-optical jamming alarm (See note)
Rangefinder: N/A
Infrared Searchlight: N/A
Sights w/Magnification:
Gunner:
Day: 9Sh119M1
Field of View (°): INA
Acquisition Range (m): 4,500
Night: 1PN65
Field of View (°): INA
Acquisition Range (m): 2,500

VARIANTS
9P137: Original launcher vehicle with 5 AT-5 (only) launch rails

AMMUNITION
Antitank Guided Missiles:
Name: AT-5/SPANDREL
Alternative Designations: Konkurs
Missile Weight (kg): 25.2 (in tube)
Warhead Type: Shaped Charge (HEAT)
Armor Penetration (mm CE): 650
Minimum/Maximum Range (m): 75/4,000
Probability of Hit (%): 90
Average Velocity (m/s): 200
Time of Flight to Max Range (sec): 20

Name: AT-5B
Alternative Designations: Konkurs-M
Missile Weight (kg): 26.5 (in tube)
Warhead Type: Tandem Shaped Charge (HEAT)
Armor Penetration (mm CE): 925
Minimum/Maximum Range (m): 75/4,000
Probability of Hit (%): 90
Average Velocity (m/s): 208
Time of Flight to Max Range (sec): 19

Name: AT-4/SPIGOT
Alternative Designations: Fagot
Missile Weight (kg): 13.0 (in tube)
Warhead Type: Shaped Charge (HEAT)
Armor Penetration (mm CE): 480
Minimum/Maximum Range (m): 70/2,000
Probability of Hit (%): 90
Average Velocity (m/s): 186
Time of Flight to Max Range (sec): 11

Russian ATGM Launcher Vehicle 9P148 continued

Name: AT-4B Alternative Designations: Factoria, Konkurs M Missile Weight (kg): 13.4 (in tube) Warhead Type: Shaped Charge (HEAT) Armor Penetration (mm CE): 550 Minimum/Maximum Range (m): 70/2,500 Probability of Hit (%): 90 Average Velocity (m/s): 180 Time of Flight to Max Range (sec): 13.2-14.0	**Other Missile Types:** N/A

NOTES
A variety of ATGM mixes have been seen with 9P148, between AT-4 and AT-5-type ATGMS. The primary benefit of adaptability is increased launcher load and adaptability to user countries' inventories of ATGMs. Most common ATGM is AT-5. As AT-5B is produced, it is likely to replace AT-5 in better-budgeted country inventories.

Reload time for the launcher is 25 seconds.

Russian firms have developed countermeasures, such as encoded-pulse beacons for ATGMs and counter-dazzler adjustments to the 9S451M1 guidance box. Filters can be mounted in front of reticles.

The 1PN66 thermal sight is available for the ATGM launcher. Acquisition range is approximately 2,500 meters.

Russian KBP offers a drop-in one-man turret, called Kliver, with a stabilized 2A72 30-mm gun, a 4 Kornet ATGM launcher, thermal sights, and improved fire control system.

Russian ATGM Launcher Vehicle 9P149/Shturm-S

Weapons & Ammunition Types	Typical Combat Load
Launcher AT-9 HEAT ATGM AT-9 HE ATGM AT-9 Anti-helicopter Older AT-6 missile for the 9P149 launcher is obsolete.	**12**

SYSTEM
Alternative Designations: AT-6 ground launcher with AT-9
Date of Introduction: 1990
Proliferation: At least 9 countries
Description:
Crew: 2
Platform: MT-LB
Combat Weight (mt): 12.3
Chassis Length Overall (m): 6.35
Height (m):
Overall: 1.8
In Firing Position: INA
Width Overall (m): 2.85

Automotive Performance:
Engine Type: 290-hp Diesel
Cruising Range (km): 500 km
Speed (km/h):
Max Road: 65
Max Off-Road: INA
Average Cross-Country: INA
Max Swim: 3-4
Fording Depths (m): Amphibious
Self-Entrenching Blade: Yes

Radio: R-123M or R-173

Protection:
Armor, Turret Front (mm): 7-14
Applique Armor (mm): N/A
Explosive Reactive Armor (mm): N/A
Active Protective System: N/A
NBC Protection System: Collective
Smoke Equipment: N/A

ARMAMENT
Antitank Guided Missile Launcher
Name: 9P149A
Launch Method: Disposable launch canister
Number of missiles on launcher: 1
Elevation (°): -5/+15
Rate of Launch: (missiles/min): 2-3, depending on range
Reaction Time (sec): INA
Emplacement Time (min): INA
Displacement Time (min): INA
Can Launch Missiles Simultaneously: No
Ready/Stowed Missiles: 12/ 0
Loader Type: Automated
Launcher dismountable: No
Auxiliary Launcher: No
Fire on the Move: No

FIRE CONTROL
FCS Name: INA
Guidance: SACLOS
Command Link: Radio frequency
Tracker Type: IR
Susceptible To Countermeasures: Smoke, counter-fire
Counter-countermeasures: 5 encoded frequencies
Rangefinder: Laser range-finder
Infrared Searchlight: INA
Sights w/Magnification:
Gunner:
Day: KPS-53AV day sight (8x)
Field of View (°): INA
Acquisition Range (m): 6,000
Night: Sanoet-1 type thermal for Tier 1 and 2 upgrades
Field of View (°): INA
Acquisition Range (m): 2,600 m
The original sight for 9P149 is an imaging infrared (II) sight.

VARIANTS
A variety of night sights are available, such as the Kornet-T sight with 3,500 m range (4,000 for detecting helicopters). In OPFOR Tier 1, the 9P149 night sight is 1PN79M3 2nd gen, and ranges to 5,500 m.

A modular AT-6 ATGM launcher system with launcher / autoloader is available for installation on vehicles, fixed sites and boats.

AMMUNITION
Antitank Guided Missiles
Name: Ataka
Alternative Designations: AT-9
Missile Weight (kg): 48.3 (in tube)
Warhead Type: Tandem Shaped Charge (HEAT)
Armor Penetration (mm CE): 1,100, 800 behind ERA
Minimum/Maximum Range (m): 400/6,000, 5,000 ground use
2,600 night with thermal
Probability of Hit (%): 90
Average Velocity (m/s): 400
Time of Flight to Max Range (sec): 15.0 to 6,000 m

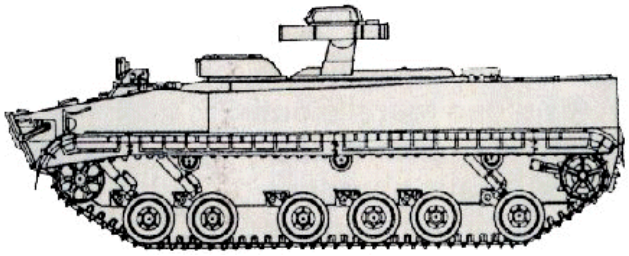
Name: AT-9 (9M120F) and AT-6 (9M114F) thermobaric HE multi-purpose missiles range to 6,000 m

Name: 9A2200 (Ataka) anti-helicopter missile. It has a proximity fuze and an HE/frangible rod warhead which assures a kill with hit or near miss. It can also be used against light armored vehicles.

Other Missile Types: A version of Ataka, 9M120-1 now has RF plus laser beam rider guidance. It can be used on 9P149 and P-157, and some RW aircraft.

NOTES
Upgrades AT-6b and AT-6c/Kokon-M (9M114M1, 2) can be launched from helicopters; but their length exceeds the 1832-mm limit for the Shturm-S autoloader, preventing ground use.

Russian ATGM Launcher Vehicle 9P162/Kornet-LR



Weapons & Ammunition Types	Typical Combat Load
ATGMs for Launcher	**16**
Kornet-LR HEAT	10-16
Kornet-LR HE	Up to 6

SYSTEM
Alternative Designations: Kornet-T, BMP M1995
Date of Introduction: 1996
Proliferation: 2 countries
Description:
Crew: 2, 3 possible
Platform: BMP-3 hull with no turret
Combat Weight (mt): 14.1
Chassis Length Overall (m): 6.73 *BMP-3 chassis
Height (m):
Hull: 1.77
In Firing Position: 2.3, with launcher arms up
Width Overall (m): 3.15 *BMP-3 chassis

Automotive Performance:
Engine Type: 500-hp Diesel
Cruising Range (km): 600
Speed (km/h):
Max Road: 70
Max Off-Road: 45+
Average Cross-Country: 35+
Max Swim: 10
Fording Depths (m): Amphibious
Self-Entrenching Blade: Yes

Radio: R-173, R-173P

Protection:
Armor, Turret Front (mm): No turret. 12.7-30 mm hull (see below)
Applique Armor (mm): Available, data is based on mounted plate.
Explosive Reactive Armor (mm): Available
Active Protective System: N/A
NBC Protection System: Collective
Smoke Equipment: Available

ARMAMENT
Antitank Guided Missile Launcher
Name: INA
Launch Method: Disposable launch canister
Number of missiles on launcher: 2
Elevation (°): INA
Rate of Launch: (missiles/min): 3-4, with 1 or 2 missiles/target. If expected probability of kill against a selected target is less than 60 percent, the launcher will launch two missiles against that target.
Reaction Time (sec): INA
Emplacement Time (min): <10 sec est
Displacement Time (min): <10 sec est
Can Launch Missiles Simultaneously: 1 or 2 (See Notes)
Ready/Stowed Missiles: 12/4, or 14/2 with launchers ready
Loader Type: Automated, two loading drums with 6 missiles
Launcher dismountable: No
Auxiliary Launcher: Available for dismount
Fire on the Move: No

FIRE CONTROL
FCS Name: INA
Guidance: Laser beam rider
Command Link: Laser beam guidance unit on each launcher arm
Beacon Type: N/A
Tracker Type: N/A
Susceptible To Countermeasures: Smoke, counter-fire
Counter-countermeasures: Laser guidance impervious t o jammers
Rangefinder: Laser rangefinder in fire control system
Infrared Searchlight: None
Sights w/Magnification:
Gunner: 1PN80/Kornet-TP Day/night sight
Day: 13.4x/4.4 x
Field of View (°): 5.41, 1.8x2.6
Acquisition Range (m): 5,500
Night: Kornet-T/1PN80 Thermal sight, 9.7x/3.2x
Field of View (°): 7.8
Acquisition Range (m): 4,000+

VARIANTS
KPB displayed a prototype overhead weapons module to mount on a variety of vehicles (displayed on a HMMWV). It has dual twin (4-tube) launcher, and a central module with TV/FLIR sights and MG.

Another alternative Kornet turret for ATGM launcher vehicles is **ATM:** A manned turret with an overhead weapon system (OWS). ATM can mount on a variety of vehicles. (see pg. 6-68) KPB offers the **Kvartet/**9P163-2 overhead weapons module to mount on a variety of vehicles (e.g., HMMWV and VBL, see pg 6-31). It has a dual twin (4-tube) launcher and central module with TV/FLIR sights.

AMMUNITION
Antitank Guided Missiles
Name: Kornet-LR (see Kornet)
Alternative Designation: Kornet, 9M133, AT-14
Missile Weight (kg): 27
Warhead Type: Tandem Shaped Charge (HEAT)
Armor Penetration (mm CE): 1,200
Min/Max Range (m): 100/5,500
Probability of Hit (%): 90
Average Velocity (m/s): 255
Time of Flight to Max Range (sec): 22

Name: Kornet-LR HE
Alternative Designations: Kornet HE, Kornet Thermobaric
Missile Weight (kg): INA
Warhead Type: High Explosive - Thermobaric
Armor Penetration (mm): INA, can defeat IFV/APC armor
Minimum/Maximum Range (m): 100/5,500
Probability of Hit (%): 90
Average Velocity (m/s): 255 (est)
Time of Flight to Max Range (sec): 22

NOTES
A new system is the Kornet-EM (pg 6-31), with new missiles. Kornet-EM (Kornet-D) missiles (tandem HEAT and HE) range 8 and 10 km. Armor penetration is 1,300 mm for HEAT. The missiles fit in a 9P162; but 9P162 fire control is less modern and may limit range.

Russian ATGM Launcher Vehicle 9P157-2/Khrizantema-S

Weapons & Ammunition Types	Typical Combat Load
ATGMs for Launcher Tamdem HEAT Thermobaric HE	**15**

SYSTEM
Alternative Designations: Khrizantema AT-15
Date of Introduction: 1996-1998
Proliferation: Fielded in 1 country**,** contracted for imminent export. Initial fielding is at division/echelon/above division, with Kornet at brigade and below. They may replace all 9P149s with Krizantema.
Description: * est based on 9P162 (pg 6-64)
Crew: 2
Platform: BMP-3 hull with no turret, as on the 9P162 (pg. 6-64).
Combat Weight (mt): 14.1 est
Chassis Length Overall (m): 6.73 est
Height (m): Hull: 1.77 est, firing with launcher arms up: 2.3, est
Width Overall (m): 3.15 est
Radio: R-173, R-173P

Automotive Performance:
Engine Type: 500-hp Diesel
Cruising Range (km): 600
Speed (km/h):
Max Road: 70
Max Off-Road: 45+
Average Cross-Country: 35+
Max Swim: 10
Fording Depths (m): Amphibious
Self-Entrenching Blade: Yes

Protection:
Armor, Turret Front (mm): No turret. 12.7-30 mm hull.
Applique Armor (mm): Available, data is based on mounted plate.
A dozer blade is mounted on the hull underside.
In travel mode, the launcher can retract under armor.
Explosive System: Collective Reactive Armor (mm): Available
Active Protective System: N/A
NBC Protection System: Collective
Smoke Equipment: Available

ARMAMENT
Antitank Guided Missile Launcher
Name: 9K123
Launch Method: Disposable launch canister
Number of missiles on launcher: 2, on auto-loading arms
Elevation (°): INA
Rate of Launch: (missiles/min): 6-8, with dual guidance mode
Reaction Time (sec): 1-3
Emplace/Displace Time (sec): <10 est
Can Launch Missiles Simultaneously: 1 (usually) or 2
Ready/Stowed Missiles: 15/0 in drum autoloaders.
Loader Type: Automated with two launcher arms, no manual
Launcher dismountable or auxiliary launcher: No
Fire on the Move: No

FIRE CONTROL
FCS Name: 9K123 (subsystem of the complex)
Guidance: Dual-mode with separate MMW radar and EO sights
Radar permits automatic command line-of-sight (ACLOS) lock-on before launch. Another missile is aimed at a second target with EO.
Simultaneous targets engaged: 2, one with radar, other with EO
Command Link: Radar, and SACLOS laser beam rider for EO
Susceptible To Countermeasures: Dust (EO sights, but not radar)
Counter-countermeasures: Laser guidance impervious to jammers. Radar impervious to smoke and dust. The MMW band avoids most radar reconnaissance assets. System can operate passively with EO.
Rangefinder: Laser rangefinder in fire control system
Sights w/Magnification:
Gunner Day sight: EO
Acquisition Range (m): 6,000+
Night sight: 1PN80/Kornet-TP thermal sight
Acquisition (m): 4,000
Radar: MMW guidance for day and night (fire-and-forget)
Acquisition Range (m): 10,000 est

VARIANTS
Krizantema-S launcher assembly can mount on ships and vehicles.

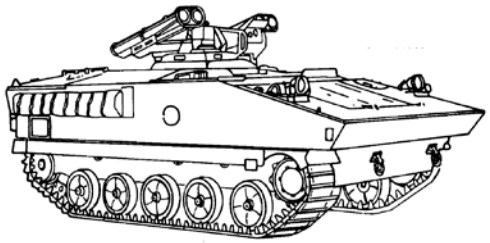
Upgrade package for Mi-28N/HAVOC helicopter includes the Khrizantema. The **Tor** gyro-stabilized EO pod can be mounted on aircraft for guiding the **Krizantema-V** air-launch variant.

AMMUNITION
Antitank Guided Missiles
Name: 9M123-2, Khrizantema
Alternative Designation: AT-15
Missile Weight (kg): 45
Warhead Type: Tandem Shaped Charge (HEAT)
Armor Penetration (mm CE): 1,500+, 1250 behind ERA
Min/Max Range (m): 400/6,000
Probability of Hit (%): 90
Average Velocity (m/s): 400 (supersonic)
Time of Flight to Max Range (sec): 15

Name: 9M123F-2
Alternative Designations: AT-15B
Missile Weight (kg): INA
Warhead Type: High Explosive - Thermobaric
Armor Penetration (mm): INA, can defeat IFV/APC armor
Minimum/Maximum Range (m): 400/6,000
Probability of Hit (%): 90
Average Velocity (m/s): 400 (supersonic)
Time of Flight to Max Range (sec): 15

NOTES
Addition of an EO auto-tracker would permit an increase in the rate of launch, because the gunner could switch more rapidly between targets. A version of AT-9/Ataka, 9M120-1 now has RF and laser beam rider guidance. Thus it can supplement Krizantema missiles in the launcher.

French ATGM Launcher Vehicle AMX-10 HOT



Weapons & Ammunition Types	Typical Combat load
Total	
HOT/ HOT 2, HOT 3	**18**

SYSTEM
Alternative Designations: INA
Date of Introduction: INA
Proliferation: At least 1 country
Description:
Crew: 4-5
Platform: AMX-10P
Combat Weight (mt): 14.1
Chassis Length Overall (m): 5.78
Height (m):
Overall: 2.57
In Firing Position: INA
Width Overall (m): 2.78

Automotive Performance:
Engine Type: 300-hp Diesel
Cruising Range (km): 600 km
Speed (km/h):
Max Road: 65
Max Off-Road: INA
Average Cross-Country: 30-40
Max Swim: 7 (with optional water jets)
Fording Depths (m): Amphibious
Self-Entrenching Blade: N/A

Radio: VHF and intercom

Protection:
Armor, Turret Front (mm): 12.7-mm frontal (distance NFI)
Applique Armor (mm): N/A
Explosive Reactive Armor (mm): Available (see NOTES)
Active Protective System: N/A
NBC Protection System: Collective
Smoke Equipment: 3 smoke grenade launchers

ARMAMENT
Antitank Guided Missile Launcher
Name: Lancelot 3
Launch Method: Disposable launch canister
Number of missiles on launcher: 4
Elevation (°): -12/+18
Rate of Launch (missiles/min): 3-4 depending on range
Reaction Time (sec): INA
Emplacement Time (min): INA
Displacement Time (min): INA
Can Launch Missiles Simultaneously: INA
Ready/Stowed Missiles: 4/14
Loader Type: Manual
Launcher dismountable: No
Auxiliary Launcher: No
Fire on the Move: No

FIRE CONTROL
FCS Name: INA
Guidance: SACLOS
Command Link: Wire
Beacon Type: INA
Tracker Type: INA
Susceptible To Countermeasures: Smoke, counter-fire
Counter-countermeasures: Infrared CM hardening on later ATGMs
Rangefinder: M427 Laser rangefinder
Infrared Searchlight: INA
Sights w/Magnification:
Gunner:
Day: M509, 3x/12x
Field of View (°): INA
Acquisition Range (m): INA
Night: Castor Thermal Image System available
Field of View (°): INA
Acquisition Range (m): INA

VARIANTS
The AMX-10 HOT constitutes a high-end application on that spectrum, and has not been widely proliferated. The Lancelot turret used on AMX-10 HOT can be mounted on other armored fighting vehicles.

The HOT Antitank guided missile can be launched from a ground launcher. But the cruciform-based single-tube ground launcher system exceeds the weight limit for the portable class of ATGM launchers. Thus it will rarely be dismounted. However, the launcher can be mounted on a variety of vehicles. Most use a simple pintle mount. The single-tube dismountable HOT firing station can be fitted on light vehicles such as the VBL. Thus the OPFOR Tier 2 battalion ATGM launcher was previously a HOT-3 pintle mount version on the VBL. It has also been fitted on infantry fighting vehicles and ATGM launcher vehicles, and helicopters.

Alternate mounts for the launcher include the ATLAS/Commando lightweight launcher (140 kg) mounted on the Spanish Santana (4 x 4 Land Rover light truck). The turret can be mounted on the VBR chassis, which permits easier carry of the larger HOT missile than for its predecessor, the VBL.

National War College Photo

The German Jaguar 1 launcher vehicle is an upgraded version of the Raketenjagdpanzer 2 vehicle which launched SS-11 ATGMs, then fitted with a single-tube HOT launcher. These vehicles were all derived from the reliable and highly mobile Leopard 1 tank chassis.

French ATGM Launcher Vehicle AMX-10 HOT continued

VARIANTS (continued)

The French-produced VAB HOT uses a Mephisto retractable twin-tube launcher, and has an onboard load of 10 HOT ATGMs.

The UTM800 turret holds 4 x HOT missiles, with a stabilized sight and Castor thermal night sight. The turret is used in two systems. The French VCR/TH employs the turret on a Panhard VCR/TT 6 x 6 APC chassis. The other is the UTM turret on a VAB APC chassis.

An updated launcher for HOT-3 offers a Thermal Modular System night sight and a dual band tracker. The ATM launcher, shown on the next page, can fit a variety of vehicles and launch HOT missiles or mount a combination of missiles and guns.

Antitank Guided Missiles

Name: HOT
- Alternative Designations: Euromissile
- Missile Weight (kg): 32 (in tube)
- Warhead Type: Shaped Charge (HEAT)
- Armor Penetration (mm CE): 800
- Minimum/ Maximum Range (m): 75/4,000
- Probability of Hit (%): INA
- Average Velocity (m/s): 233
- Time of Flight to Max Range (sec): 17.3

Name: HOT 2
- Alternative Designations: INA
- Missile Weight (kg): 32 (in tube)
- Warhead Type: Tandem Shaped Charge (HEAT)
- Armor Penetration (mm CE): 900
- Minimum/Maximum Range (m): 75/4,000
- Probability of Hit (%): INA
- Average Velocity (m/s): 233
- Time of Flight to Max Range (sec): 17.3

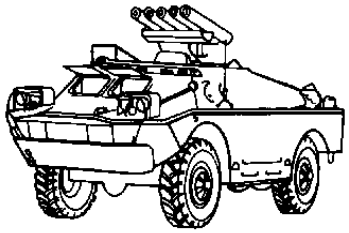
Name: HOT 3
- Alternative Designations: Formerly HOT-2T
- Missile Weight (kg): 32 (in tube)
- Warhead Type: Tandem shaped Charge (HEAT)
- Armor Penetration (mm CE): 1250
- Minimum/Maximum Range (m): 75/4,300
- Probability of Hit (%): INA
- Average Velocity (m/s): INA
- Time of Flight to Max Range (sec): INA
- Note: HOT 3 has improved countermeasures over -2T. Also the laser proximity fuze assures precisely timed detonation.

Other Missile Types: HOT 2MP multi-purpose

NOTES

French SNPE explosive reactive armor can be employed on AMX-10 type vehicles, but they then lose their swim capability.

Russian/European BRDM-2 HOT 3 ATGM Launcher Vehicle



9P148 ATGM Launcher Vehicle

ATM turret variant w/MG and 2 HOT launchers

Weapons & Ammunition Types	Typical Combat load
BRDM-2 HOT 3	**est 14**
HOT-3 Tandem HEAT	10
HOT-2 Multi-purpose	4

SYSTEM:
Alternative Designations: ATM on BRDM-2
Date of Introduction: INA
Proliferation: This system represents the HOT launcher on wheeled ATGM lchr vehicles in more than eight countries.
Description:
Crew: 3
Platform: BRDM-2, with an ATM upgrade turret variant
Combat Weight (mt): INA, close to BRDM-2
Chassis Length Overall (m): 5.78
Height (m):
Overall: 2.57
In Firing Position: INA
Width Overall (m): 2.78
Automotive Performance: See BRDM-2
Radio: R-173 (est)
Protection: See BRDM-2

ARMAMENT
Antitank Guided Missile Launcher
Name: ATM
Launch Method: Disposable launch canister
Number of missiles on launcher: 4
Elevation (°): -12/+18
Rate of Launch (missiles/min): 3-4 depending on range
Can Launch Missiles Simultaneously: No
Ready/Stowed Missiles: 14/0
Loader Type: Manual
Launcher dismountable: No
Auxiliary Launcher: No
Fire on the Move: No

FIRE CONTROL
FCS Name: ATM
Guidance: SACLOS
Command Link: Wire
Beacon Type: Xenon
Tracker Type: INA
Susceptible To Countermeasures: Smoke, counter-fire
Counter-countermeasures: Infrared CM hardening on later ATGMs
Rangefinder: Laser rangefinder range 15,000 m
Sights w/Magnification:
Gunner:
Day: TV, NFI
Field of View (°): INA
Acquisition Range (m): 4,000
Night: Thermal Image System, NFI
Field of View (°): INA
Acquisition Range (m): 4,000

VARIANTS
ATM variants include sensor only pods, and ATGMs on up to 4 weapon stations in mix with MG, 20/30-mm cannon, and Russian or Euospatiale ATGMs. Other ATM vehicle applications include BMP-3/ATM, Pandur/ATM (photo), HMMWV/ATM, Puma 4x4 ATM, Tactica/ATM, Fennek/ATM, and Wiesel/ATM **HOT** variants.

AMMUNITION
Antitank Guided Missiles
Name: HOT 3
Alternative Designations: Formerly HOT-2T
Missile Weight (kg): 32 (in tube)
Warhead Type: Tandem shaped Charge (HEAT)
Armor Penetration (mm CE): 1250
Minimum/Maximum Range (m): 75/4,300
Probability of Hit (%): INA
Average Velocity (m/s): INA
Time of Flight to Max Range (sec): INA

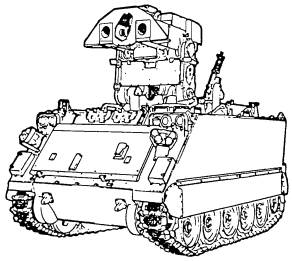
Other Missile Types: HOT, HOT 2,
HOT 2MP multi-purpose (with HEAT and Frag warheads)

NOTES
The HOT Antitank guided missile is produced by a European consortium, which includes companies in France and Germany. The cruciform-based single-tube ground launcher system exceeds the weight limit for the portable class of ATGM launchers. An updated launcher for HOT 3 offers a Thermal Modular System night sight and a dual band tracker. The HOT can be launched from a ground launcher, the same launcher mounted on a variety of vehicles, from infantry fighting vehicles and ATGM launcher vehicles, and from helicopters.

The vehicle represents VAB HOT, Pandur HOT, Santana/HOT and other wheeled HOT vehicles. The AMX-10 HOT constitutes a high-end application on that spectrum, and has not been widely proliferated. Alternate mounts for the launcher include the ATLAS/Commando lightweight launcher (140 kg) mounted on the Spanish Santana (4 x 4 Land Rover light truck). The Lancelot turret used on AMX-10 HOT can be mounted on other armored fighting vehicles. The French-produced VAB HOT uses a Mephisto retractable twin-tube launcher, and has an onboard load of 10 HOT ATGMs. The UTM800 turret holds four HOT missiles, with a stabilized sight and Castor thermal night sight. The UTM800 is used on two applications. The French VCR/TH employs the turret on a Panhard VCR/TT 6 x 6 APC chassis. The other is the UTM turret on a VAB APC chassis. The turret can be mounted on the VBR chassis, which permits easier carry of the larger HOT missile than does its predecessor, the VBL.

The single-tube dismountable HOT firing station can be mounted on light vehicles such as the VBL.

US ATGM Launcher Vehicle M901



Weapons & Ammunition Types	Typical Combat Load
ATGM Launcher TOW, ITOW, TOW 2, TOW 2A, TOW 2B	**12**
7.62-mm Cupola MG	**2,000**

SYSTEM
Alternative Designations: ITV (Improved TOW Vehicle), ITOW
Date of Introduction: 1978
Proliferation: At least 8 countries
Description:
Crew: 4-5
Platform: M113A1
Combat Weight (mt): 11.79
Chassis Length Overall (m): 4.90
Height (m):
Overall: 2.91
In Firing Position: 3.35
Width Overall (m): 2.70

Automotive Performance:
Engine Type: 212-hp Diesel
Cruising Range (km): 483
Speed (km/h):
Max Road: 64
Max Off-Road: INA
Average Cross-Country: INA
Max Swim: 5.8
Fording Depths (m): Amphibious
Self-Entrenching Blade: N/A

Radio: Various, including intercom

Protection:
Armor, Turret Front (mm): INA
Applique Armor (mm): Available. Anti-mine armor on bottom
Explosive Reactive Armor (mm): Available
Active Protective System: No
NBC Protection System: No
Smoke Equipment: 4 smoke grenade launchers on each front corner

ARMAMENT
Antitank Guided Missile Launcher
Name: M27 cupola with launcher head ("Hammerhead")
Launch Method: Disposable launch canister
Number of missiles on launcher: 2
Elevation (°): -30/+34
Rate of Launch: (missiles/min): 2
Reaction Time (sec): 4.25
Emplacement Time (min): 0.33
Displacement Time (min): INA
Can Launch Missiles Simultaneously: No
Ready/Stowed Missiles: 2/10
Loader Type: Manual
Launcher dismountable: No
Auxiliary Launcher: No
Fire on the Move: No

Auxiliary Weapon:
Caliber, Type, Name: 7.62-mm (7.62x51) MG
Mount Type: Cupola
Direct Fire Range (m): INA
Max Effective Range (m):
Day: INA
Night: INA
Fire on Move: Yes
Rate of Fire: INA

Firing Ports: INA

FIRE CONTROL
FCS Name: INA
Guidance: SACLOS
Command Link: Wire
Beacon Type: Xenon (Infrared), thermal on TOW-2 and after
Tracker Type: INA
Susceptible To Countermeasures: Smoke, counter-fire
Counter-countermeasures:
Rangefinder: INA
Infrared Searchlight: INA
Sights w/Magnification:
Gunner:
Day: Day sight/tracker, 13x
Field of View (°): 5.5 x
Acquisition Range (m): INA
Night: AN/TAS-4 thermal sight
Field of View (°): INA
Acquisition Range (m): INA

VARIANTS
ITOW: Launcher variants have been upgraded with new turrets and launchers to fit the later TOW variants, such as ITOW, TOW 2, 2A and 2B. **M901A2:** Launcher vehicle fitted for TOW 2.

A variety of M113-based vehicles have incorporated TOW "hammerhead" launcher for use as ATGM launcher vehicles. These include the Italian VCC-1-based launcher vehicle, and the Dutch Armored Infantry Fighting Vehicle (AIFV) -based launcher vehicle.

MAPATS: Israeli TOW missile variant with laser-beam rider guidance and a laser guidance system.

Further-Improved TOW (FITOW): UK-developed program expected to be similar to TOW 2B, but with two smaller warheads.

TAAS: Israeli tandem warhead, same diameter as the warhead on the original TOW missile. It appears to be a candidate for retrofit. The warhead is claimed to be able to penetrate 1,020 mm of armor.

Toophan: Iranian copy of TOW.

US ATGM Launcher Vehicle M901 continued

Toophan-2: Iranian variant of ITOW.

AMMUNITION
Antitank Guided Missiles
Name: TOW
Alternative Designations: BGM-71
Missile Weight (kg): 25.5 (in tube)
Warhead Type: Shaped Charge (HEAT)
Armor Penetration (mm CE): 600
Minimum/ Maximum Range (m): 65/3,750
Probability of Hit (%): INA
Average Velocity (m/s): 179
Time of Flight to Max Range (sec): 21

Name: ITOW
Alternative Designations: BGM-71C
Missile Weight (kg): 25.7 (in tube)
Warhead Type: 127-mm HEAT with a short probe
Armor Penetration (mm CE): 800
Minimum/ Maximum Range (m): 65/3,750
Probability of Hit (%): INA
Average Velocity (m/s): 179
Time of Flight to Max Range (sec): 21

Name: TOW 2
Alternative Designations: BGM-71D
Missile Weight (kg): 28.1 (in tube) / 21.5 (missile only)
Warhead Type: 152-mm HEAT with bigger probe
Armor Penetration (mm CE): 900 est
Minimum/ Maximum Range (m): 65/3,750
Probability of Hit (%): 90
Average Velocity (m/s): 179
Time of Flight to Max Range (sec): 21

Name: TOW 2A
Alternative Designations: BGM-71E
Missile Weight (kg): 22.65 (missile only)
Warhead Type: Tandem Shaped Charge (Large HEAT, long probe)
Armor Penetration (mm CE): 900+ est
Minimum/ Maximum Range (m): 65/3,750
Probability of Hit (%): INA
Average Velocity (m/s): 188
Time of Flight to Max Range (sec): 20

Name: TOW 2B
Alternative Designations: BGM-71F
Missile Weight (kg): 22.60 (missile only)
Warhead Type: Dual explosive-formed penetrators (EFP), top-attack
Armor Penetration (mm CE): >900+
Minimum/ Maximum Range (m): 200/3,750
Probability of Hit (%): INA
Average Velocity (m/s): 179
Time of Flight to Max Range (sec): 21

Other Missile Types: See NOTES, below

NOTES
The loader has side and overhead protection during loading, which requires 40 seconds.

The Improved Target Acquisition System (ITAS) was developed for TOW 2 and later. It includes a laser rangefinder, increased acquisition range, improved night capabilities (second-generation thermal channel), an automatic bore-sight and greater hit probability.

Chinese ATGM Launcher Vehicle Type 92B and Red Arrow-9 ATGM

Weapons & Ammunition Types	Typical Combat load
Launcher	**est 12**
RA-9 Tandem HEAT	12
RA-9 HE-Thermobaric	As needed

SYSTEM:
Alternative Designations: WXLZ602B for vehicle. Other missile nomenclatures include RA-9, Hong Jian-9, and HJ-9
Date of Introduction: 1999
Proliferation: 1 country for vehicles and missile
Description:
Crew: 3 or 4
Platform: WZ-550, 4 X 4 variant of WZ-551/Type 92 APC
Combat Weight (mt): 12.5
Chassis Length Overall (m): INA
Height (m):
Overall: INA
In Firing Position: INA
Width Overall (m): 2.8

Automotive Performance:
Engine Type: 320-hp BF8L413F Diesel
Cruising Range (km): 800
Speed (km/h):
Max Road: 95
Max Off-Road: INA
Average Cross-Country: INA, good cross-country mobility
Max Swim: 8
Fording Depths (m): Amphibious

Radio: INA

Protection: Armor defeats 12.7-mm AP round.

ARMAMENT
Antitank Guided Missile Launcher
Name: Red Arrow-9
Launch Method: Disposable launch canister
Number of missiles on launcher: 4
Elevation (°): -10/+10
Can Launch Missiles Simultaneously: No
Ready/Stowed Missiles: 12/0
Rate of Launch (missiles/min): 3-4 depending on range
Loader Type: Auto-load or manual
Launcher dismountable: No
Auxiliary Launcher: No
Fire on the Move: No

FIRE CONTROL
FCS Name: ATM
Guidance: SACLOS
Command Link: Laser beam rider guidance
Beacon Type: INA
Tracker Type: Not required with LBR
Susceptible To Countermeasures: Smoke, counter-fire
Counter-countermeasures: LBR guidance is immune to jamming
Rangefinder: Laser rangefinder range 10,000 m+
Sights w/Magnification:
Gunner:
Day: Low light level TV with auto-tracker, NFI
Field of View (°): Wide and narrow
Acquisition Range (m): 5,000
Night: Thermal Image System, INA
Field of View (°): INA
Acquisition Range (m): 4,000

VARIANTS
The system is only vehicle-mounted. First fielded vehicle is Type 92B. A recently shown 4-tube launcher mounts missiles in an armored box.

A single tube launcher was developed for light vehicles. Initial version is on the NJ2046 4x4 light utility vehicle.

There are reports that a helicopter launcher is being developed.

AMMUNITION
Antitank Guided Missiles
Name: Red Arrow-9
Alternative Designations: RA-9/Hong Jian-9 (HJ-9)
Missile Weight (kg): 37 (in tube)
Warhead Type: 152-mm Tandem shaped Charge (HEAT)
Armor Penetration (mm CE): 1200
Minimum/Maximum Range (m): 100/5,000
Probability of Hit (%): 80+
Average Velocity (m/s): INA
Time of Flight to Max Range (sec): INA

Other Missile Types:
High explosive thermobaric
Red Arrow-9A: MMW-homing version - in development
Red Arrow-9B: Semi-active laser homing- in development

NOTES
The missile appears to have been derived from the U.S. TOW missile, with upgrades in range, guidance, and warhead design.

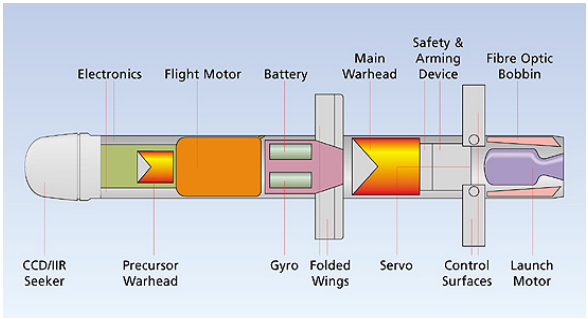
Beyond-Line-of-Sight (BLOS) and Non-Line-Of-Sight (NLOS) Missile Systems

New missile designs in the last decade have extended ranges for ATGMs beyond the previous limits, with capabilities to reach beyond line of sight. Terrain and other obstructions limit line of sight (LOS) and significantly reduce the effectiveness of those relatively expensive weapons when intended targets can hide from view. Therefore, new missile guidance and design technologies were incorporated to extend the useful range target availability for those weapons.

Most ATGMs fielded today utilize the decades-old method of semi-active command line-of-sight (SACLOS) wire guidance. The missile has a beacon (which can be tracked) and a trailing wire (for receiving course correction instructions). The launcher has a cross-hair sight for the operator, and a missile tracker (which sends correction instructions when the missile gets off-course). Some ATGMs use SACLOS laser beam rider guidance, with a similar sight and a laser guidance unit (the missile rides the beam to target). Both systems require the operator to see the target with direct sights limited to LOS range. The only option for use beyond LOS is to maneuver to a new LOS in order to launch. So weapons with alternative guidance are needed.

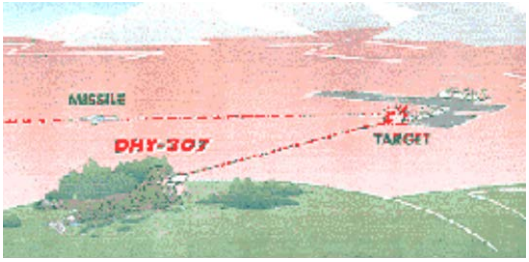
MILAN ATGM View

One such guidance is fiber-optic (FOG), in which a camera in the missile nose transmits a forward image to the launcher unit. The missile is guided around obstructions and toward a location at a sufficiently slow speed to make course corrections. When it reaches the expected target location, the operator can adjust for moving targets or change targets as desired. Some of these missiles use seeker algorithms and tandem warheads for top attack, to defeat even the heaviest frontal protection or cover. Fielded systems include the Israeli Spike (pg 6-25) and others noted at page 6-75. One challenge which is common to all BLOS/NLOS systems is the requirement for confirmation of the target identity and location before launch, to assure that a valuable missile is not wasted. If UAVs are available, they can confirm targets and monitor their activities to support FOG ATGM employment.



Spike Fiber-Optic ATGM

Another example of BLOS guidance is semi-active laser homing (SAL-H). A launcher directs the missile toward the target area. As the missile approaches, a remote laser target designator (LTD) directs a laser beam onto the target. The missile seeker searches for laser "splash", and homes on it upon detection. Although the laser has to be generally near the missile flight path, it does not need to be directly in line; and the seeker can scan a wide area to locate the splash. Examples include HELLFIRE, Mokopa, LAHAT, Nimrod, and Hermes (pg 6-75).



Lasing a target with a LTD

One limitation is that it requires an LTD within line-of-sight of the target. Users will be challenged to have LTDs in all possible target locations to service targets in a timely way. In the past, LTDs were ground, vehicle, aircraft, or ship/boat-mounted. Now, however, the ability to mount LTDs on unmanned aerial vehicles greatly expands the utility of SAL-H weapons. The Israelis added another method for the tank-launched LAHAT ATGM with SAL homing. With an LTD in the warhead, it has self-homing.

DHY-307 LTD

LAHAT

An LTD offers flexible use, in that it can guide not only ATGMs but also, mortar, artillery, tank, rocket, aircraft, and naval launched munitions. Thus LTD teams and platforms can deliver a wider range of destruction against a variety of battlefield targets. Some of these can also be used to engage moving aircraft. Although LTDs can trip laser warning receivers, and trigger countermeasures (CM) or even counter-fire, there are measures to avoid tactical and technical countermeasures. Current trends in SAL-H systems are described in the next section (pg 6-74).

Other guidance technologies are used in ATGMs for BLOS. These include ATGMs with MMW radar or TV/IR imagers that facilitate lock-on after launch (LOAL). The missiles can launch using FOG or other guidance based on expected target location. When the missile arrives at a target area, the operator can select a specific target and lock the missile onto the target. The missile then remotely homes to the target, without need for further operator involvement, even if the target is a moving vehicle. Examples of these include the Brimstone (SAL-H with MMW homing), and Spike-ER (FOG with IIR homing).

Hermes

Increasingly, missiles are being offered with multiple warhead options, and the capability to reach beyond the BLOS range (0-10 km), and well into the NLOS range (10+ km). These use radio-frequency (RF) guidance, or a programmed/ inertial phase with global navigation satellite system (GNSS, like GPS) guidance, coupled with a terminal phase upon arrival at the target area. That phase may use GNSS guidance, and/or will alert the operator upon arrival for more precise targeting, retargeting, or homing options. Thus, the operator can assure that missiles are used to achieve maximum damage against the highest priority targets available. Earlier examples of this technology are in self-homing anti-radar missiles/CMs, e.g., Harpy (radar-homing, Vol 2, pg 5-13). Other missiles are being introduced. They include the Nimrod 3 with GPS course correction, and the SAL-homing option. Another is the Russian Hermes-A, with SAL-H, radar, IIR, and MMW-homing options for use to 40 km. The developmental Hermes-K can range 100 km. European Polyphem and Spike-NLOS also offer NLOS range capability

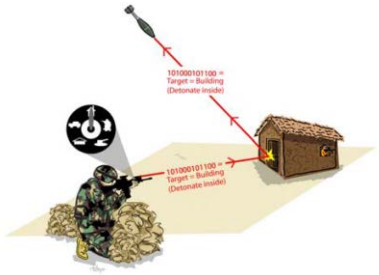
Aircraft can launch selected missiles using direct fire sights to NLOS range, using their elevated view to see over or around obstructions blocking ground-level line-of-sight. Also, attack UAVs, UCAVs, and cruise missiles can attack armored NLOS targets. Use of GPS/GNSS course corrected munitions permit deep precision strikes called by a variety of concealed observers.

6-73

Semi-active Laser Homing (SAL-H) Antitank/Anti-armor System Trends

In the previous section, we noted that SAL-H systems offer an attractive option for use against armored targets beyond-line-of-sight (BLOS) or non-line-of-sight (NLOS) weapons. For SAL-H weapons, there are challenges to be considered. But advantages of these weapons are considerable; and new weapons are in going into production and being deployed.

The three required elements of a SAL-H system are: launch weapon, missile or munition, and laser target designator (LTD) to direct missile/munition to a target. In some cases, a system features specially designed guns/launchers with new rounds, and compatible LTD. But most legacy weapon systems can fire/launch SAL-H munitions, if compatible; and almost any separate LTD can be used to guide the munition to target. In addition, most LTDs are also laser rangefinders, and are powerful enough to range targets to 20 km or more. Thus the components can turn conventional non-precise weapons into precision weapon systems.



Lasing a target with an LTD

An early SAL-H munition was the US Copperhead 155-mm artillery round. With its shaped charge warhead for use against armored targets, it proved less than successful; because a slight error in precision could mean a near miss and no effect. The Russians are more successful with their 2K25/Krasnopol 152-mm artillery round; because the Frag-HE warhead and improved accuracy render a multi-role munition large enough to kill armored and unarmored targets. Since the early 1980s, a wide range of systems have been equipped to deliver SAL-H munitions. Although some SAL munitions are not heavy enough to kill a tank, almost all can inflict major damage on a tank and kill other vehicles. The following are a few examples of systems in this category:

2K25/Krasnopol artillery round

- Fixed-wing and rotary-wing aircraft bombs (e.g., KAB-500L at V2/pg 2-26), missiles (e.g., AS-10/KAREN at V2/pg 2-25), and rockets (e.g., S-8Cor at V2/pg 2-23).
- Rounds from naval and artillery cannons (e.g., Firn-1 130-mm gun round at V3/pg 3-13, and Krasnopol-M 155-mm howitzer round at V1/pg 7-76).
- Mortar projectiles and artillery rockets (e.g., Russian Gran 120-mm mortar rd at V1/pg 7-76, and Ugroza 122-mm rocket at V1/pg 7-76).
- ATGMs e.g., Japanes ChuMat/Type 87 ground launch, Israeli LAHAT (tanks, RW aircraft, etc., pg 6-75), and Mikholit UAV launch and Nimrod 3 vehicle (pg 6-75).

Producers of SAL-H systems include Russia, the Ukraine, Bulgaria, China, the U.S., UK, South Africa, Israel, Japan, Germany, Poland, France, Turkey, and others. A wide variety of countries have purchased these systems. The numbers are not easily determined, since the weapons used can be legacy systems. Munitions and LTDs are easily hidden and not easily distinguishable from conventional munitions and sensors by most observers.

SAL-H munitions have a gimbaled seeker in the nose which permits them to home to the laser splash (see pg 6-72). Some munitions feature highly maneuverable fins. Others use less expensive "bump jets". Still others can be converted from unguided munitions into SAL-H by replacing the nose mount fuze unit with a vaned tilting seeker unit. SAL-H missiles vary in cost from less than other precision guidance munitions, to more, depending on design.

Any precision munition is likely to spur countermeasures (CM) to reduce their effectiveness. Some vehicles and aircraft have laser warning receivers, to alert the user and trigger CM or counter-tactics. Smoke is often a CM against precision munitions. Neither smoke nor infrared CM can work for aircraft; but aircraft can flee the area. For ground systems, a warning receiver can trigger a false target generator, to decoy the seeker of the SAL-H munition. Some seekers can be decoyed, but other designs limit sensitivity to decoys. One CM to FTGs for many SAL-H munitions is to encode a preset pulse repetition frequency (PRF) of the infrared laser light (often 1.067 microns), which links it to the command laser beam from the LTD. The munitions will only home to targets showing laser splash with the coded light pulse. One counter-tactic is to lase off-target and slew it to the target late in flight, or to turn the laser on late in flight. Some forces use a device with a coordination link from the firer that tells the operator when to turn on the LTD seconds before impact.

LAHAT

Key advantages of SAL-H munitions include the following:

- A wide variety of legacy systems can be used with low fielding or adaptation cost.
- Vehicles can mount an LTD without initially having to integrate it into their fire control.
- Weapons can launch munitions at targets beyond their direct view, if an LTD is positioned downrange to lase the target. Thus firers have reduced risk of detection.
- Most of the munitions are effective beyond the range of other precision munitions, because the seeker reduces operator or ballistic errors, even against moving targets.
- Seeker designs permit some munitions to execute a pitch-over impact, for top-attack kill.

As ranges of SAL-H systems are extended farther to meet the requirement for precision kill of BLOS and NLOS targets, a number of trends have emerged. One is that the longer-range munitions have increased in cost, but also in size and in lethality to offer multi-purpose effectiveness against more high-value targets, beyond just armored vehicles. Users have found that HELLFIRE missile is a multi-purpose munition for roles such as destroying buildings and bunkers. Russia claims that Hermes-A can be used against RW aircraft, ships, materiel such as radars, and more. Many missiles have tandem warheads (some with HE and HEAT, others with two HEAT). Large HEAT warheads offer residual HE effects against unarmored targets.

Longer SAL-H range also has led to adding multi-guidance modes to the munitions. Many now include an inertial or GNSS course-corrected (see Nimrod 3) in-flight phase with SAL homing. Others (e.g., Hermes-A) use SAL-H with infrared/millimeter wave homing for precision against moving targets. The LAHAT gun-launched or helicopter launched ATGM can

LAHAT helicopter

lock on after launch with SAL-H and designate for itself in the terminal phase. Russian makers claim that the Sokol-1 125-mm tank gun round

(not yet fielded) can be either LTD guided, or can lock on with its infrared seeker and home onto the target hot spot in its terminal phase.

Earlier limitations in one component of the SAL-H complex delayed wider use of SAL-H munitions – the laser target designator. Early LTDs (1970s-90s) tended to be large, cumbersome, and easy to detect for counter-fires, and difficult to employ against deep targets. This limitation reduced the utility and applications of SAL-H to mostly aircraft-delivered munitions and artillery rounds. Most ground mount LTDs were limited to a range of 3-5 km.

ChuMat launcher and LTD

Revolutions in electro-optics and power supply brought an explosion of new compact, longer range, and less costly LTDs after 2000. Now there are man-portable shoulder mount or hand-held LTDs (e.g., Israeli Rattler) ranging to 5 km, and man-portable tripod versions to 10+ km. Vehicle and aircraft LTDs can reach 15+ km. Sophisticated vehicles and aircraft integrate LTDs into their fire control. An auto-tracker is preferred for any LTD, because it allows the system to lock onto moving targets and eliminate operator error. Thanks to the revolution in gyro-synchronization and servo-motors (pioneered with video-cameras), even some hand-held LTDs offer image stabilization and auto-trackers. Thermal channels also offer LTDs night capability.

DHY-307 LTD

For a number of countries, the most effective course is to fit UAVs with LTDs. Significant limitations for most LTDs are the delay time and risk in getting deep in enemy territory to designate fleeting targets. UAVs can fly more quickly with lower detectability than other assets. They also are often a better alternative to UCAVs and attack UAVs, because they can patrol wide areas and execute missions against more successive targets. The aircraft is retained, usually undetected, and able to fly the next day. Some manufacturers now offer unmanned combat aerial vehicles (UCAVs) with LTDs and SAL-H homing ATGMs. An example is the Israeli Hermes 450S, which can launch 2-4 new Mikholit ATGMs, then guide them to target.

An Israeli firm recently began marketing remotely operated ground-based LTDs. One is the Engager tripod-mounted LTD. The man-portable hand-emplaced device has an 8 km day range and 4.5 km night range. It can link to a display unit with cable or radio link. Of course, it also serves as a remote-operated electro-optical surveillance system. Positioned at key locations along avenues of approach, they perform the duties of special purpose teams and facilitate precision strikes against high value moving targets, with almost no detectability.

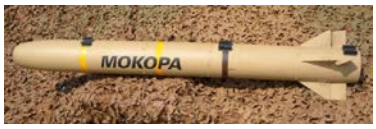
The Russian firm AMETECH developed the S-25L air-to-surface rocket. Now Ametech offers several SAL-H munitions, such as the Ugrosa-1 122-mm rocket for BM-21 MRLs. A recent line is the S-Cor line, which mates the S-series of air-to-surface rockets (57-mm S-5, 80-mm S-8, 122-mm S-13, etc.) with detachable SAL-H maneuvering warheads. The warheads offer greater range than their unguided predecessors (8 km for S-8Cor versus 4 km for S-8). Lethality dramatically increases (400 mm top attack versus S-8Cor versus 400 slant attack for S-8KOM).

These rockets could revolutionize anti-armor attack capabilities of ground attack aircraft. For example, a Russian Mi-24P/HIND-F attack helicopter (V2, pg 2-9), with the most likely

armament mix (for mixed targets), has 8 x AT-9C ATGMs, 40 x S-8 80-mm air-to-surface rockets (ASRs), and 2 x SA-24 SAMs. The ATGMs feature excessive penetration versus nearly all light armored vehicles; but the ASRs are too inaccurate with too short a range (4 km) to face the guns and SAMs found with light armored vehicles. With the SCor conversion, the helicopter now has the ATGMs, plus 40 x 80-mm rockets for precision kills of light armored and unarmored targets, with an 8 km range. Of course, 122-mm or 240-mm SAL-H rockets, and bombs could be used for heavier targets.

S-25L air-to-surface rocket

Many heavy SAL-H munitions begin their use life as air-to-surface munitions launched from FW or RW aircraft. Over time, some of these are being adapted for use on ground launchers. For instance, the South African Mokopa/ZT-6 ATGM (see pg 6-80) is now fitted on helicopters; but a Mokopa LUV launcher is also offered for mounting on ground vehicles. Initial display has the launcher on a flatbed off-road truck chassis, similar to "technicals" in Third World countries.



Mokopa ATGM

Developers continue to find new applications for SAL-H munitions. An Israeli firm developed G-LAW, a SAL-homing grenade for the Russian RPG-7 antitank grenade launcher. The same guidance was used with the Panzerfaust 3LR (pg 2-35) grenade for the German Pzf 3-T600 ATGL. Although these munitions are more costly than other AT grenades, the high probability of hit, and their increased range (800 m for G-LAW) would make the upgrade worthwhile. The greatest limitation for such a change is the cost for the associated LTD. The requirement for infantry precision AT has led to other costly but effective systems, such as the British NLAW, and the shoulder-launched Eryx ATGM (pg 6-22). It is likely that future increased SAL-H proliferation and EO sensor developments will offer affordable shoulder or tripod mount LTDs SAL-H systems for man-portable weapons and munitions used by platoons and squads.

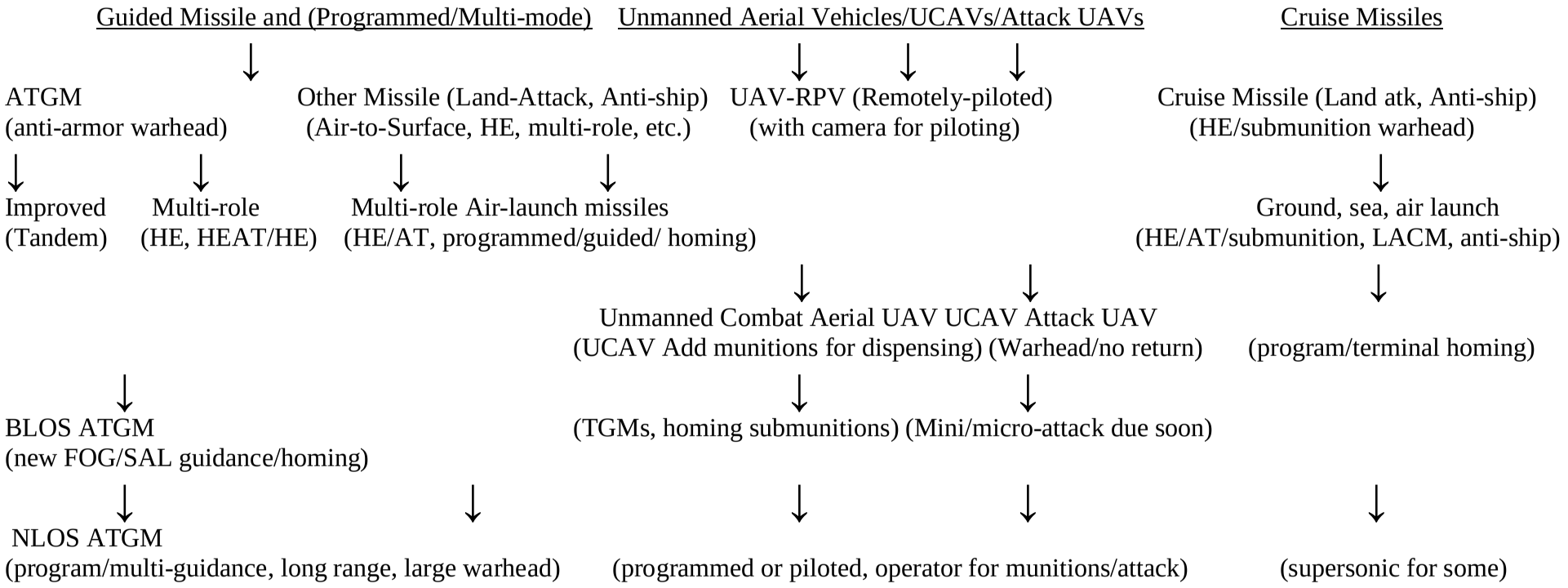
It is likely that continued improvements in LTDs and new SAL-H seeker designs will expand applications of this guidance mode. The challenges of hybrid warfare in urban areas continue to place a premium on use of precision weapons to reduce collateral damage and loss of civilian lives. The SAL-H munitions require eyes on the target, and can be redirected right up to the point of impact. In addition, battlefield mobility will limit use of many other precision munitions, which can be counter-measured or out-maneuvered. Even though lower tier regular and irregular forces often lack training to use many precision munitions, SAL-H munitions have been used in some of these countries. Although SAL-H munitions are more expensive than some precision alternatives, the cost savings from economical fires (1-2 munitions per kill) can be significant in reducing ammunition costs, and in the ability of weapons to fire and move, to extend the use lives of tanks, antitank weapons, artillery, aircraft, vessels, and other weapons.

ChuMat bipod ATGM launcher

Categories of Non-Ballistic Missiles and Munitions for BLOS/NLOS

Military forces have exploited developments in delivery platforms, compact precision guidance, propulsion, C^2, and warhead technologies across various disciplines for aerial munitions. These have led to UAVs, UCAVs, ATGMs, cruise missiles, and other guided missiles. Cross-application of designs has improved all missile categories, expanding their roles, and blurring distinctions. Please note a few fundamental terms. A rocket is unguided. A missile adds precision for 50% or higher probability of hit. Precision comes from guidance e.g., inertial/GPS navigation programming, human guidance/intervention, and/or self-homing. These weapons and munitions can be ground-, sea-, or air-launched, against land or sea targets (as well as air, as a secondary role for some). The evolution chart below can help clarify terms for systems and applications.

Interestingly, as weapons have developed and borrowed guidance, missile, and warhead designs, they have become somewhat similar in capabilities, variety of targets, and application methodologies. These systems will augment (not eliminate) each other. But there are distinctions. Harpy (Vol 2 pg 5-13) can be remotely piloted as an attack UAV, or a GNSS-programmed CM with terminal homing. An air-launched missile is classed as guided, ATGM, or ALCM. Land-attack missiles and anti-ship missiles can be ground-, sea- or air launched. Missiles/UAVs such as Harpy and ATGMs can be used to attack selected naval, littoral, and land targets. All categories include recent models with options for lock-on and programming before or after launch. The optimum system will be selected for range, availability, responsiveness, and applicability for a given target.



Beyond-Line-of-Sight (BLOS) and Non-Line-Of-Sight (NLOS) Antitank Guided Missile Systems

NAME	PRODUCER COUNTRY	NUMBER OF USERS/ STATUS	LAUNCHER PLATFORMS	GUIDANCE SYSTEM	NUMBER OF LAUNCHERS	WARHEAD DIAMETER (mm) PENETRATION	RANGE (km) MIN	MAX	REMARKS
Hellfire/	US	14 countries	Vehicles, helicopter, ground available	Semi-active laser (SAL) homing	1/2/8 vehicle, 8-16 helicopter	178-mm HEAT /1000	.5	8	Vehicle eg Pandur/ grnd mount limited use
Hellfire IHW/ Hellfire II	US, UK	At least 8 countries	Vehicles, helicopter, ground available	SAL/course-correction	1/2/8 vehicle, 8-16 helicopter	178-mm tandem HEAT/1000+	.5	8-9	Vehicle eg GLH II/ grnd mount limited use
Brimstone	UK	Fielded	Helicopter	MMW homing	INA	178 Tandem/1000+	INA	8-12	Interim Hellfire variant
Hellfire Longbow	US	At least 2	Helicopter	SAL/MMW homing	8-16 helicopter	178 HEAT/ 1000+	.5	9	Fragmentation liner
Mokopa /ZT-6	South Africa	1 country, marketed	Helicopter, vehicle option offered	SAL, IIR possible	8 helicopter	178-mm Tandem /1350	INA	10	MMW homing in development
Nimrod Nimrod 3 Mikholit	Israel	2 countries, exported 1 country	Jeep-type, tracked AMX-13 UCAV version of UAV	SAL/ course correction SAL/GPS CC SAL	TUV 4 Tracked 16 2 or 4	170-mm/ 800 top atk 160-mm/Remarks 170-mm/ 800 top atk	.8 .8	26 55+ 10	Also UCAV variant Nimrod 3 50-kg warhead Heron, Hermes 450s, etc.
Hermes-A (Russian Germes)	Russia	Developed and marketed	BMP-3 IFV and boat. Helicopter, ship, truck-based TELAR to 40 km	SAL-H/inertial, Add radar-guided 40 km IIR/MMW homing	12 on BMP-3, Hokum, and ship 24 on truck	130-mm Frag-HE 28 kg (=1300+ mm) CMs larger whds	INA	18 40	Thermal, radar auto-track. Multi-role missile for ground, naval, air targets
Hermes-K and other	Russia	Marketed	Truck launcher complex	Radar, SAL, IIR/MMW-H	Up to 24	See above		100	6-vehicles including radar
LAHAT	Israel	2 countries, marketed	Tank, recoilless rifle, heli, LAV, ship pod	SAL. Missile designator option for self-homing	Gun-launch, Veh 6-8, heli 4-8	Tandem/1000+ MP-Frag	INA	8+ 13 heli	106-mm recoilless rifle poss. Pod sensor launch.
Shin-JuMat/ATM-4	Japan	Development	High-Mobility 4x4	FOG TV, IIR Homing	6 launchers	Unitary 160-mm	INA	10	Dive attack
FOG-MPM -MPM 12 and 20	Brazil	Ready for production	Available for ship, 4x4 vehicle, helicopter	FOG TV	Up to 8 on 4x4, 16 for larger	Tandem 180-mm /1000+	INA	10 12/20	Dive attack, option for Astros MRL launch
Polyphem	European consortium	Decision due on fielding	Ground vehicle, ship, helicopter launch	FOG TV/IIR terminal homing, GPS-corrected	INA	220-mm 20 kg, Frag-HE, HEAT	INA	60 poss +	Land/sea attack, shorter range variant expected
Spike-LR (Long-Range)	Israel	3 countries, 2 more soon	Man-portable grd lchr, vehicle, helicopter	IIR or CCD FOG, IIR homing option	1 Ground, 8 helicopter	110 Tandem/800+ and MP-Frag	INA	4/2.5 Euro	Gill upgrade for Spike. Euro version, top atk
Spike-ER (Extended-Range)	Israel	Fielded, for export	Helicopter, vehicle, tripod, ship	FOG CCD, IIR-Homing, lock-on after launch	4-8 heli 1-8 veh, tripod	Tandem/1000+ and MP-Frag	.4	8	Previously known as Dandy/NTD, dive attack
Spike-NLOS	Israel	2 countries, 1 export	Helicopter, vehicle, ship, RWS, pod	FOG CCD, IIR-Homing, LOAL, sensor retarget	4-8 heli 4 LAV, TUV	Tandem/1000+ and MP-Frag	.4	25	Remote guidance (UAV/ heli) option, Dive attack

NOTES:

(1) Generally BLOS is considered to be in the 0-10 km band, and NLOS 10+. These systems can be used for multiple attack roles, not only as armor killers but for use against high-priority land targets, ships, and helicopters. Missiles of 12+ km can be categorized Land attack cruise missiles (LACMs). FOG NLOS systems can be used for reconnaissance, battle damage assessment, and for lethal attack. AT missile units are not employed above battery level. Platoons or companies are assigned to combat units, including indirect fire support units, as needed.

(2) Systems are fielded, or marketed, or in prototype/testing stage prior to marketing and production. Other programs and concepts are underway, and could result in fielded systems 2005-2020. Examples are the Alfo and Micro-Alfo shoulder and/mortar launch FOG systems, or FOG-MPM 20.

(3) For SAL systems using self-designation, ground range is generally limited by vegetation and defilade to 5-6 km. Users often employ cooperative engagement with remote cueing and designation by other observers. A laser target designator in an AT unit may designate not only SAL missiles, but other guidance-compatible missiles, artillery and naval SAL rounds, and aerial bombs. Systems with FOG-M guidance do not need a designator, as the missile eye is used to fly the missile, select targets, and home to target. Because most pitch downward into to the vulnerable vehicle top, P-Kill on impact is greater. Several systems employ a pre-programmed (inertial) phase to avoid operator fatigue. The final phase may employ terminal homing.

South African NLOS ATGM Launcher System Mokopa

Ratel Swift/Ingwe ATGM Launcher

Mokopa ATGM

Weapons & Ammunition Types	Typical Combat Load
Launcher	**12**
Mokopa Tandem ATGM	

SYSTEM
Alternative Designations: ZT-6, Black Mamba
Date of Introduction: Ratel ATGM 1990. Mokopa due by 2004
Proliferation: The Ratel vehicle is fielded in 3 countries. Mokopa is now fielded. The system represents Nimrod, Shin-JuMat, Hermes, and other NLOS ATGM launcher systems.
Crew: 3 est
Platform: Ratel IFV, (See Notes)
Combat Weight (mt): 18.5 as IFV
Chassis Length Overall (m): 7.21
Height (m):
Overall: 2.92
In Firing Position: INA for Swift or Ingwe (See Notes)
Width Overall (m): 2.52
Drive Formula: 6x6

Automotive Performance:
Engine Type: 282-hp Diesel
Cruising Range (km): 1,000
Speed (km/h):
Max Road: 105
Max Off-Road: 30
Average Cross-Country: 30
Max Swim: 3-4
Fording Depths (m): 1.2

Radio: INA

Protection:
Armor, Turret Front (mm): 20 hull, 8-10 elsewhere
Applique Armor (mm): N/A
Explosive Reactive Armor (mm): N/A
Active Protective System: N/A
NBC Protection System: No
Smoke Equipment: 2 smoke grenade launchers each side

ARMAMENT
Antitank Guided Missile Launcher
Name: INA
Launch Method: Erectable launcher
Number of missiles on launcher: 3
Rate of Launch: (missiles/min): 1-2, depending on range
Ready/Stowed Missiles: 12/ 0 from internal rack
Loader Type: Manual
Launcher dismountable: No
Auxiliary Launcher: No
Fire on the Move: No

FIRE CONTROL
FCS Name: INA
Guidance: SACLOS
Command Link: Semi-active laser homing (SAL), with lock-on before launch or LOAL, and course correction with digital autopilot
Beacon or Tracker Type: None needed with seeker on missile
Susceptible To Countermeasures: Smoke, counterfire (self-lase only)
With remote lasing by a down-range LTD, launcher vehicle does not need to see the (NLOS) target.
Counter-countermeasures: Probable encoded laser frequencies
Rangefinder: Laser
Sights w/Magnification:
Gunner:
Day: TV guidance est
Acquisition Range (m): 500-10,000 based on LOS to 10,000 without LOS but with remote designator
Night: Thermal night sight
Acquisition Range (m): >5,000 est

VARIANTS
Swift/ZT-5 and **Ingwe/ZT-35** ATGM launcher vehicles (see photo) launch indigenous ATGMs with similar guidance.

Ratel Mk1, 2, and 3 variants include fire support vehicle with 90-mm gun, 81-mm mortar carrier, command vehicle, IFV with 60-mm mortar, armored maintenance vehicle, logistics vehicle.

Mokopa is **a** variant of the US **Hellfire/Hellfire II** developed initially for helicopter launch from Rooivalk. The system can also launch British **Brimstone** ATGMs. They have developed an upgrade package for the Mi-24/35 HIND, which includes Mokopa.

Mokopa LUV (Light Utility Vehicle) turret system: A remote weapon station to fit on vehicle flat beds, with 4 Mokopa launchers. With the launcher-high laser target designator, the vehicle can launch while hull-down. A variant can launch Ingwe beam-rider ATGMs.

Thor: The light turret (pg 6-23) can launch a SAL missile, e.g., Hellfire or the Mokopa variant, and use a remote laser designator from a UAV, helicopter, vehicle or dismount to guide it to target.

AMMUNITION
Antitank Guided Missiles
Name: Mokopa
Alternative Designations: ZT-6
Missile Weight (kg): 52
Warhead Type: Tandem Shaped Charge (HEAT)
Armor Penetration (mm CE): 1,400+ est (1,350 behind ERA)
Minimum/ Maximum Range (m): 500/10,000
Probability of Hit (%): 90 est based on SAL guidance
Time of Flight to Max Range (sec): 35

Other Missile Types: HE warhead in development. MMW and IIR-homing, and anti-bunker versions due out in the near-term.

NOTES
Developers noted that Mokopa will fit various modular launch applications, and can be mounted on a ground launcher (truck, LAV or tactical utility vehicle chassis), and on naval vessels. Since current South African Swift (ZT-3) and Ingwe (ZT-35) ATGM launcher vehicles are based on the robust RATEL IFV chassis, we selected that chassis as a candidate for the Mokopa system.

Chapter 7
Artillery

This chapter provides the basic characteristics of selected artillery weapon systems, artillery reconnaissance, and artillery command and control (C2) systems in use or readily available to the OPFOR. Therefore, systems discussed in this chapter are those likely to be encountered by U.S. forces in varying levels of conflict. The selection of artillery systems is not intended to be all-inclusive, rather a representative sampling of weapons and equipment supporting various military capabilities.

This update is divided into the following categories—artillery command and reconnaissance, towed cannon, self-propelled cannon, multiple-rocket launchers, mortars and combination guns, and artillery ammunition.

Please note that other chapters describe some other systems which can be employed in artillery units. Additional reconnaissance systems used by artillery units are noted in the Vol 1 Reconnaissance chapter (3). Increasingly, artillery units are employing assigned or organic unmanned aerial vehicles (UAVs) to locate targets, guide laser guided projectiles (LGPs), and conduct battle damage assessment (Vol 2, Chapter 3). The Vol 1 C^2 chapter (9) describes some C^2 systems used in artillery units.

Weapons outside of the category Artillery can provide supporting fires and strikes for Integrated Fires Commands (IFCs). Those weapons include naval weapons (Vol 3, Chapter 1), fixed and rotary-wing aircraft (Vol 2, Chapters 1 and 2), unmanned combat aerial vehicles (UCAVs in Vol 2, pg 4-16), theater missiles (Vol 2, Chapter 5), and non-line-of-sight antitank guided missiles (NLOS ATGMs, Vol 1, pgs 6-73 to 6-75).

Questions and comments on data listed in this chapter should be addressed to:

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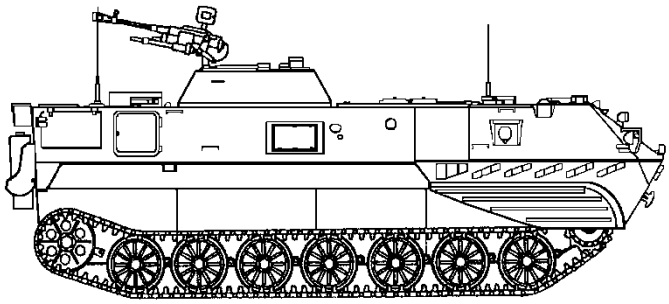
Russian Artillery Command and Reconnaissance Vehicle 1V13



Weapons &Ammunition Types	Typical Combat Load
12.7-mm DShK MG	**500**

SYSTEM
Alternative Designations: M1974-1
Date of Introduction: 1974
Proliferation: At least 1 country
Description:
Crew: 6
Platform (chassis): MT-LBu
Combat Weight (mt): 15.7
Chassis Length Overall (m): 7.62
Height Overall (m): 2.72
Width Overall (m): 2.85

Automotive Performance:
Engine Type: YaMZ-238, 240 hp diesel
Cruising Range (km): 500 km
Speed (km/h):
Max Road: 60
Max Off-Road: 26
Cross-Country: INA
Max Swim: 4.5
Fording Depths (m): Amphibious

Radio: R-123M radio (3 each)

Protection:
Armor, Turret Front (mm): 20
Armor Turret Top (mm): INA
Armor Hull (mm): 15
NBC Protection System: Yes
Smoke Equipment: No

ARMAMENT
Caliber, Type, Name: 12.7-mm heavy machinegun, DShK
Mount Type: Pintle
Direct Fire Range (m): 1,500
Max Effective Range (m):
Day: 1,500
Night: N/A
Fire on Move: Yes
Rate of Fire (rpm): 80-100 (practical)

VARIANTS
1V13M: INA

SENSORS/COMPONENTS
Navigation: 1T121-M Navigation System

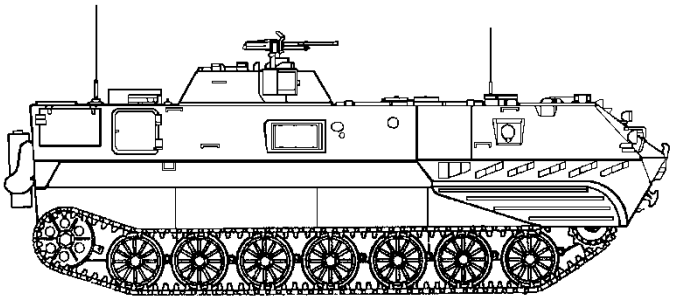
Fire direction:
Automated: APK automated firing data receiver
Manual: PUO-7

Other equipment: DSP-30 rangefinder, K-1 collimator, roof mounted periscopic aiming circle, VOP-7 vision blocks and driver's periscopes.

NOTES
The MT-LBu-based 1V12 *Maschina* ACRV set was first noted in 1974. The set provides the command and control vehicles for SP cannon battalions. The eight-vehicle set consists of three 1V13 battery senior officer's vehicles, three 1V14 battery commander's vehicles, one 1V15 battalion commander's vehicle, and one 1V16 battalion FDC/chief of staff's vehicle. The 1V12M *Faltset* ACRV set is a modernized version of the system. The installation of an upgraded electronics package in the vehicles necessitated the requirement for an external-mounted power generator (the 1V12 *Machina* ACRV generator was mounted internally). In addition to freeing a small amount of space inside the vehicle, the external mounting reduces the internal noise level.

The ACRV 1V13 is the battery FDC of the 1V12 ACRV Complex. The battery senior officer, assisted by fire direction and communications personnel mans the vehicle. It has direct radio communications with the battery COP, the battalion COP, and the battalion FDC. The vehicle is equipped with a land navigation system and has a roof mounted periscopic aiming circle. The roof mounted periscopic aiming circle allows the battery senior officer the ability to lay the howitzers for direction from within his vehicle. There is no battlefield observation equipment present on the 1V13.

Russian Artillery Command and Reconnaissance Vehicle 1V14/1V15



Weapons &Ammunition Types	Typical Combat Load
7.62-mm MG	**2,000**

SYSTEM
Alternative Designations: M1974-2A (1V14), M1974-2B (1V15)
Date of Introduction: 1974
Proliferation: At least 1 country
Description:
Crew: 1V14 (6)/1V15 (7)
Platform (chassis): MT-LBu
Combat Weight (mt): 15.7
Chassis Length Overall (m): 7.26
Height Overall (m): 2.72
Width Overall (m): 2.85

Automotive Performance:
Engine Type: YaMZ-238, 240hp diesel
Cruising Range (km): 500 km
Speed (km/h):
- Max Road: 60
- Max Off-Road: 26
- Cross-Country: INA
- Max Swim: 4.5

Fording Depths (m): Amphibious

Radios:
- 1V14: R-123M (3 each), R-107M (1 each)
- 1V15: R-123M (2 each), R-107M (1 each), R-111 (1 each), R-130M (1 each)

Protection:
Armor, Turret Front (mm): 20
Armor Turret Top (mm): INA
Armor Hull (mm): 15
NBC Protection System: Yes
Smoke Equipment: No

ARMAMENT
Caliber, Type, Name: 7.62-mm machinegun, PKT
Mount Type: Pintle
Direct Fire Range (m): 1,500
Max Effective Range (m):
- Day: 1,000
- Night: N/A

Fire on Move: Yes
Rate of Fire (rpm): 650 (cyclic), 2-10 round bursts

VARIANTS
1V14M/1V15M: INA

SENSORS/COMPONENTS
Navigation: 1T121-M Navigation System

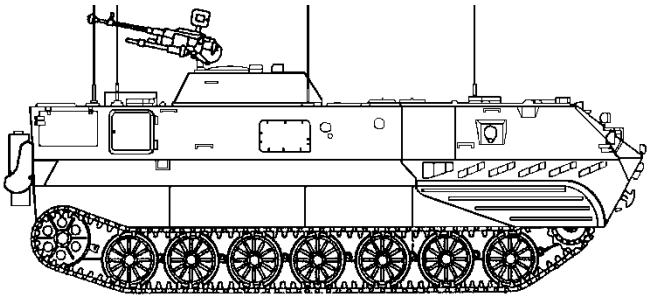
Fire direction:
- Automated: 1V520.
- Manual: PUO-7

Other equipment: 1D15 laser rangefinder, DSP-30 rangefinder, 1PN44 day/night sight, PAB-2AM aiming circle, DS-1 stereoscopic rangefinder, VOP-7 vision blocks and driver's periscopes.

NOTES
The MT-LBu-based 1V12 *Maschina* ACRV set was first noted in 1974. The set provides the command and control vehicles for SP cannon battalions. The eight-vehicle set consists of three 1V13 battery senior officer's vehicles, three 1V14 battery commander's vehicles, one 1V15 battalion commander's vehicle, and one 1V16 battalion FDC/chief of staff's vehicle. The 1V12M *Faltset* ACRV set is a modernized version of the system. The installation of an upgraded electronics package in the vehicles necessitated the requirement for an external-mounted power generator (the 1V12 *Machina* ACRV generator was mounted internally). In addition to freeing a small amount of space inside the vehicle, the external mounting reduces the internal noise level.

The ACRV 1V14 and ACRV 1V15 are the battery and battalion commander's vehicles of the 1V12 ACRV Complex. Both vehicles are equipped with the 1T121 land navigation system, a 1D15 laser rangefinder, and the 1PN44 day/night sight mounted in a basketed turret. The observer uses an analog coordinate converter to translate the polar location data when determining rectangular target coordinates. The 1V14 has an internal power generator. The 1V15 can be distinguished from the 1V14 by the external antenna bracket on the rear of the vehicle. The 1V520 fire direction computer may be transported internally and dismounted at a command observation post. The artillery commander, assisted by target acquisition, fire direction and communications personnel mans the vehicle. The artillery commander decides how to attack targets of opportunity and targets relayed to him by the supported maneuver unit.

Russian Artillery Command and Reconnaissance Vehicle 1V16



Weapons &Ammunition Types	Typical Combat Load
12.7-mm DShK MG	**500**

SYSTEM
Alternative Designations: M1974-3
Date of Introduction: 1974
Proliferation: At least 1 country
Description:
Crew: 7
Platform (chassis): MT-LBu
Combat Weight (mt): 15.7
Chassis Length Overall (m): 7.26
Height Overall (m): 2.72
Width Overall (m): 2.85

Automotive Performance:
Engine Type: YaMZ-238, 240hp diesel
Cruising Range (km): 500 km
Speed (km/h):
Max Road: 60
Max Off-Road: 26
Cross-Country: INA
Max Swim: 4.5
Fording Depths (m): Amphibious

Radios:
R-123M (2 each), R-111M (1 each),
R-130M (1 each, R-326 receiver (1 each)

Protection:
Armor, Turret Front (mm): 20
Armor Turret Top (mm): INA
Armor Hull (mm): 15
NBC Protection System: Yes
Smoke Equipment: No

ARMAMENT
Caliber, Type, Name: 12.7-mm HMG, DShK
Mount Type: Pintle
Direct Fire Range (m): 1,500
Max Effective Range (m):
Day: 1,500
Night: N/A
Fire on Move: Yes
Rate of Fire (rpm): 80-100 (practical)

VARIANTS
1V16M: INA

SENSORS/COMPONENTS

Fire direction:
Automated: 9V59
Manual: PUO-7

NOTES
The MT-LBu-based 1V12 *Maschina* ACRV set was first noted in 1974. The set provides the command and control vehicles for SP cannon battalions. The eight-vehicle set consists of three 1V13 battery senior officer's vehicles, three 1V14 battery commander's vehicles, one 1V15 battalion commander's vehicle, and one 1V16 battalion FDC/chief of staff's vehicle. The 1V12M *Faltset* ACRV set is a modernized version of the system. The installation of an upgraded electronics package in the vehicles necessitated the requirement for an external-mounted power generator (the 1V12 *Machina* ACRV generator was mounted internally). In addition to freeing a small amount of space inside the vehicle, the external mounting reduces the internal noise level.

The 1V16 is the simplest of the vehicles in the 1V12 ACRV Complex and serves as the battalion FDC/chief of staff's vehicle. Normally, the battalion chief of staff, assisted by fire direction and communication personnel mans the vehicle. It has neither battlefield observation optics nor a navigation system. However, the vehicle is equipped with the standard VOP-7 vision blocks and driver's periscopes. It is equipped with extra radios and has an extendable antenna mast mounted on the vehicle rear. The 9V59 fire-direction computer is mounted in the vehicle.

The 9V59 fire-control computer comes in several different models believed to be designated as 9V59-1, -2, and –3. For example, the 9V59-2 is associated with 152-mm artillery units. The 9V59 fire-control computer is probably a 4-bit computer and, although quite rugged, is assessed to have a low mean time between failures because of a large number of discrete components. The 1V510 is assessed to be a replacement for the 9V59 fire-control computer. The 1V510 is capable of performing survey calculations and technical firing data. The system is assessed to be 33% faster than the 9V59.

Russian Artillery Command and Reconnaissance Vehicle 1V18/1V19 _____

Weapons &Ammunition Types	Typical Combat Load

SYSTEM
Alternative Designations: M1979-2A (1V17), M1979-2B (1V18)
Date of Introduction: 1979
Proliferation: At least 1 country
Description:
Crew: 6
Platform (chassis): BTR-60PB
Combat Weight (mt): 10.1
Chassis Length Overall (m): 7.22
Height Overall (m): 2.06
Width Overall (m): 2.82

Automotive Performance:
Engine Type: 2 GAZ-49B 90 hp(180 hp total) in-line, water-cooled gasoline
Cruising Range (km): 500 km
Speed (km/h):
- Max Road: 80
- Max Off-Road: 60
- Cross-Country: INA
- Max Swim: 10

Fording Depths (m): Amphibious

Radio:
- 1V18: R-123M (3 each), R-107M (1 each)
- 1V19: R-123M (2 each), R-107M (1 each), R-111 (1 each), R-130M (1 each)

Protection:
Armor, Turret Front (mm): INA
Armor Turret Top (mm): INA
Armor Hull (mm): INA
NBC Protection System: Yes
Smoke Equipment: No

VARIANTS
None

SENSORS/COMPONENTS
Navigation: 1T121-M Navigation System

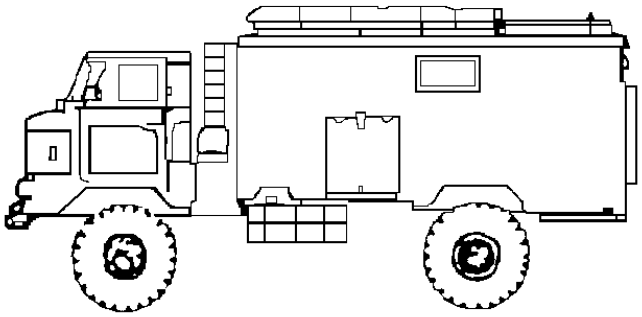
Fire direction:
- Automated: 1V520
- Manual: PUO-7

Other equipment: 1D15 laser rangefinder, 1PN44 day/night sight, PAB-2AM aiming circle, DS-1 stereoscopic rangefinder

NOTES
In 1979, the Soviet Union introduced a similar wheeled ACRV set for multiple rocket launcher and towed cannon units. The eight-vehicle set consists of three 1V110 battery senior officer's vehicles, three 1V18 battery commander's vehicles, one 1V19 battalion commander's vehicle, and one 1V111 battalion chief of staff's vehicle. Early versions of the 1V17 ACRV set included a 1V111 equipped with a modified ZIL-130-mounted 9S77M instead of the ZIL-131. There have been no upgrades to the 1V17 like that of the 1V12 to 1V12M.

The ACRV 1V18 and 1V19 are the battery and battalion commander's vehicles of the 1V17 ACRV Complex. Both vehicles are equipped with the 1T121 land navigation system, a 1D15 laser rangefinder, and the 1PN44 day/night sight. The observer uses an analog coordinate converter to translate the polar location data when determining rectangular target coordinates. The 1V520 fire direction computer may be transported internally and dismounted at a command observation post.

Russian Artillery Command and Reconnaissance Vehicle 1V110



Weapons &Ammunition Types	Typical Combat Load

SYSTEM
Alternative Designations: M1979-1
Date of Introduction: 1979
Proliferation: At least 1 country
Description:
Crew: 5
Platform (chassis): GAZ-66B, 4x4 wheeled, Box Body Van
Combat Weight (mt): 3.6
Chassis Length Overall (m): 5.66
Height Overall (m): 2.44
Width Overall (m): 2.34

Automotive Performance:
Engine Type: ZMZ-66, 115 hp V-8, water-cooled, gasoline
Cruising Range (km): 875 km
Speed (km/h):
Max Road: 87
Max Off-Road: 35
Cross-Country: INA
Fording Depths (m): .80

Radio: R-123M radio (3 each)

VARIANTS
None

SENSORS/COMPONENTS
Navigation: See NOTES.

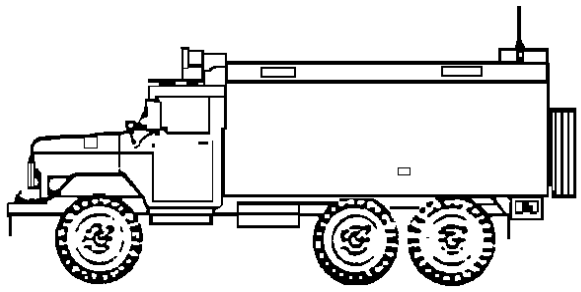
Fire direction: No computation system is installed. The vehicle is equipped with the APK automated firing data receiver.

Other equipment: DSP-30 laser rangefinder, K-1 collimator

NOTES
In 1979, the Soviet Union introduced a similar wheeled ACRV set for multiple rocket launcher and towed cannon units. The eight-vehicle set consists of three 1V110 battery senior officer's vehicles, three 1V18 battery commander's vehicles, one 1V19 battalion commander's vehicle, and one 1V111 battalion chief of staff's vehicle. Early versions of the 1V17 ACRV set included a 1V111 equipped with a modified ZIL-130-mounted 9S77M instead of the ZIL-131. There have been no upgrades to the 1V17 like that of the 1V12 to 1V12M.

The ACRV 1V110 battery FDC serves the same function as the ACRV 1V13 (1V12 ACRV Complex) and is similarly equipped. However, the land navigation system is a different model.

Russian Artillery Command and Reconnaissance Vehicle 1V111



Weapons &Ammunition Types	Typical Combat Load

SYSTEM
Alternative Designations: M1979-3
Date of Introduction: 1979
Proliferation: At least 1 country
Description:
Crew: 7
Platform (chassis): ZIL 131 6x6 box body van
Combat Weight (mt): 6.7
Chassis Length Overall (m): 6.90
Height Overall (m): 2.48
Width Overall (m): 2.50

Automotive Performance:
Engine Type: ZIL 131 61, 150 hp V-8, water-cooled, gasoline
Cruising Range (km): 850 km
Speed (km/h):
Max Road: 80
Max Off-Road: 35
Cross-Country: INA
Fording Depths (m): 1.4

Radio: R-111M (I each), R-123M (2 each) radios; R-130M short-wave radio (1 each), and R-326 receiver (1 each)

VARIANTS
None

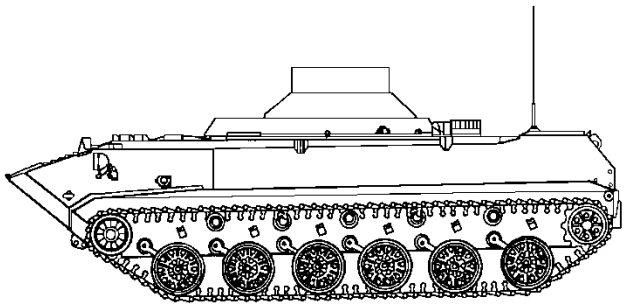
SENSORS/COMPONENTS

Fire direction: 9V59 fire-control computer

NOTES
In 1979, the Soviet Union introduced a similar wheeled ACRV set for multiple rocket launcher and towed cannon units. The eight-vehicle set consists of three 1V110 battery senior officer's vehicles, three 1V18 battery commander's vehicles, one 1V19 battalion commander's vehicle, and one 1V111 battalion chief of staff's vehicle. Early versions of the 1V17 ACRV set included a 1V111 equipped with a modified ZIL-130-mounted 9S77M instead of the ZIL-131. There have been no upgrades to the 1V17 like that of the 1V12 to 1V12M.

The ACRV 1V111 battalion FDC/chief of staff's vehicle serves the same function as the ACRV 1V16 (1V12 ACRV Complex) and houses the fire-direction computer. Like the 1V16, it is the simplest of the vehicles in the 1V17 ACRV Complex and lacks a land navigation system.

Russian Artillery Command and Reconnaissance Vehicle 1V119



Artist Drawing From Photo

Weapons &Ammunition Types	Typical Combat Load

SYSTEM
Alternative Designations: 1V119 Spektr
Date of Introduction: 1981
Proliferation: At least 1 country
Description:
Crew: 6
Platform (chassis): BMD-1
Combat Weight (mt): 6.7
Chassis Length Overall (m): 5.88
Height Overall (m): 1.97
Width Overall (m): 2.63

Automotive Performance:
Engine Type: Type 5D20, 240 hp V-6, liquid-cooled diesel
Cruising Range (km): 500 km
Speed (km/h):
- Max Road: 61
- Max Off-Road: 35
- Cross-Country: INA
- Max Swim: 10

Fording Depths (m): Amphibious

Radio: R-123M (3 each), R-107M (1 each)

Protection:
Armor, Turret Front (mm): INA
Armor Turret Top (mm): INA
Armor Hull (mm): 15
NBC Protection System: Yes
Smoke Equipment: No

VARIANTS
None

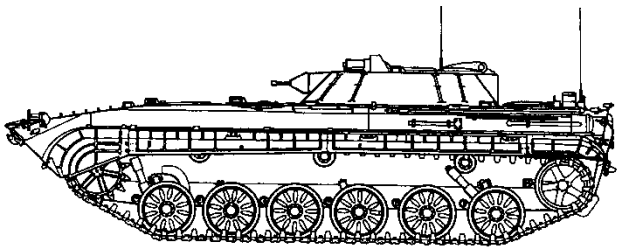
SENSORS/COMPONENTS
Navigation: 1T121-M Navigation System

Fire direction:
- Automated: 1V520.
- Manual: PUO-7

Other equipment: 1D15 laser rangefinder, DSP-30 rangefinder, 1PN44 day/night sight, PAB-2AM aiming circle, DS-1 stereoscopic rangefinder, VOP-7 vision blocks and driver's periscopes.

NOTES
The ACRV 1V119 is associated with the deployment of the 2S9 Nona-S 120-mm Combination Gun and can be parachute landed with airborne troops. The 1V119's sensor and fire direction package is similar to the ACRV 1V14. The 1V118 Reostat is classified as a command and reconnaissance vehicle and is not associated with an ACRV complex.

Russian Artillery Mobile Reconnaissance Vehicle PRP-3 and PRP-4M



PRP-3 with SMALL FRED radar

Weapons & Ammunition Types	Typical Combat Load
7.62 PKT MG	2,000

SYSTEM
Alternative Designations: PRP-3 aka: Val. It is also referred to as a mobile reconnaissance post (MRP).
Date of Introduction: 1975
Proliferation: At least 1 country
Description:
Crew: 5, including two scouts for dismounted operations
Platform (chassis): BMP-1
Combat Weight (mt): 13.2
Chassis Length Overall (m): 6.73
Height Overall (m): 2.14
Width Overall (m): 2.94

Automotive Performance:
Engine Type: 293-hp Diesel
Cruising Range (km): 600
Speed (km/h):
- Max Road: 60
- Max Off-Road: 35
- Cross-Country: INA
- Max Swim: 7

Fording Depths (m): Amphibious

Radio: R-123M on PRP-3. For variants, see right

Protection:
Armor, Turret (mm): 23
Armor Hull (mm): 19
Self-Entrenching Blade: No
NBC Protection System: NBC filtration and overpressure system.
Smoke Equipment: Vehicle engine exhaust smoke system (VEESS)

ARMAMENT
Main Armament:
Caliber, Type, Name: 7.62-mm machinegun PKT
Mount Type: coax
Direct Fire Range (m): 1,300
Max Effective Range (m):
- Day: 1,000 / 400-500 on the move
- Night: 800

Fire on Move: Yes
Rate of Fire (rpm): 600 cyclic in 2-10 round bursts

SENSORS/COMPONENTS
PRP-3/Val Sensors/Components:
Navigation: 1G25 gyrocompass and 1G13 gyro course indicator Fire Direction: 1V520 Ballistic Computer
Right Side Sensors: Day sight, 1PN61 passive IR night sight (with a laser illuminator, aka: laser radar), and 1D11 laser rangefinder
Left Side Sensors: None
Radar: 1RL126 SMALL FRED Radar
- Operating Band: K (36.2 – 37.0 GHz)
- Detection Range: 20 km
- Tracking Range: 7–12 km

Other sensors: There are two periscopes for commander and operator. The PRP-3 has launcher racks on the back of the turret for illumination rockets.

VARIANTS
The below variants still use a BMP-1 chassis, but lack the rocket launchers. They differ in their upgraded sensors and components.

PRP-4/Nard Sensors/Components (fielded mid-1980s):
Navigation: 1G25-1 gyrocompass and 1G13 gyro course indicator
Fire Direction: 1V520 Ballistic Computer
Communications: R-173
Right Side Sensors: LLLTV sight, 1PN61 and 1D11M-1 LRF
Range (km): 10 for TV and LRF, 3 1PN61
Left Side Sensors: 1PN59 Thermal sight and 1D14
Range (km): 3
Radar: 1RL133-1 PSNR-5K/TALL MIKE Radar
- Operating Band: I
- Detection Range (vehicle): 10, 15 larger vehicles
- Detection Range (personnel): 3.0 km

The radar can be dismounted for tripod mount in a remote OP.
A 1D13 LRF is provided for dismounts.

PRP-4M/Deytery Sensors/Components (1988):
Radar is PSNR-5M (see pg 4-30); and the LRF is now 1D14.

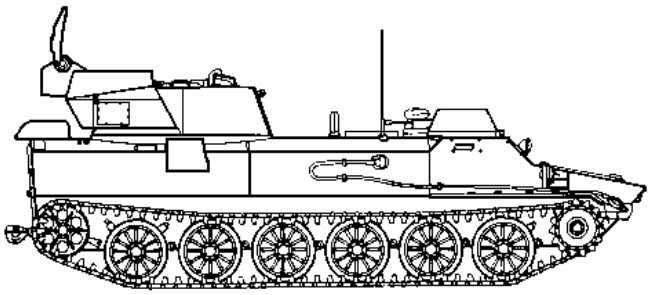
PRP-4MU Sensors/Components (1997):
Communications: R-163-50, with 60-km range, and digital transmission and digital map overlay capability.
Radar: PSNR-5M, but Kredo-M1 is now optional (see pg 4-30)

PRP-4MU with Kredo-M radar

NOTES:
A BRM-3K has the same sensors as the PRP-4M, and has been upgraded similarly. It can be used in its place but costs more.

The latest available radar for replacing PSNR-5K or PSNR-5M is Kredo-1E. The Kredo-1E coherent Doppler radar offers a mast-mounted drop-in replacement for the PSNR-5/Kredo-M1 radars, with range to 40 km. Processing, display, and transmission equipment changes required similar to those on the Kredo-M1 upgrade. See pg 4-30 for data.

Russian Battlefield Surveillance Radar SNAR 10



SNAR 10 with radar raised and the turret mounted 7.62 PKT MG pointed to the rear

Weapons & Ammunition Types	Typical Combat Load
7.62 PKT MG	**2,000**

SYSTEM
Alternative Designations: BIG FRED, 1RL232, 1RL232-1
Date of Introduction: 1975
Proliferation: At least 12 countries
Description:
Crew: 5
Platform (chassis): MT-LBu
Combat Weight (mt): 12.6
Chassis Length Overall (m): 7.62
Height Overall (m): 2.72 (est.)
Width Overall (m): 2.85

Automotive Performance:
Engine Type: YaMZ-238, 240 hp diesel
Cruising Range (km): 500 km
Speed (km/h):
- Max Road: 60
- Max Off-Road: 26
- Cross-Country: INA
- Max Swim: N/A

Fording Depths (m): INA

Radio: R-123M radio, 2 each

Protection:
Armor, Turret Front (mm): 20
Armor Turret Top (mm): INA
Armor Hull (mm): 15
NBC Protection System: Yes
Smoke Equipment: No

ARMAMENT
Main Armament:
Caliber, Type, Name: 7.62-mm machinegun PKT
Mount Type: Coax
Direct Fire Range (m): 1,300
Max Effective Range (m):
- Day: 1,000 / 400-500 on the move
- Night: 800

Fire on Move: Yes
Rate of Fire (rpm): 600 cyclic in 2-10 round bursts

VARIANTS
SNAR-10M: This updated vehicle replaces the BIG FRED radar with a Kredo-1E radar, for a ground vehicle detection range of 40 km. It also has digital display and communications. See page 4-31 for further radar data.

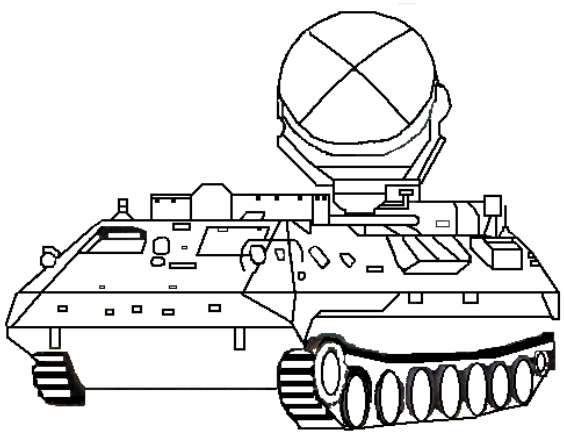
RADAR
Performance Capability
Antenna Type: Parabolic
Operating Band: K (34.55 to 35.25 GHz)
Detection Range Against Moving Targets, Without MTI (km):
- Vehicles: 16.0
- Ships: 30.0
- Shell Impact: 10.0

Detection Range Against Moving Targets, With MTI (km):
- Vehicles: 10.0

Emplacement Time (minutes): 5.0
Displacement Time (minutes): 5.0

NOTES
The primary mission of the Big Fred radar is to detect and track both moving ground and water surface targets. Additionally, the radar can be used to provide friendly fire correction data to artillery units. The SNAR 10 is not capable of amphibious operations (unlike other members of the MT-LBu family) due to the heavy turret. The vehicles are also equipped with a NBC filtration and overpressure system.

Russian Artillery Locating Radar ARK-1M Rys



SYSTEM
Alternative Designations: None
Date of Introduction: 1986
Proliferation: At least 1 country
Description:
Crew: 4
Platform (chassis): MT-LBu
Combat Weight (mt): 15.7
Chassis Length Overall (m): 7.62
Height Overall (m): 2.72
Width Overall (m): 2.85

Automotive Performance:
Engine Type: YaMZ-238, 240 hp diesel
Cruising Range (km): 500 km
Speed (km/h):
- Max Road: 60
- Max Off-Road: 26
- Cross-Country: INA
- Max Swim: 4.5

Fording Depth (m): Amphibious

Radio: R-123M radio

Protection:
Armor, Turret Front (mm): 20
Armor Turret Top (mm): INA
Armor Hull (mm): 15
NBC Protection System: Yes
Smoke Equipment: No

RADAR
Antenna:
Antenna Type: Reflector

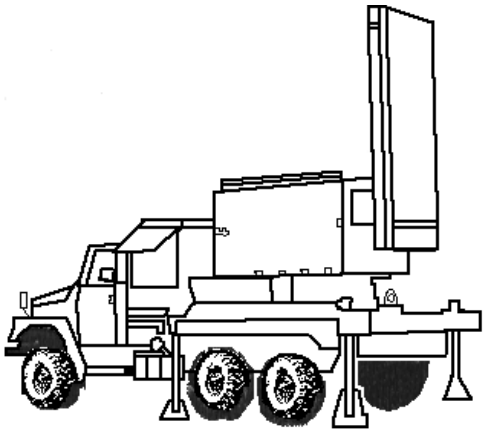
Receiver:
Noise Figure (dB): 8.0

Performance Capability
Detection Range (km):
- Mortar: 13.0
- Gun/howitzer: 8.0
- MLRS: 25.0
- Tactical Missile: 30.0

Max Number of Targets (tracks/min): 3
Emplacement Time (minutes): 5.0
Displacement Time (minutes): 5.0

NOTES
The ARK-1M power supply is located on the rear of the vehicle.

Chinese Artillery Locating Radar BL-904



SYSTEM
Alternative Designations: Type 704 and Type 704M
Date of Introduction: 1991
Proliferation: Ready for production
Description:
Crew: 4
Platform (chassis): Dong Feng EQ2100E6D, 2500 kg, 6x6
Combat Weight (mt): 11.5
Chassis Length Overall (m): 6.84 (est.)
Height Overall (m): INA
Width Overall (m): 2.40 (est.)

Automotive Performance:
Engine Type: Cummins 6BT5.9 Diesel
Cruising Range (km): INA
Speed (km/h):
- Max Road: 85
- Max Off-Road: INA
- Cross-Country: INA
- Max Swim: N/A

Fording Depths (m): 0.9

Radio: INA

RADAR
Antenna:
Antenna Type: Phased-Array
Antenna Gain (dBi): 43.3
Mode: Search
- Scan Method: Electronic
- Scan Type: Sector (azimuth)
- Scan Width (deg):
  - Narrow: 30.0
  - Wide: 90.0

Mode: Verification
- Scan Method: Electronic
- Scan Type: Non-periodic

Mode: Track
- Scan Method: Electronic
- Scan Type: Non-periodic

Transmitter:
Transmitter Type: Traveling Wave Tube
RF minimum (GHz): 8.0
RF maximum (GHz): 12.0
Mode: All

Receiver:
Noise Figure (dB): 8.0
Single Pulse Processing: Coherent
Multiple Pulse Processing: Doppler Filters

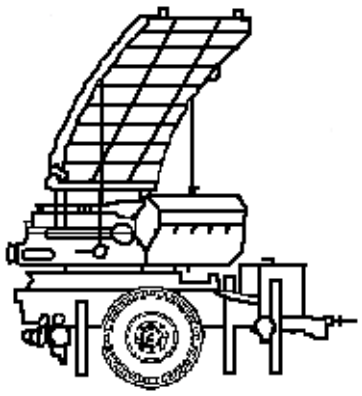
Performance Capability
Detection Range, Wide Scan Mode (km):
- 82-mm Mortar: 15.0
- 122-mm Howitzer: 16.0
- 155-mm Howitzer: 18.0

Detection Range, Narrow Scan Mode (km):
- 122-mm Howitzer: 20.0
- 155-mm Howitzer: 25.0
- 273-mm Rocket: 30.0

Max Number of Targets (tracks/min): 8
Emplacement Time: 10.0 (2 vehicle configuration)
Displacement Time: 10.0 (2 vehicle configuration)

NOTES
Versions of the BL-904 have been offered for sale by NORINCO Industries since at least 1991. While China's army is a prime candidate for the deployment of the BL-904, there is no evidence of it being fielded to operational units. Additionally, the system has not been exported. It was initially named the Type 704. Later an improved-performance version was called the Type 704M. The system is similar to the U.S. AN/TPQ-36 in both appearance and performance (as claimed by the manufacturer). The system can be used to track friendly artillery fire. The system calculates the impact error of friendly artillery rounds and provides automatic correction parameters for increased accuracy. The radar system is employed as a two-vehicle set. One vehicle carries the radar while the other vehicle carries the command cabin and the system power supply. The command cabin contains the operation and control panel, data processing equipment, computer monitors/displays, etc.

British Artillery Locating Radar Cymbeline



Alternative Designations: MUFAR/PIF-518
Date of Introduction: 1973
Proliferation: At least 3 countries
Description:
Crew: 3
Platform (chassis): MK 1 version trailer
Combat Weight (kg): 980
Chassis Length Overall (m): 2.90 (transit)
Height Overall (m): 1.80 (transit)
Width Overall (m): 1.78 (transit)

Automotive Performance:
Cruising Range (km): INA
Speed (km/h):
- Max Road: INA
- Max Off-Road: INA
- Cross-Country: INA
- Max Swim: N/A

Fording Depths (m): .75

Radio: INA

RADAR
Antenna
Antenna Type: Reflector

Search Mode:
- Scan Method: Mechanical
- Scan Type: Sector
- Scan Width (°): 40

Transmitter
Transmitter Type: INA
RF Minimum (GHz): 8.0
RF Maximum (GHz): 12.0
Mode: Search

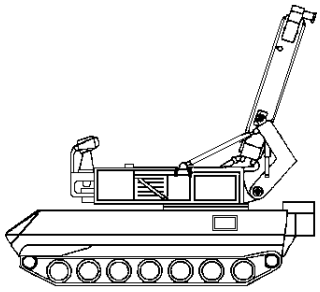
Receiver
Noise Figure (dB): INA
Multiple Pulse Processing: MTI Optional

Performance Capability
Detection Range (km):
- Min: 1.0
- Max: 20.0

Max Number of Targets (tracks/min): 3
Emplacement Time (min): 10.0
Displacement Time (min): 10.0

NOTES
The primary power source for the Cymbeline radar is a Wankel engine-driven generator delivering 1.5 kW at 28 volts dc. The generator is capable of operating for a period of eight hours prior to refueling. Normally, the radar is transported on a two-wheeled trailer towed behind a prime mover like a Land Rover (or similar type vehicle). Four men for short distances can carry the radar. Additionally, the Cymbeline radar may be mounted on a self-propelled vehicle like the British FV432 Armored Personnel Carrier.

Russian Artillery Locating Radar 1L219



Alternative Designations: Zoopark-1
Date of Introduction:
Proliferation: At least 1 country
Description:
Crew: 3
Platform (chassis): MT-LBu
Combat Weight (mt): INA
Chassis Length Overall (m): 7.62
Height Overall (m): 2.72
Width Overall (m): 2.85

Automotive Performance:
Engine Type: YaMZ-238, 240 hp diesel
Cruising Range (km): 500
Speed (km/h):
- Max Road: 60
- Max Off-Road: 26
- Cross-Country: INA
- Max Swim: 4.5

Fording Depths (m): Amphibious

Radio: R-123M radio

RADAR
Antenna
Antenna Type: Phased-Array
Antenna Gain (dBi): 40.0
Search Mode:
- Scan Method: Electronic
- Scan Type: Sector
- Scan Width (°): 60

Verification Mode:
- Scan Method: Electronic
- Scan Type: Non-scanning
- Scan Width (°): N/A

Track Mode:
- Scan Method: Electronic
- Scan Type: Non-periodic
- Scan Width (°): 6 (azimuth - nominal value indicated, equal to 10% of the maximum scan)
- Scan Width (°): 4 (elevation - nominal value indicated, equal to 10% of the maximum scan)

Transmitter
Transmitter Type: INA
RF Minimum (GHz): 6.0
RF Maximum (GHz): 8.0
Mode: All

Receiver
Noise Figure (dB): 5.0
Single Pulse Processing: INA
Multiple Pulse Processing: INA

Performance Capability
Detection Range (km):
- 81-mm Mortar: 12.0
- 120-mm Mortar: 15.0
- 105-mm Howitzer: 8.0
- 155-mm Howitzer: 10.0
- 122-mm Rocket: 12.0
- 220-mm Rocket: 20.0
- Tactical Missile: 35.0

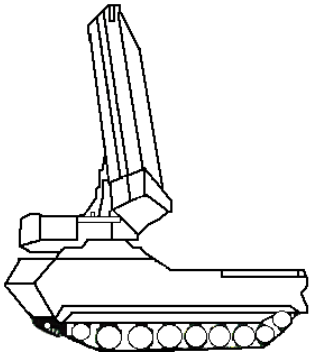
Max Number of Targets (tracks/min): 12
Emplacement Time (min): 5.0
Displacement Time (min): 5.0

NOTES
The Zoopark-1 automated multifunctional reconnaissance and control complex consists of the 1L259 radar mounted on a MT-LBu chassis, 1IZ0 maintenance van on a URAL-43203 truck, and the trailer-mounted ED30-T230P-1RPM power station. The MT-LBu engine-driven generator allows for autonomous operation. The ED30-T230P-1RPM power station provides power during vehicle and radar maintenance.

The Zoopark-1 is capable of tracking friendly artillery fire. The system calculates the impact error of friendly artillery rounds and provides automatic correction parameters for increased accuracy. Additionally, the system is also capable of controlling (simultaneously) several remote piloted vehicles (RPVs) using an automatic screen indication with a topographic mapping of calculated and real RPV flight routes. The radar is capable of conducting air traffic control around an airfield or operating area. The radar tracks and establishes the current position of aircraft in the operating area of responsibility and provides real-time data transmission of data received to the air control center.

The antenna beam is electronically phase-steered in azimuth and elevation. The reflect-array is composed of 3328 phase shifters, space-fed by a mono-pulse horn located on the front side of the array and electronics enclosure. After coming into position, and after the array is raised from the travel position, it is rotated so that its bore sight is centered in the assigned coverage sector. The search scan elevation angle is probably fixed, nominally at a low angle in the range of 30 to 50 mils. The search mode will be interrupted by verification and track mode scans during periods when targets are detected. Verification is most likely a non-scanning mode, with the beam pointed at the same elevation angle as the search scan. Also, verification may be repeated for some targets. During the track mode, the radar tracks the target by scanning in both azimuth and elevation.

Ukrainian Artillery Locating Radar 1L220U



Alternative Designations: Zoopark-2
Date of Introduction: Ready for production
Proliferation: At least 1 country
Description:
Crew: INA
Platform (chassis): GM-5951 ATV
Combat Weight (mt): 39.6
Chassis Length Overall (m): 9.42
Height Overall (m): 3.35
Width Overall (m): 3.25

Automotive Performance:
Engine Type: INA
Cruising Range (km): INA
Speed (km/h):
- Max Road: 60
- Max Off-Road: INA
- Cross-Country: INA
- Max Swim: INA

Fording Depths (m): INA

Radio: INA

RADAR
Antenna
Antenna Type: Phased-Array
Antenna Gain (dBi): INA
Search Mode:
- Scan Method: Electronic
- Scan Type: Sector
- Scan Width (°): 60

Verification Mode:
- Scan Method: Electronic
- Scan Type: Mono-pulse
- Scan Width (°): 2.3 (single beam position is assumed)

Track Mode:
- Scan Method: Electronic
- Scan Type: Mono-pulse
- Scan Width (°): 6 (10% of the full azimuth sector assumed for a crossing trajectory)

Transmitter
Transmitter Type: Traveling Wave Tube (TWT)
RF Minimum (GHz): 3.0
RF Maximum (GHz): 4.0
Mode: Pulsed

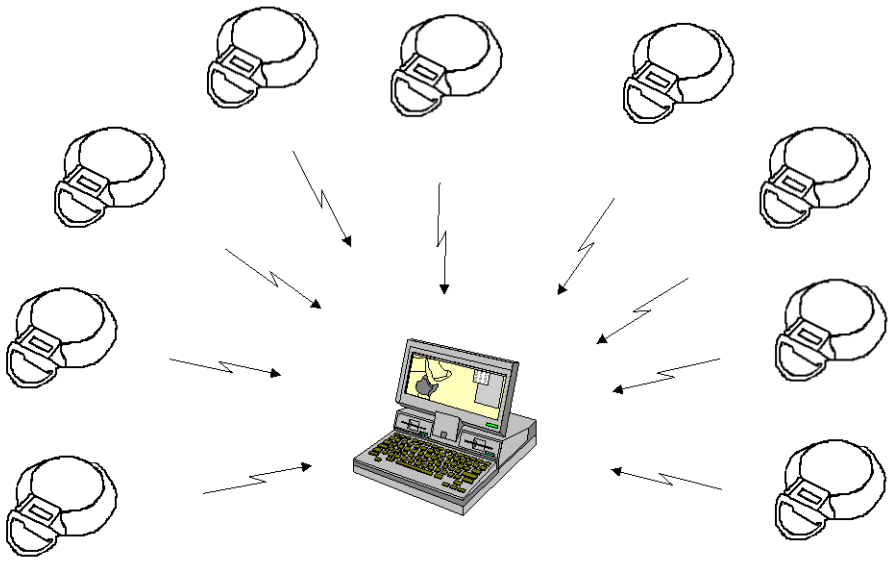
Receiver
Noise Figure (dB): 5.0
Single Pulse Processing: Coherent
Multiple Pulse Processing: MTI and Doppler Filters

Performance Capability
Detection Range (km):
- Mortar: 30.0
- Tube Artillery: 20.0
- Rocket: 40.0
- Tactical Missile: 55.0

Max Number of Targets (tracks/min):
Emplacement Time (min): 5.0
Displacement Time (min): 5.0

NOTES None

Swedish Sound Ranging System SORAS 6



For system description and operation, see NOTES

Alternative Designations: None
Date of Introduction: INA
Proliferation: At least 3 countries
Radio: INA
Calculator
Dimension:
- Length (mm): 400
- Width (mm): 535
- Height (mm): 565

Weight (kg): 52
Memory: 200 targets
Length of microphone cable (km): 1 - 8
Data Output: Display and Paper Strip

Microphones
Total Number: 9
Dimension:
- Circumference (mm): 255
- Height (mm): 52

Weight (kg): 2.8
Sound Frequency (Hz): 2 to 150
Length of microphone cable (km): 1 - 8

Meteorological Unit
Mast height (m): 15
Mast weight (kg): 40

Performance Capability
Detection Range (km):
- Minimum: INA
- Maximum: 30.0

Precision:
- Under 10 km: 1% of the measured distance
- Under 30 km: 2% of the measured distance

Emplacement Time (min): Varies
Displacement Time (min): Varies

NOTES
SOund RAnging System (SORAS) 6 is a fully automated, EMP-protected, completely passive sound ranging system capable of accurately locating enemy gun positions. Each microphone is surveyed into position, and acoustically designates an azimuth to each firer. The computer terminal then calculates intersection points with the azimuths, for target locations. The system operates in temperatures ranging from -40° to +55° C. Normally, it takes between 2 and 45 seconds for the calculator to calculate target coordinates. But, the target coordinate calculation time depends on the number of sound sources within the same interval of time. Nine microphones are deployed in an area 8 km wide and 1-2 km deep. The microphone positions are determined by conventional surveying methods or by special equipment. An alarm on the calculator is automatically triggered if contact is broken with any of the microphones. Two people can connect the meteorological unit and raise the mast in 15 to 20 minutes.

The above schematic is representative of the system, and does not reflect the actual SORAS 6 computer terminal and associated hardware.

Artillery Weapons: Cannon Systems

OPFOR indirect fire support weapons include cannon systems, rocket launchers (RLs), mortars, and hybrid systems. These systems can be mounted on fixed launchers, towed or self-propelled (SP). The weapons generally use the indirect fire mode; but most can also deliver direct fires.

Traditional cannon artillery includes guns and howitzers. Guns generally have longer tubes, higher muzzle velocities, and longer ranges with lower trajectory fire. Howitzers can deliver both low- and high-angle fire. Each cannon type has advantages and tradeoffs for tactical conditions. Some guns sacrifice mobility and projectile lethality to increase range. Howitzers may sacrifice range and conventional precision for versatility. High-angle fire lends itself to attacking targets located behind cover or on reverse slopes. Howitzers can fire a wide variety of rounds and are used for long-term sustained fire.

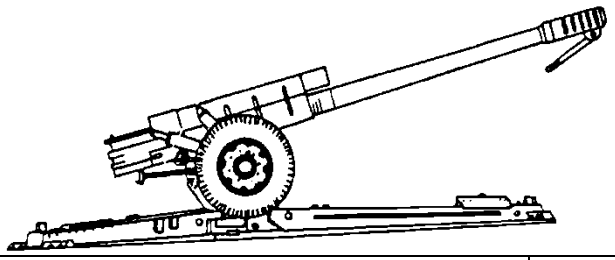
In recent decades modern cannon are gun-howitzers employing the best features of both guns and howitzers. Most use "Gerald Bull technology" designs (longer barrels 39 cal or greater, long breaches, and long-recoil), for long range, precision, and a higher rate of fire. They can handle older ammunition, and a new family of increased lethality munitions (pg 7-62) with extended range. Gun-howitzer SP systems with this technology are still usually called SP howitzers.

Towed cannon systems are lightweight, low-cost, simple, and extremely mobile on hard surfaces. Their disadvantages are lack of cross-country mobility and no gun crew protection against chemical, biological, radiological, and nuclear (CBRN) strikes or counter-battery fire. Tracked SP systems greatly enhance artillery's ability to provide continuous support to mechanized infantry and tank brigades. Their cross-country mobility and speed allows them to keep pace with combined arms combat. Their armor protection improves crew and weapon survivability. These SP systems may still have ammunition resupply limitations because they depend on soft-skinned, wheeled vehicles for logistics support. For road-bound mechanized infantry forces with wheeled APCs, and for deep-firing artillery employed in depth, wheeled weapons can move on roads and pull off to the side for shoot-and-move fire missions.

Other Artillery. Rocket launchers and multiple rocket launchers are described at pg 7-36. Mortars and hybrid systems such as combination guns are described on pg 7-50.

Other Weapons. Theater missiles, naval weapons, aircraft, unmanned combat aerial vehicles (UCAVs), and antitank/anti-armor guided missiles (ATGMs) are not artillery. But they can be used for strike support in coordination with an Integrated Fires Command.

Russian 122-mm Towed Howitzer D-30



Weapons & Ammunition Types	Typical Combat Load
122-mm howitzer Frag-HE Smoke Illumination	

SYSTEM
Alternative Designations: 122-mm D-30A Lyagushka
Date of Introduction: 1963
Proliferation: At least 13 countries
Description:
Crew: 5 (section of 6)
Carriage: D-30
Combat Weight (mt): 3.2
Chassis Length Overall (m):
Travel Position: 5.4
Firing Position: INA
Height Overall (m): 1.6
Width Overall (m):
Travel Position: 1.9
Firing Position: INA
Towing Speed (km/h):
Max Road: 60
Max Off-Road: 25
Max Cross-Country:
Fording Depths (m): .5
Emplacement Time (min): 1.5
Displacement Time (min): 3.5

Prime Mover: MT-LB; Ural-375, or equivalent

ARMAMENT
Main Armament:
Caliber, Type, Name: 122-mm, 2A18M cannon
Barrel Length (cal): 38 (approximately)
Rate of Fire (rpm):
Burst: 8
Normal: 6
Sustained: 4
Loader Type: Semi-automatic
Breech Type: Vertical sliding wedge
Muzzle Brake Type: Multi-baffle
Traverse: (°):
Left: 360
Right: 360
Total: 360
Elevation (°) (-/+): -7/+70°

FIRE CONTROL
Indirect Fire: PG-1M Panoramic Telescope (PANTEL)
Direct Fire: OP 4M-45
Collimator: K-1
Gun Display Unit: None
Fire Control Computer: None

VARIANTS
Saddam: Iraqi produced version of the D-30
D30J: Yugoslavian produced version of the D-30
M1977: North Korean self-propelled howitzer with a VTT-323 APC chassis and a D-30 mounted in the side-armored rear bay.
SP 122: Egyptian self-propelled howitzer (M109A2 chassis and turret with an Egyptian made D-30 howitzer).
Type 85: Chinese self-propelled howitzer (Chinese Type 85 APC chassis and a licensed produced version of the D-30 in a semi-open superstructure).
Type 86: Chinese copy of D-30
Type 89/PLZ89: Chinese turreted SP howitzer with a D-30 gun.

MAIN ARMAMENT AMMUNITION
Caliber, Type, Name:
122-mm Frag-HE, OF-81
Indirect Fire Range (m):
Minimum Range: 1000
Maximum Range: 15,300
Complete Projectile Weight (kg): 21.76 (OF-56)
Muzzle Velocity: 680 m/s
Fuze Type: RGM-2 PD

122-mm, HEAT-FS
Direct Fire Range (m):
Minimum Range: 0
Maximum Range: 1000
Armor Penetration (mm): 460 (@ 0° obliquity any range)
Complete Projectile Weight (kg): 21.58
Muzzle Velocity: 740 m/s
Fuze Type: GPV-2 PIBD

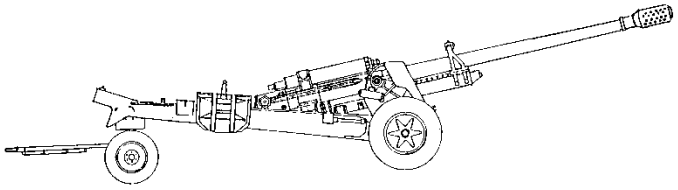
122-mm Frag-HE Rocket Assisted
Indirect Fire Range (m):
Minimum Range: INA
Maximum Range: 21,900
Complete Projectile Weight (kg): 21.76 (3OF-56)
Muzzle Velocity: INA
Fuze Type: PD

Other Ammunition Types: Incendiary, Chemical, Flechette, Semi-active laser-guided Kitolov-2M Frag-HE. It also fires the Chinese Frag-HE extended range full-bore hollow-base (Frag-HE-ERFB-HB) round 21 km, with improved accuracy compared to rocket-assisted rounds.

The cannon is ballistically matched to that on the 2S1 self-propelled howitzer (pg 7-25). Thus it can generally fire the same ammunition to the same range (pg 7-70).

NOTES
The D-30A is a midlife product improvement of the D-30. The original D-30 was fielded in 1963 and the midlife product improvements occurred in the mid to late 1970's. The original D-30 is in use with at least 50 different countries.

Russian 130-mm Towed Gun M-46



Weapons & Ammunition Types	Typical Combat Load
130-mm howitzer Frag-HE Smoke Illumination	

SYSTEM
Alternative Designations: None
Date of Introduction: 1954
Proliferation: At least 25 countries
Description:
Crew: 8
Carriage: M-46
Combat Weight (mt): 8.45
Chassis Length Overall (m):
- Travel Position: 11.73
- Firing Position: 11.10

Height Overall (m): 2.55
Width Overall (m):
- Travel Position: 2.45
- Firing Position: INA

Towing Speed (km/h):
- Max Road: 50
- Max Off-Road: 20
- Max Cross-Country: 10

Fording Depths (m): INA
Emplacement Time (min): 6
Displacement Time (min): 7

Prime Mover: AT-S 59, KrAZ-255 or equivalent

ARMAMENT
Main Armament:
Caliber, Type, Name: 130-mm, cannon
Barrel Length (cal): 52 (approximately)
Rate of Fire (rpm):
- Burst: 8
- Normal: 6
- Sustained: 5

Loader Type: Manual
Breech Type: Horizontal sliding wedge
Muzzle Brake Type: Multi-perforated (pepper pot)
Traverse: (°):
- Left: 25
- Right: 25
- Total: 50

Elevation (°) (-/+): -2.5/+45°

FIRE CONTROL
Indirect Fire: PG-1 Panoramic Telescope (PANTEL)
Direct Fire: OP 4-35
Collimator: K-1
Gun Display Unit: None
Fire Control Computer: None

VARIANTS
Type 59: Chinese copy. **Type 59-1** is a reduced weight variant.
Bereg: Russian coastal defense SP gun complex (Vol 3, pg 3-11).

MAIN ARMAMENT AMMUNITION
Caliber, Type, Name:
130-mm Frag-HE, OF44
- Indirect Fire Range (m):
  - Minimum Range: INA
  - Maximum Range: 22,500
- Complete Projectile Weight (kg): 33.40 (OF33)
- Muzzle Velocity: 930 m/s
- Fuze Type: V-429 PD

130-mm, APC-T
- Direct Fire Range (m):
  - Minimum Range: 0
  - Maximum Range: 1140
- Armor Penetration (mm): INA
- Complete Projectile Weight (kg): 33.49 (BR-482B)
- Muzzle Velocity: INA
- Fuze Type: DBR BD

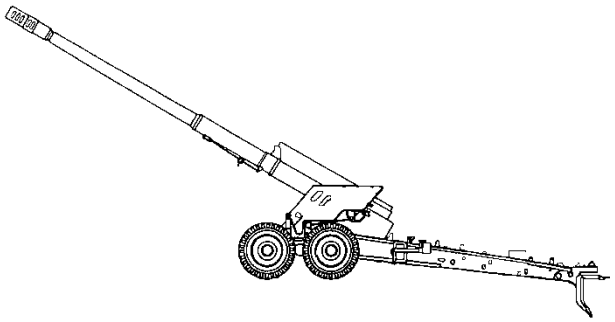
130-mm Frag-HE, OF-43
- Indirect Fire Range (m):
  - Minimum Range: INA
  - Maximum Range: 27,500
- Complete Projectile Weight (kg): 33.40 (OF-33)
- Muzzle Velocity: 930 m/s
- Fuze Type: V-429 PD

130-mm Frag-HE, ERFB-BB
- Indirect Fire Range (m):
  - Minimum Range: INA
  - Maximum Range: 38,000
- Complete Projectile Weight (kg): 33.40
- Muzzle Velocity: 940 m/s
- Fuze Type: ML-5 PD

Other Ammunition Types: Smoke, Chemical, Illumination
The cannon is ballistically matched to the cannon on the Bereg coastal defense system (Vol 3, pg 3-13). Thus it can generally fire the same ammunition to the same range, when FCS is compatible.

NOTES:
The M-46 gun crew is provided limited frontal protections by virtue of a frontal V-shaped shield (approximately 7-mm thick). Otherwise, the crew, ammunition supply, and equipment are vulnerable to casualties and damage from small arms fire, artillery fire, and bomb shrapnel. The Extended Range Full Bore-Base Bleed round was specifically designed by NORINCO Industries (China) for use with the Chinese 130-mm Type 59 Field Gun. However, this round may be fired by the M-46.

Russian 152-mm Towed Gun 2A36



Weapons &Ammunition Types	Typical Combat Load
152-mm gun Frag-HE Smoke Illumination	

SYSTEM
Alternative Designations: 2A36 Giatsint-B
Date of Introduction: 1981
Proliferation: At least 11 countries
Description:
Crew: 8
Carriage: 2A36
Combat Weight (mt): 9.80
Chassis Length Overall (m):
Travel Position: 12.9
Firing Position: 11.0
Height Overall (m): 2.7
Width Overall (m):
Travel Position: 2.7
Firing Position: 8.7
Towing Speed (km/h):
Max Road: 70
Max Off-Road: 20
Max Cross-Country: 15
Fording Depths (m): .6
Emplacement Time (min): 5
Displacement Time (min): 7

Prime Mover: KrAZ-4556, KrAZ-255B, or AT-S tractor

ARMAMENT
Main Armament:
Caliber, Type, Name: 152-mm, cannon
Barrel Length (cal): 49
Rate of Fire (rpm):
Burst: 6
Normal: 5
Sustained: 4
Loader Type: Semi-automatic
Breech Type: Horizontal sliding wedge
Muzzle Brake Type: Multi baffle
Traverse (°):
Left: 25
Right: 25
Total: 50
Elevation (°) (-/+): -2/+57°

FIRE CONTROL
Indirect Fire: PG-1M Panoramic Telescope (PANTEL)
Direct Fire: N/A
Collimator: K-1
Gun Display Unit: None
Fire Control Computer: None

VARIANTS: None

MAIN ARMAMENT AMMUNITION
Caliber, Type, Name:
152-mm Frag-HE, OF-39 (RAP)
Indirect Fire Range (m):
Minimum Range: 9,100
Maximum Range: 28,400
Complete Projectile Weight (kg): 43.51 (OF-29)
Muzzle Velocity (m/s): 945
Fuze Type: V-429 PD

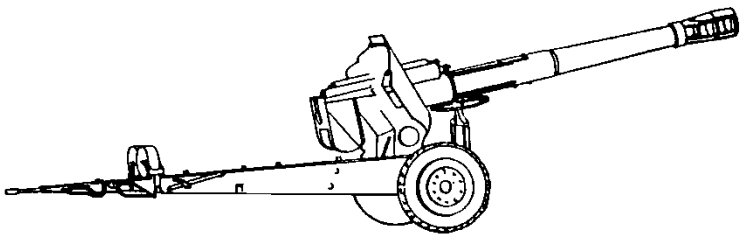
Caliber, Type, Name:
152-mm, HEAT, BP-540
Direct Fire Range (m):
Minimum Range: 0
Maximum Range: 1,000
Armor Penetration (mm): INA
Complete Projectile Weight (kg): 27.00
Muzzle Velocity (m/s): 655
Fuze Type: GPV-3 PD

Caliber, Type, Name:
152-mm Frag-HE, OF-86
Indirect Fire Range (m):
Minimum Range: INA
Maximum Range: 30,500
Complete Projectile Weight (kg): 43.8 (OF-59)
Muzzle Velocity (m/s): 945
Fuze Type: V-429 PD

Other Ammunition Types: DPICM, DPICM-BB, Incendiary, Chemical, Flechette, Semi-active laser-guided Krasnopol-M Frag-HE
The cannon is ballistically matched to the gun on the 2S5/2S5M self-propelled gun system (pg 7-27). Thus it can generally fire the same ammunition to the same range (see pg 7-71).

NOTES
The most distinguishing feature of the 2A36 is its lower carriage. The large system weight required the use of tandem "walking-beam" axles and four wheels to provide mobility. A hydraulically powered firing pedestal is mounted on the front of the lower carriage and serves as part of the travel lock (similar to the D-20). Although the trails do not have the folding summer spades of the D-20, they do have two large spades similar to those found on the M-46/M-47. The weight of the 2A36 normally requires it to be towed by a heavy truck (like the KrAZ-255B). The KrAZ-255B is equipped with a special winch used to lift the trails in order to attach the gun's lunette to the towing pintle.

Russian 152-mm Towed Gun-Howitzer D-20



Weapons & Ammunition Types	Typical Combat Load
152-mm howitzer Frag-HE Smoke Illumination	

SYSTEM
Alternative Designations: None
Date of Introduction: 1955
Proliferation: At least 13 countries
Description:
Crew: 8
Carriage: 122-mm gun D-74
Combat Weight (mt): 5.7
Chassis Length Overall (m):
Travel Position: 8.10
Firing Position: 8.69
Height Overall (m): 2.52
Width Overall (m):
Travel Position: 2.35
Firing Position: INA
Towing Speed (km/h):
Max Road: 60
Max Off-Road: 30
Max Cross-Country: 15
Fording Depths (m): .5
Emplacement Time (min): 2.5
Displacement Time (min): 2.5

Prime Mover: AT-S Tracked vehicle; MT-LB; Ural-375; Ural-4320

ARMAMENT
Main Armament:
Caliber, Type, Name: 152-mm, cannon
Barrel Length (cal): 25
Rate of Fire (rpm):
Burst: 5-6
Normal: INA
Sustained: 1 (65 rounds the first hour)
Loader Type: Manual
Breech Type: Vertical sliding wedge
Muzzle Brake Type: Double flared
Traverse: (°):
Left: 29
Right: 29
Total: 58
Elevation (°) (-/+):-5/+45°

FIRE CONTROL
Indirect Fire: PG-1M Panoramic Telescope (PANTEL)
Direct Fire: OP 4M
Collimator: K-1
Gun Display Unit: None
Fire Control Computer: None

VARIANTS
M1974: North Korean self-propelled howitzer with a VTT-323 APC chassis and a D-20 mounted in the side-armored rear bay.
Type 66: Chinese copy of D-30
Type 83: Self-propelled howitzer based on the Type 66, and an armored tracked chassis (pg 7-31).

MAIN ARMAMENT AMMUNITION
Caliber, Type, Name:
152-mm Frag-HE, OF32
Indirect Fire Range (m):
Minimum Range: 4600
Maximum Range: 17,400
Complete Projectile Weight (kg): 43.56 (OF25)
Muzzle Velocity: 655 m/s
Fuze Type: V-90 PD

152-mm, HEAT, BP-540
Direct Fire Range (m):
Minimum Range: 0
Maximum Range: 1000
Armor Penetration (mm): INA
Complete Projectile Weight (kg): 27.00
Muzzle Velocity: 655 m/s
Fuze Type: GPV-3 PD

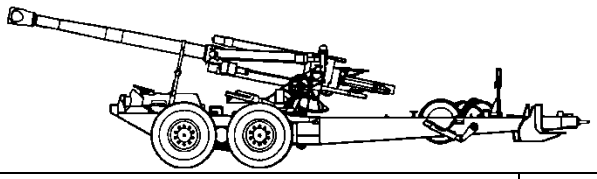
152-mm Frag-HE, OF-96
Indirect Fire Range (m):
Minimum Range: INA
Maximum Range: 24,400
Complete Projectile Weight (kg): 43.56 (OF-64)
Muzzle Velocity: INA
Fuze Type: PD

Other Ammunition Types: DPICM, DPICM-BB, Incendiary, Expendable Jammer, Chemical, Flechette, Semi-active laser-guided Krasnopol-M Frag-HE

The cannon is ballistically matched to the cannon on the 2S3M self-propelled howitzer (pg 6-25). Thus it can generally fire the same ammunition to the same range (see pg 6-70). Selection of rounds available may differ based on Tier of the system.

NOTES
The D-20 was the first 152-mm cannon system to incorporate a semiautomatic vertical-sliding-wedge breech block. Although the ammunition for the system was not changed, this modification allowed a slightly higher rate of fire to be achieved (6 rounds per minute rather than 4), although the sustained rate of fire was unchanged. Because the carriage is based on that of the 122-mm gun D-74, the D-20 cannot be elevated above 45°.

South African 155-mm Towed Gun-Howitzer G5



Weapons & Ammunition Types	Typical Combat Load
155-mm howitzer Frag-HE Smoke Illumination	

SYSTEM
Alternative Designations: None
Date of Introduction: 1981
Proliferation: At least 4 countries
Description:
Crew: 8
Carriage: G5
Combat Weight (mt): 13.75
Chassis Length Overall (m):
Travel Position: 12.1
Firing Position: 11.0
Height Overall (m): 2.3
Width Overall (m):
Travel Position: 3.3
Firing Position: 8.7
Towing Speed (km/h):
Max Road: 90
Max Off-Road: 50
Max Cross-Country: 15
Fording Depths (m): .6
Emplacement Time (min): 2
Displacement Time (min): 1

Auxiliary Propulsion Unit Performance:
Engine Type: 76 hp air-cooled diesel
Cruising Range (km): 100
Speed (km/h):
Max Road: 16
Max Off-Road: INA
Cross-Country: 3
Max Swim: N/A

Prime Mover: Samil 100 6x6 artillery tractor or a 10 ton equivalent

ARMAMENT
Main Armament:
Caliber, Type, Name: 155-mm, cannon
Barrel Length (cal): 45
Rate of Fire (rpm):
Burst: 3
Normal: 2
Sustained: 2
Loader Type: Semi-automatic
Breech Type: Interrupted screw
Muzzle Brake Type: Single baffle
Traverse: (°):
Left: 41
Right: 41
Total: 82
Elevation (°) (-/+): -3/+75°

FIRE CONTROL
Indirect Fire: Digital Panoramic Telescope
Direct Fire: Trunnion mounted telescopic sight
Collimator: INA
Gun Display Unit: None
Fire Control Computer: None

VARIANTS
G-5 MkIII Upgrade of G-5 (see NOTES)

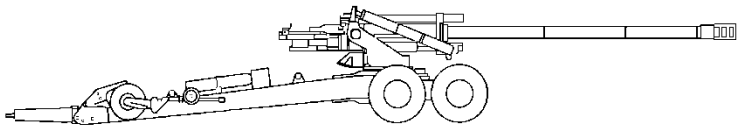
MAIN ARMAMENT AMMUNITION
Caliber, Type, Name:
155-mm Frag-HE, M1 HE
Indirect Fire Range (m):
Minimum Range: 3000
Maximum Range: 30,000
Complete Projectile Weight (kg): 8.7
Muzzle Velocity: 897 m/s
Fuze Type: PD M841

155-mm Frag-HE BB, M1 HE
Indirect Fire Range (m):
Minimum Range: INA
Maximum Range: 39,000
Complete Projectile Weight (kg): 8.7
Muzzle Velocity: 895 m/s
Fuze Type: PD M841

Other Ammunition Types: It is fully compatible with NATO standard 155-mm ammunition (see pg 7-78). The cannon has a direct fire range of 3000 meters with a Frag-HE round.

NOTES
The APU, combined with the tandem walking-beam suspension, gives the G5 excellent self-propelled mobility over short distances. The four wheels are all powered and give the gun excellent traction over most terrain. But, the APU serves purposes other than mobility. It provides power to open and close the trails, raise and lower the trail wheels, and raise and lower the firing platform. However, there is no power traverse or elevation. Although designed for an eight-man section, the South African Defense Force normally operates the G5 with a five-man section. However, the G5 can operate with minimum of two people when all of the powered systems are working. The G-5 MkIII includes 35 reliability modifications and performance improvements. The improvements include the addition of the AS2000 Gun Monitor, an improved braking system, bigger diameter and wider trail wheels (specifically designed for sand), and incorporation of the REUTECH ACV 58 Communications System.

Austrian 155-mm Towed Gun-Howitzer GH N-45



Weapons &Ammunition Types	Typical Combat Load
155-mm howitzer Frag-HE Smoke Illumination	

SYSTEM
Alternative Designations: None
Date of Introduction: 1980
Proliferation: At least 9 countries
Description:
Crew: 6
Carriage: GH N-45
Combat Weight (mt):
GH N-45: 8.90
GH N-45 APU: 11.00
Chassis Length Overall (m):
Travel Position: 9.06
Firing Position: 11.53
Travel Position (GH N-45 APU): 9.55
Firing Position (GH N-45 APU): 11.53
Height Overall (m): (at 0º elevation)
Travel Position: 2.15
Firing Position: 2.20
Travel Position (GH N-45 APU): 2.15
Firing Position (GH N-45 APU): 2.20
Width Overall (m):
Travel Position: 2.50
Firing Position: 9.93
Travel Position (GH N-45 APU): 2.75
Firing Position (GH N-45 APU): 9.93
Towing Speed (km/h):
Max Road: 90
Max Off-Road: 50
Max Cross-Country: 15
Fording Depths (m): .6
Emplacement Time (min): 4
Displacement Time (min): 4

Auxiliary Propulsion Unit Performance:
Engine Type: 125 hp air-cooled diesel
Cruising Range (km): 150
Speed (km/h):
Max Road: 35
Max Off-Road: INA
Cross-Country: 3
Max Swim: N/A

Prime Mover: 10 ton 6x6 truck or artillery tractor

ARMAMENT
Main Armament:
Caliber, Type, Name: 155-mm, cannon
Barrel Length (cal): 45
Rate of Fire (rpm):
Burst: 7
Normal: 3
Sustained: 2
Loader Type: Semi-automatic
Breech Type: Interrupted screw
Muzzle Brake Type: Multi-baffle
Traverse (°):
Left: 30
Right: 40
Total: 70
Elevation (°) (-/+): -5/+72°

FIRE CONTROL
Indirect Fire: Digital Panoramic Telescope
Direct Fire: Trunnion mounted telescopic sight
Collimator: INA
Gun Display Unit: None
Fire Control Computer: None

VARIANTS
GH N-45 A1 Upgrade of GH N-45 (See NOTES)

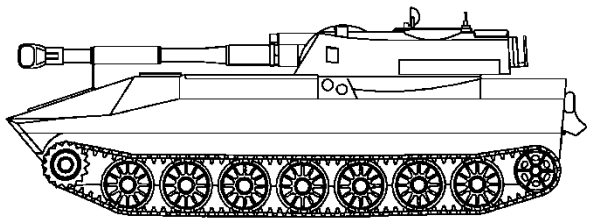
MAIN ARMAMENT AMMUNITION
Caliber, Type, Name:
155-mm Frag-HE, SN-101
Indirect Fire Range (m):
Minimum Range: INA
Maximum Range: 25,100
Complete Projectile Weight (kg): 42.3
Muzzle Velocity (m/s): 897
Fuze Type: PD

Caliber, Type, Name:
155-mm Frag-HE ERFB
Indirect Fire Range (m):
Minimum Range: INA
Maximum Range: 39,600
Complete Projectile Weight (kg): 45.4
Muzzle Velocity (m/s): 895
Fuze Type: PD

Other Ammunition Types: It is fully compatible with NATO standard 155-mm ammunition (see pg 7-78).

NOTES
The APU, combined with the tandem walking-beam suspension, gives the GH N-45 excellent self-propelled mobility over short distances. The four wheels are all powered and give the gun excellent traction over most terrain. But, the APU serves purposes other than mobility. It provides power to open and close the trails, raise and lower the trail wheels, and raise and lower the firing platform. However, there is no power traverse or elevation. The GH N-45 also includes an optional chain system (reducing the ground pressure) to improve cross-country mobility in deep, muddy, or sandy terrain. The GH N-45 A1 includes reliability modifications and performance improvements.

Russian 122-mm Self-Propelled Howitzer 2S1



Weapons & Ammunition Types	Typical Combat Load
122-mm howitzer	**45**
Frag-HE HEAT-FS Smoke Illumination	

SYSTEM
Alternative Designations: 122-mm 2S1 Gvozdika
Date of Introduction: 1974
Proliferation: At least 12 countries
Description:
Crew: 4 (section of 6 with 2 in ammo carrier)
Platform (chassis): MT-LBu
Combat Weight (mt): 15.7
Chassis Length Overall (m): 7.26
Height Overall (m): 2.72
Width Overall (m): 2.85

Automotive Performance:
Engine Type: V-8, 300 hp, Diesel
Cruising Range (km): 500 km
Speed (km/h):
- Max Road: 60
- Max Off-Road: 30
- Cross-Country: INA
- Max Swim: 4.5

Fording Depths (m): Amphibious
Emplacement Time (min): 2
Displacement Time (min): 1

Radio: R-123M

Protection:
Armor, Turret (mm): 20
Armor Turret Top (mm): 10
Armor Hull (mm): 15
Self-Entrenching Blade: No
NBC Protection System: Yes
Smoke Equipment: No

ARMAMENT
Main Armament:
Caliber, Type, Name: 122-mm, cannon, 2A31
Barrel Length (cal): 36
Rate of Fire (rpm):
- Burst: 5
- Normal: 4
- Sustained: 1-2
- Fire from Ground: INA

Loader Type: Semi-automatic
Breech Type: Horizontal sliding wedge
Muzzle Brake Type: Double baffle
Traverse: (°):
- Left: 360
- Right: 360
- Total: 360

Elevation (°) (-/+): -3/+70°

FIRE CONTROL
Indirect Fire: PG-2 Panoramic Telescope (PANTEL)
Direct Fire: OP 5-37
Collimator: K-1
Gun Display Unit: None
Fire Control Computer: None

VARIANTS
2S1M: Adds an amphibious kit to increase amphibious capability.

MAIN ARMAMENT AMMUNITION
Caliber, Type, Name:
122-mm Frag-HE, OF-81
Indirect Fire Range (m):
- Minimum Range: 1000
- Maximum Range: 15,300

Complete Projectile Weight (kg): 21.76 (OF-56)
Muzzle Velocity: 680 m/s
Fuze Type: RGM-2 PD

122-mm, HEAT-FS
Direct Fire Range (m):
- Minimum Range: 0
- Maximum Range: 1000

Armor Penetration (mm): 460 (@ 0° obliquity any range)
Complete Projectile Weight (kg): 21.58
Muzzle Velocity: 740 m/s
Fuze Type: GPV-2 PIBD

122-mm Frag-HE Rocket Assisted
Indirect Fire Range (m):
- Minimum Range: INA
- Maximum Range: 21,900

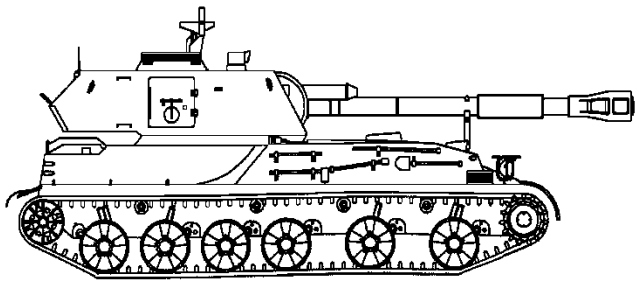
Complete Projectile Weight (kg): 21.76 (3OF-56)
Muzzle Velocity: INA
Fuze Type: PD

Other Ammunition Types: Includes Smoke/Incendiary, Chemical, Flechette, Expendable Jammer, Semi-active laser-guided Kitolov-2M Frag-HE, and Frag-HE extended range full-bore.

The cannon is ballistically matched to the cannon on the D-30 towed howitzer (pg 7-19). Thus it can generally fire the same ammunition to the same range (7-70).

NOTES
The 2S1's ammunition stowage rack is not mechanized. The 2S1 is manually loaded with a semiautomatic ramming capability. The four-man crew consists of the commander, driver, gunner, and loader.

Russian 152-mm Self-Propelled Howitzer 2S3M, 2S3M1, and 2S3M2



Weapons & Ammunition Types	Typical Combat Load
152-mm howitzer	**46**
Frag-HE	
Smoke	
Illumination	
7.62 PKT MG	**1500**

SYSTEM
Alternative Designations: 152-mm 2S3M Akatsiya
Date of Introduction: 1973, 1975 for 2S3M, 1987 for 2S3M1
Proliferation: At least 8 countries
Description:
Crew: 4
Platform (chassis): Modified SA-4 Ganef
Combat Weight (mt): 27.5
Chassis Length Overall (m): 7.75
Height Overall (m): 3.13
Width Overall (m): 3.21

Automotive Performance:
Engine Type: 520-hpV-59 V-12 multi-fuel diesel
Cruising Range (km): 450 km
Speed (km/h):
- Max Road: 60
- Max Off-Road: 25
- Cross-Country: INA
- Max Swim: N/A

Fording Depth (m): 1.00
Emplacement/Displacement Time (min): 3

Radio: R-123M

Protection:
Armor, Turret (mm): 20
Armor Turret Top (mm): 15
Armor Hull (mm): INA
Self-Entrenching Blade: Yes
NBC Protection System: Yes
Smoke Equipment: No

ARMAMENT
Main Armament:
Caliber, Type, Name: 152-mm, 2A33M
Barrel Length (cal): 28, see 2S3M2 at VARIANTS
Rate of Fire (rpm):
- Burst: 4
- Normal: 3
- Sustained: 1
- Fire from Ground: INA

Loader Type: Original ammo stowage was modified to a standardized **2S3M** version with a higher capacity semi-automated ammo loader. Ammo racks are not mechanized. The cannon has an electrical loader/ rammer, fed from the cradle. Rounds and charges from the ground feed through a hatch at the rear to the cradle, for a high rate of fire. The feature also permits the vehicle to retain its onboard load.
Breech Type: Vertical sliding wedge
Muzzle Brake Type: Double baffle
Traverse: (°): 360 left, right, and total
Elevation (°) (-/+): -4/+60°

Auxiliary Weapon:
Caliber, Type, Name: 7.62-mm machinegun PKT
Mount Type: Bow (ball-mounted)
Direct Fire Range (m): 1000
Max Effective Range (m):
- Day: 1000 /400-500 on the move
- Night: 800

Fire on Move: Yes
Rate of Fire (rpm): 650 (cyclic)

FIRE CONTROL
Indirect Fire: PG-4 Panoramic Telescope (PANTEL)
Direct Fire: OP 5-38
Collimator: K-1
Gun Display Unit: None
Fire Control Computer: None

VARIANTS
2S3M1: Upgrade begun in 1987 with a new RG-4 sight, 1V116 intervene, and a monitor which can receive fire calculations directly from the ACRV or transmit sight data back to ACRV from the sight. Russian 2S3Ms were upgraded to 2S3M1during overhauls.

2S3M2: After 2000 an M1 upgrade enables a new 39-cal barrel to use 2S19 rounds (e.g., OF-61 HE-BB with a range of 25.1 km). Also included is GPS-based nav, automated battlefield information, and FCS. A new version includes radar reflective/IR-absorbent paint. It is fielded in 5 Russian units, continues fielding in Russian forces, and will be fitted on 2S3M1s during overhauls.

2S3M3: Optional upgrade with Russian-made M-385 155-mm 39-cal length barrel, computerized GPS nav and FCS. Range is 30 km.

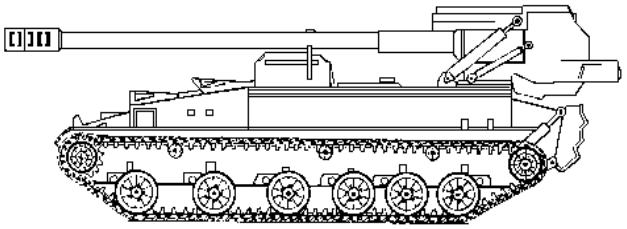
MAIN ARMAMENT AMMUNITION
Caliber, Type, Name:
152-mm Frag-HE, OF32
- Indirect Fire Range (m): 4,600-17,400
- Complete Projectile Weight (kg): 43.56 (OF25)
- Muzzle Velocity: 655 m/s
- Fuze Type: V-90 PD

152-mm Frag-HE, OF-96
- Indirect Fire Range (m): INA- 24,400
- Complete Projectile Weight (kg): 43.56 (OF-64)
- Muzzle Velocity: INA
- Fuze Type: PD

Other Ammunition Types: DPICM, DPICM-BB, Incendiary, Chemical, Flechette, Semi-active laser homing, and HEAT. For standard rounds see pg 7-70. For 155 mm rounds, see pg 7-73. For special rounds and other smart munitions, see pgs 7-74 thru 76. The cannon is ballistically matched to that of the D-20 (pg 7-22), and can generally fire the same ammunition to the same range (see pg 7-71).

NOTES
The 2S3M turret has the cannon, fire-control equipment, ammunition storage space, and work positions for commander, gunner, and loader.

Russian 152-mm Self-Propelled Gun 2S5 and 2S5M



Weapons & Ammunition Types	Typical Combat Load
152-mm howitzer	**30**
Frag-HE	
Smoke	
Illumination	
7.62 PKT MG	**1500**

SYSTEM
Alternative Designations: 152-mm 2S5 Giatsint-S
Date of Introduction: 1981
Proliferation: At least 4 countries
Description:
Crew: 5 (section of 7 with 2 in ammo carrier)
Platform (chassis): Modified 2S3
Combat Weight (mt): 28.2
Chassis Length Overall (m): 8.33
Height Overall (m): 2.76
Width Overall (m): 3.25

Automotive Performance:
Engine Type: 520-hp V-59-V-12 multi-fuel diesel
Cruising Range (km): 500 km
Speed (km/h):
- Max Road: 63
- Max Off-Road: 25
- Cross-Country: INA
- Max Swim: 4.5

Fording Depths (m): 1.05
Emplacement Time (min): 2
Displacement Time (min): 1

Radio: R-123M

Protection:
Armor, Turret (mm): INA, top 15
Armor Hull (mm): 15
Self-Entrenching Blade: Yes
NBC Protection System: Yes
Smoke Equipment: None

ARMAMENT
Main Armament:
Caliber, Type, Name: 152-mm, cannon, 2A37
Barrel Length (cal): 52
Rate of Fire (rpm):
- Burst: 6
- Normal: 5
- Sustained: 1-2
- Fire from Ground: INA

Loader Type: Semi-automatic loader and outside feed door (pg 7-26), but with a main ammo rack carousel and manual transfer to feed tray.
Breech Type: Horizontal sliding wedge
Muzzle Brake Type: Multi baffle
Traverse: (°): 15 left and right, 30 total
Elevation (°) (-/+): -2/+57°

Auxiliary Weapon:
Caliber, Type, Name: 7.62-mm machinegun PKT
Mount Type: Bow (ball-mounted)
Direct Fire Range (m): 1000
Max Effective Range (m)`:
- Day: 1000 /400-500 on the move
- Night: 800

Fire on Move: Yes
Rate of Fire (rpm): 650 (cyclic)

FIRE CONTROL
Indirect Fire: PG-1M Panoramic Telescope (PANTEL)
Direct Fire: D-726 for direct fire and indirect fire
Collimator: K-1
Gun Display Unit: None
Fire Control Computer: None

VARIANTS
2S5M: upgrade version with Mekhanizator-M GPS-based nav and computer FCS. Modernization also permits new 152-mm rounds (e.g., OF-60 HE-RA to 37 km). Also included is RA reflective/ IR absorbent paint. Upgrades are made during overhauls.

MAIN ARMAMENT AMMUNITION
Caliber, Type, Name:
152-mm Frag-HE, OF-39
- Indirect Fire Range (m):
  - Minimum Range: 9100
  - Maximum Range: 28,400
- Complete Projectile Weight (kg): 43.51 (OF-29)
- Muzzle Velocity: 945 m/s
- Fuze Type: V-429 PD

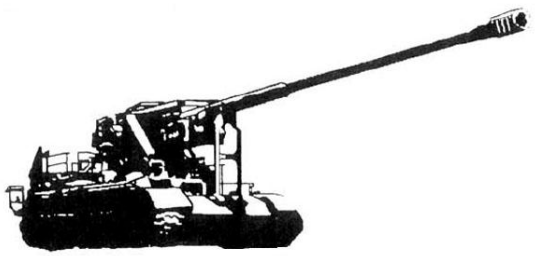
152-mm, HEAT, BP-540
- Direct Fire Range (m):
  - Minimum Range: 0
  - Maximum Range: 1000
- Armor Penetration (mm): INA
- Complete Projectile Weight (kg): 27.00
- Muzzle Velocity: 655 m/s
- Fuze Type: GPV-3 PD

152-mm Frag-HE, OF-86
- Indirect Fire Range (m):
  - Minimum Range: INA
  - Maximum Range: 30,500
- Complete Projectile Weight (kg): 43.8 (OF-59)
- Muzzle Velocity: 945 m/s
- Fuze Type: V-429 PD

Other Ammunition Types: DPICM, DPICM-BB, HE-RA (33 km) Incendiary, Chemical, Flechette, Semi-active laser homing Frag-HE. For standard rounds see pg 7-71. For special rounds and other smart munitions, see pg 7-73 thru 75.
The cannon is ballistically matched to the cannon on the 2A36 towed gun (pg 7-20). Thus it can generally fire the same ammunition to the same range (see pg. 7-68).

NOTES
The 2S5 is more powerful, has a longer range and a higher rate of fire than the 2S3. However, the 2S5 has a limited main armament traverse and a narrower elevation range than the 2S3.

North Korean 170-mm Self-Propelled Gun M1978 and M1989 (Koksan Gun)



Koksan Gun M1978 on Type 59 chassis

Weapons & Ammunition Types	Typical Combat Load
170-mm gun	**30**
Frag-HE	**(on supply vehicle)**

SYSTEM
Alternative Designations: The name Koksan Gun applies to both M1978 and M1989 170-mm SP guns.
Date of Introduction: By 1978
Proliferation: At least 3 countries
Description:
Crew: 2 The gun crew is in a separate vehicle
Platform (chassis): Type 59 tank chassis
Combat Weight (mt): 40.0
Chassis Length Overall (m): 14.90
Road Wheels: 5
Height Overall (m): 3.10
Width Overall (m): 3.27

Automotive Performance:
Engine Type: 520-hp V-59-V-12 multi-fuel diesel
Cruising Range (km): 300 km
Speed (km/h):
- Max Road: 40
- Max Off-Road: <20
- Cross-Country: N/A
- Max Swim: N/A

Fording Depths (m): INA
Emplacement Time (min): <20 est
Displacement Time (min): <10 est

Radio: R-123M

Protection:
Armor, Turret (mm): None, but gun mount and hull offer vehicle top protection equivalent to 50 mm. The gun crew is completely exposed during firing.
Armor Hull (mm): 79-97
Self-Entrenching Blade: No
NBC Protection System: N/A
Smoke Equipment: N/A

ARMAMENT
Main Armament:
Caliber, Type, Name: 170-mm
Barrel Length (cal): INA
Rate of Fire (rpm): 1
Loader Type: Manual with loading tray and power rammer
Breech Type: Screw type
Muzzle Brake Type: Multi baffle
Traverse: (°): 5-10 left and right, 10-20 total
Elevation (°) (-/+): INA

Auxiliary Weapon: None

FIRE CONTROL
Indirect Fire: Range drum
Direct Fire: N/A
Collimator: K-1 type
Gun Display Unit: None
Fire Control Computer: None

VARIANTS
M1989: The improved Koksan Gun uses a T-62 tank chassis. The onboard load is 12 rounds, but is supplemented by the supply vehicle.

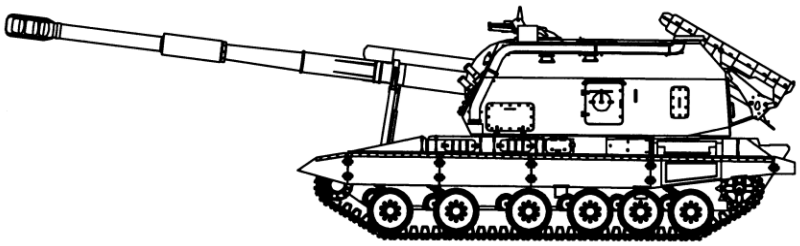
MAIN ARMAMENT AMMUNITION
Caliber, Type, Name:
170-mm Frag-HE
- Indirect Fire Range (m):
  - Minimum Range: INA
  - Maximum Range: 40,000

Caliber, Type, Name:
170-mm Frag-HE-RA (rocket assist)
- Indirect Fire Range (m):
  - Minimum Range: INA
  - Maximum Range: 53,000

Other Ammunition Types: There are unconfirmed reports of chemical rounds and ICM submunition rounds.

NOTES
Many of these weapons generally are kept in underground hardened artillery sites (HARTS), and moved to nearby prepared firing positions. They may then return to the HARTS or to alternate positions for subsequent fire missions.

Russian 152-mm Self-Propelled Howitzer 2S19M1, and 155-mm 2S19M1-155 _____



Weapons & Ammunition Types	Typical Combat Load
152-mm howitzer	**50**
Frag-HE Smoke Illumination	
12.7-mm MG	**300**

SYSTEM
Alternative Designations: 152-mm 2S19 Msta-S
Date of Introduction: 1989
Proliferation: At least 7 countries
Description:
Crew: 5 (section of 7 with 2 in ammo carrier)
Platform (chassis): Modified T-72
Combat Weight (mt): 42
Chassis Length Overall (m): 11.91
Height Overall (m): 2.98
Width Overall (m): 3.58

Automotive Performance:
Engine Type: 840-hp V84-A diesel
Cruising Range (km): 500 km
Speed (km/h):
- Max Road: 60
- Max Off-Road: 25
- Cross-Country: INA
- Max Swim: N/A

Fording Depths (m): Unprepared: 1.5
Emplacement Time (min): 1-2
Displacement Time (min): 1-2

Radio: R-173

Protection:
Armor, Turret (mm): 15, also on turret top
Armor Hull (mm): 15
Self-Entrenching Blade: Capable of digging a complete firing pit in 40-60 minutes
NBC Protection System: Yes
Smoke Equipment: Six Type 902 smoke grenade launchers and Vehicle engine exhaust smoke system (VEESS)

ARMAMENT
Main Armament:
Caliber, Type, Name: 152-mm, cannon, 2A64
Barrel Length (cal): 48
Rate of Fire (rpm):
- Burst: 8
- Normal: 6
- Sustained: 2
- Fire from Ground: 6-7

Loader Type: Automated, with a feed tray and outside feed door. In case of damage to the loader, rounds can be loaded manually.
Breech Type: Vertical sliding wedge
Muzzle Brake Type: Double baffle
Traverse: (°): 360 left, right, and total
Elevation (°) (-/+): -4/+68°

Auxiliary Weapon:
Caliber, Type, Name: 12.7-mm NSVT machinegun
Mount Type: PZU-5 AA
Max Effective Range (m)`:
- Day: 1,500 (AA)/1,500 (Ground)
- Night: N/A

Fire on Move: Yes
Rate of Fire (rpm): 800 (cyclic)

FIRE CONTROL
Indirect Fire: 1P22 Panoramic Telescope (PANTEL)
Direct Fire: 1P23
Collimator: K-1
Gun Display Unit: None
Fire Control Computer: None

VARIANTS
2S19M1: Upgrade version with GPS navigation, automated gun laying, comms and information system, ASUNO automated fire mission data calculation, automatic gun laying, and automated loading system. Although the howitzers could operate autonomously, relying on ACRV automated fire mission links, they are more likely to operate in split batteries (3 or 4-vehicle platoon formations), for rapid movement, no discernible formations and short lethal precision strikes. About 150 systems called **MSTA-SM** is fielded in Russian units. Other upgrades, noted for the 155 version, such as new paint, powered travel locks and spades, are being fitted to the 2S19M1.

2S19M1-155: It has upgrades noted for the M1 variant (e.g., ASUNO-155 FCS), plus a 52-cal length 155-mm gun. Other features include motorized spades and travel locks, enabling the crew to stay inside the vehicle during emplace and displace. As a result, emplace time is <2 minutes, and displace is < 1 min (est). The vehicle design was modified for reduced visual, IR, and radar signatures. Firing range is 33.8 km unassisted, and 41 assisted (45 with foreign rounds). Other nomenclatures used for this system include **2S30** and Iset

MAIN ARMAMENT AMMUNITION
Caliber, Type, Name:
152-mm Frag-HE, OF-72
- Indirect Fire Range (m):
  - Minimum Range: 6500
  - Maximum Range: 24,700
- Complete Projectile Weight (kg): 43.56 (OF-45)
- Muzzle Velocity: 864 m/s
- Fuze Type: RGM-2 PD

Russian 152-mm Self-Propelled Howitzer 2S19M1, 155-mm 2S19M1-155 continued

MAIN ARMAMENT AMMUNITION
Caliber, Type, Name:

152-mm, HEAT, BP-540
Direct Fire Range (m):
Minimum Range: 0
Maximum Range: 1000
Armor Penetration (mm): INA
Complete Projectile Weight (kg): 27.00
Muzzle Velocity: 655 m/s
Fuze Type: GPV-3 PD

152-mm Frag-HE BB, OF-91
Indirect Fire Range (m):
Minimum Range: 6710
Maximum Range: 29,000
Complete Projectile Weight (kg): 42.86 (OF-61)
Muzzle Velocity: 828 m/s
Fuze Type: KZ-88 PD

Other 152-mm Ammunition Types: All standard 152-mm artillery rounds, including DPICM, DPICM-BB, HE-RA, Incendiary, Chemical, Flechette, Semi-active laser homing (pg 7-71and 7-74). For special rounds and other smart munitions, see pgs 7-74 thru 77.

The cannon is ballistically matched to the cannon on the 2A65 towed howitzer. Thus it can generally fire the same ammunition to the same range (see pg 7-71).

155-mm Frag-HE ERFB
Indirect Fire Range (m):
Minimum Range: INA
Maximum Range: 34,000

155-mm Frag-HE ERFB-BB
Indirect Fire Range (m):
Minimum Range: INA
Maximum Range: 41,000

155-mm DPICM-BB and Frag-HE VLAP
Indirect Fire Range (m):
Minimum Range: INA
Maximum Range: 45,000

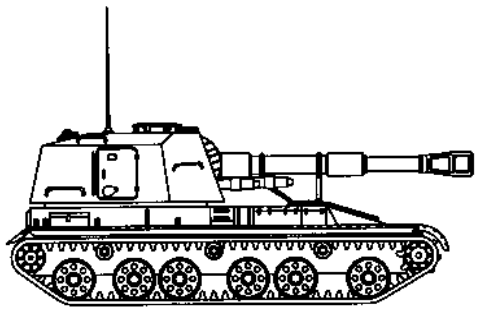
Other 155-mm Ammunition Types: All standard 155-mm artillery rounds, including DPICM, DPICM-BB, HE-RA, Incendiary, Chemical, Flechette, (see pg 7-71). For special rounds and other smart munitions, e.g., Krasnopol-M Semi-active laser homing see pgs 7-72 thru 75.

With an L52-cal length gun, ammunition and range capabilities are similar to other 155-mm weapons such as Caesar (pg 7-33).

NOTES
The 2S19's gun crew can load the gun at any angle of elevation. The 2S19 can also produce a smokescreen by injecting diesel fuel into the exhaust outlet. The 21-hp gas turbine AP-18D Auxiliary Power Unit provides power for turret operations when the vehicle engine is shut down.

The 2S19 can displace quickly even without a barrel lock immediately after completing a fire mission. After spades are lifted and area cleared, the vehicle can displace 200-300 m away, where the barrel is then locked. Remote-operated barrel/travel locks are especially useful for rapid emplacement, and to emplace/ displace for short fire missions from the move, without need for fully occupying a battery firing position.

Chinese 152-mm Self-Propelled Howitzer Type 83



Weapons & Ammunition Types	Typical Combat Load
152-mm howitzer	**30**
Frag-HE Smoke Illumination	
12.7-mm MG	**650**
7.62-mm MG	**650**

SYSTEM
Alternative Designations: None
Date of Introduction: 1984
Proliferation: At least 1 country
Description:
Crew: 5
Platform (chassis): Type 83
Combat Weight (mt): 30.0
Chassis Length Overall (m): 7.33
Height Overall (m): 3.50
Width Overall (m): 3.24

Automotive Performance:
Engine Type: Type 12150L, V-12, 520-hp liquid-cooled diesel
Cruising Range (km): 450 km
Speed (km/h):
- Max Road: 55
- Max Off-Road: 35
- Cross-Country: INA
- Max Swim: N/A

Fording Depth (m): 1.3
Emplacement Time (min): 1
Displacement Time (min): 1

Radio: Type 889D

Protection:
Armor, Turret (mm): INA
Armor Turret Top (mm): INA
Armor Hull (mm): INA
Self-Entrenching Blade: No
NBC Protection System: No
Smoke Equipment: No

ARMAMENT
Main Armament:
Caliber, Type, Name: 152-mm, Type 66 cannon
Barrel Length (cal): 29
Rate of Fire (rpm):
- Burst: 4
- Normal: INA
- Sustained: INA
- Fire from Ground: INA

Loader Type: Semiautomatic
Breech Type: Vertical sliding wedge
Muzzle Brake Type: Double baffle
Traverse: (°):
- Left: 360
- Right: 360
- Total: 360

Elevation (°) (-/+): -5/+65°

Auxiliary Weapon:
Caliber, Type, Name: 12.7-mm (12.7x108) AA MG Type 54
Mount Type: Turret top
Direct Fire Range (m): 1500
Max Effective Range (m):
- Day: 1500 ground/1600 for air targets (APDS)
- Night: INA

Fire on Move: Yes
Rate of Fire (rpm): 80-100 practical, 600 for air targets in 2-10 round bursts

Caliber, Type, Name: 7.62 (7.62 x 54R) Machinegun Type 59
Mount Type: Turret coax
Direct Fire Range (m): 1800
Max Effective Range (m)`:
- Day: 1000
- Night: 800

Fire on Move: Yes
Rate of Fire (rpm): 250 practical, 600 cyclic in 2-10 round bursts

FIRE CONTROL
Indirect Fire: Panoramic
Direct Fire: INA
Collimator: INA
Gun Display Unit: None
Fire Control Computer: None

VARIANTS
This system is based on the Type 66, Chinese copy of the **D-20** howitzer (see pg 7-21).

425-mm Mineclearing Rocket Launcher Type 462: 2-round rocket launcher for use in clearing minefields.

120-mm SP Anti-Tank Gun: The AT gun is fitted with a 120-mm smoothbore mounted inside a turret on a Type 83 Gun-Howitzer chassis.

Chinese 152-mm Self-Propelled Howitzer Type 83 continued

MAIN ARMAMENT AMMUNITION
Caliber, Type, Name:
152-mm Frag-HE, Type 66
Indirect Fire Range (m):
Minimum Range: 9600
Maximum Range: 17,230
Complete Projectile Weight (kg): 43.6
Muzzle Velocity: 655 m/s
Fuze Type: Liu-4 PD and Proximity

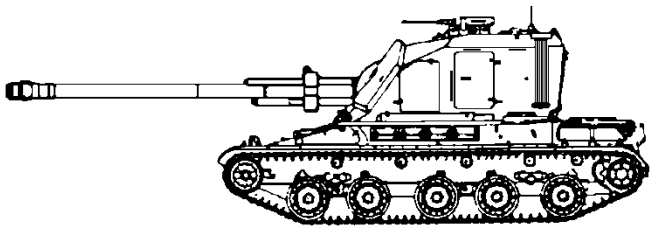
152-mm Frag-HE Rocket Assisted Projectile
Indirect Fire Range (m):
Minimum Range: INA
Maximum Range: 21,880
Complete Projectile Weight (kg): INA
Muzzle Velocity: INA
Fuze Type: PD

152-mm Frag-HE Type 83
Indirect Fire Range (m):
Minimum Range: INA
Maximum Range: 30,370
Complete Projectile Weight (kg): 46.95
Muzzle Velocity: 955 m/s
Fuze Type: Liu-4 PD and Proximity

Other Ammunition Types: HE-I, Illumination, Smoke
For compatible standard ammunition see D-20 and 2S3M, pg 7-71.

NOTES
The Type 83 152-mm SP Howitzer is capable of firing all standard types of 152-mm rounds. The main armament cannon is based on the Chinese 152-mm Towed Type 66 mounted on a vehicle hull similar to the Russian 152-mm SP Gun-Howitzer 2S3. The crew communicates with each other using the Type 803 intercom system. There are reports of the Type 83 being equipped with an anti-tank rocket launcher referred to as the Type 40. However, it is suspected that the rocket launcher is really the 40-mm anti-tank rocket launcher Type 69-1 (an upgraded variant of the Russian RPG-7).

French 155-mm Self-Propelled Howitzer AU-F1 and AU-F1T



Weapons & Ammunition Types	Typical Combat Load
155-mm howitzer	**42**
Frag-HE	
Smoke	
Illumination	
.50 Cal. M2 HB MG	**800**

SYSTEM
Alternative Designations: 155-mm GCT (Export Version)
Date of Introduction: 1979
Proliferation: At least 4 countries
Description:
Crew: 4
Platform (chassis): Modified AMX-30
Combat Weight (mt): 42.0
Chassis Length Overall (m): 10.25
Height Overall (m): 3.25
Width Overall (m): 3.15

Automotive Performance:
Engine Type: Hispano-Suiza HS110, 720-hp water-cooled multi-fuel
Cruising Range (km): 450 km
Speed (km/h):
- Max Road: 60
- Max Off-Road: 40
- Cross-Country: INA
- Max Swim: N/A

Fording Depth (m): 2.10
Emplacement Time (min): 1-2
Displacement Time (min): 1

Radio: TRC 559 (VHF-FM)

Protection:
Armor, Turret (mm): The AU-F1's armor provides crew protection against artillery shrapnel and small arms fire.
Armor Turret Top (mm): See NOTES
Armor Hull (mm): See NOTES
Self-Entrenching Blade: No
NBC Protection System: Yes
Smoke Equipment: 4 grenade launchers

ARMAMENT
Main Armament:
Caliber, Type, Name: 155-mm, cannon
Barrel Length (cal): 40
Rate of Fire (rpm):
- Burst: 8
- Normal: 6
- Sustained: 2-3 (manual loading)
- Fire from Ground: INA

Loader Type: Autoloader
Breech Type: Vertical sliding wedge
Muzzle Brake Type: Double baffle

Traverse: (°):
- Left: 360
- Right: 360
- Total: 360

Elevation (°) (-/+): -4/+66°

Auxiliary Weapon:
Caliber, Type, Name: .50 (12.7x99) heavy machinegun, M2HB
Mount Type: Cupola AA mount
Direct Fire Range (m): INA
Max Effective Range (m)`:
- Day: 1000
- Night: INA

Fire on Move: Yes
Rate of Fire (rpm): 450-550 (cyclic)

FIRE CONTROL
Indirect Fire: M 589 Optical Goniometer
Direct Fire: INA
Collimator: INA
Gun Display Unit: ATILA fire direction system
Fire Control Computer: None

VARIANTS
AU-F1T: Upgrade of AU-F1. The AU-F1T is fitted with the Sagem Cita 20 inertial navigation system as well as a 20-24 hp gas turbine auxiliary power unit (APU).

MAIN ARMAMENT AMMUNITION
Caliber, Type, Name:
155-mm Frag-HE, OE-155-56/69
- Indirect Fire Range (m):
  - Minimum Range: 9600
  - Maximum Range: 23,000
- Complete Projectile Weight (kg): 43.75
- Muzzle Velocity: 810 m/s
- Fuze Type: PD

155-mm Frag-HE Rocket Assisted H3
- Indirect Fire Range (m):
  - Minimum Range: INA
  - Maximum Range: 31,500
- Complete Projectile Weight (kg): INA
- Muzzle Velocity: 830 m/s
- Fuze Type: PD

Other Ammunition Types: DPICM, Illumination, Smoke
For other ammunition, see pg 7-72.

NOTES
A four-man gun crew can reload the AU-F1 in 15 minutes. A two-man gun crew can reload the AU-F1 in 20 minutes.

French 155-mm Truck-Mounted Howitzer CAESAR

Sherpa 5 truck version National War College Photos Unimog truck version

Weapons & Ammunition Types	Typical Combat Load
155-mm howitzer	**18**
Frag-HE	
Smoke	
Illumination	
.50 Cal. M2 HB MG	**800**

SYSTEM
Alternative Designations: 155-mm GCT (Export), CAESAR is a French acronym for Truck-Mounted Artillery Team System.
Date of Introduction: 2007
Proliferation: At least 3 countries. Other countries are trialing the system. This system represents a growing trend in development of less expensive truck-based artillery systems which offer mobility and portability of longer-barreled gun-howitzers, while employing modern portable and robust fire control systems.
Description:
Crew: 6 (with driver). Minimum with the vehicle is 3.
Platform (chassis): SOFRAME UNIMOG, original version
Combat Weight (mt): 17.7
Chassis Length Overall (m): 10.00
Height Overall (m): 3.70
Width Overall (m): 2.55

Automotive Performance:
Engine Type: OM 366 LA 6 turbo diesel, 240 hp
Cruising Range (km): 600 km
Speed (km/h):
Max Road: 100
Max Off-Road: 50
Cross-Country: INA
Max Swim: N/A
Fording Depth (m): 1.2
Emplacement Time (min): <1
Displacement Time (min): 0.5

Radio: INA. It employs digital encrypted communications.

Protection:
Armor, Cab (mm): Defeats small arms and shell splinters
NBC Protection System: No

ARMAMENT
Main Armament:
Caliber, Type, Name: 155-mm gun-howitzer cannon. The gun assembly swings down to the ground on a linked hydraulic system, with spades, to fire from a ground base. After firing it swings back.
Barrel Length (cal): 52
Rate of Fire (rpm):
Burst: 3 rounds in 15 sec
Sustained: 6 (manual loading)
Loader Type: Manual, from palletized rounds on truck bed
Onboard Load: 18 in original design pallet. Varies based on pallets.
Breech Type: Screw breech block
Muzzle Brake Type: Double baffle

Traverse: (°):
Left or right of centerline: 17
Total: 34
Elevation (°) (-/+): -4/+66°

Auxiliary Weapon: Optional
Caliber, Type, Name: .50 (12.7x99) heavy machinegun, M2HB
Mount Type: Cupola AA mount
Max Effective Range (m)`:
Day: 2,000
Night: INA
Fire on Move: Yes
Rate of Fire (rpm): 450-550 (cyclic)

FIRE CONTROL
Fire Control Computer: FAST-Hit computer FCS with Sagem Signal 30 and GPS navigation, aiming, and command net combined. In French forces, it will link to the Atlas artillery C^2 net.
Muzzle Velocity Radar: ROB4
Direct Fire: N/A

VARIANTS
The French version uses a Renault Sherpa 5 truck chassis, with an ammo rack for 24 rounds.

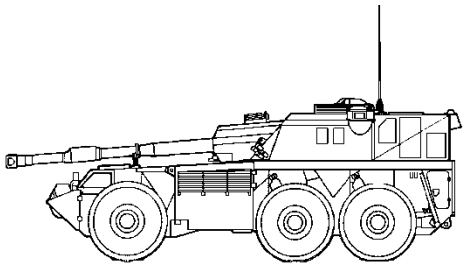
MAIN ARMAMENT AMMUNITION
Caliber, Type, Name:
155-mm Frag-HE Extended Range Full-Bore/ Base Bleed
Indirect Fire Range (m):
Minimum Range: 4,500
Maximum Range: 35,000 ERFB
42,000 ERFB-BB
Complete Projectile Weight (kg): INA
Muzzle Velocity: 895 m/s est max
Fuze Type: PD

155-mm Cargo (DPICM) Ogre, with 63 submunitions
Indirect Fire Range (m):
Minimum Range: 4,500
Maximum Range: 35,000
Complete Projectile Weight (kg): INA
Muzzle Velocity: 897 m/s est max
Fuze Type: Proximity on submunitions
Penetration (mm): 90, top-attack, 500 m^2 coverage

Other Ammunition Types: Illumination, Smoke, BONUS Sensor-fuzed submunition round (pg 7-75)

NOTES
System can fit on a C-130 Transport. It is similar to other 155-mm truck-mounted systems, e.g., the Swedish FH77BW, Chinese SH1, and Israeli ATMOS 2000. Other truck mounted systems include 105 mm and 122 mm systems. Several systems, e.g., Dana, Zuzana, Chinese SH2, Kazak Semser, and Serb Nora B-52 actually mount the gun on the bed and fire mounted. Other systems like GHN-45 (pg 7-23) have their own APU.

South African 155-mm Self-Propelled Howitzer G6



Weapons & Ammunition Types	Typical Combat Load
155-mm howitzer	**45**
Frag-HE Smoke Illumination	
.50 Cal. M2 HB MG	**900**

SYSTEM
Alternative Designations: 155-mm G6 Rhino
Date of Introduction: 1988
Proliferation: At least 2 countries
Description:
Crew: 6
Platform (chassis): Purpose built 6x6 wheeled
Combat Weight (mt): 48
Chassis Length Overall (m): 10.4
Height Overall (m): 3.5
Width Overall (m): 3.4

Automotive Performance:
Engine Type: 525-hp air-cooled diesel
Cruising Range (km): 700 km
Speed (km/h):
- Max Road: 85
- Max Off-Road: 30
- Cross-Country: INA
- Max Swim: N/A

Fording Depth (m): 1.00
Emplacement Time (min): 1
Displacement Time (min): 0.5

Radio: INA

Protection:
Armor, Turret (mm): See NOTES
Armor Turret Top (mm): See NOTES
Armor Hull (mm): See NOTES
Self-Entrenching Blade: No
NBC Protection System: Yes
Smoke Equipment: 8 81-mm grenade launchers

ARMAMENT
Main Armament:
Caliber, Type, Name: 155-mm, cannon
Barrel Length (cal): 45
Rate of Fire (rpm):
- Burst: 3
- Normal: 2
- Sustained: 1
- Fire from Ground: INA

Loader Type: Semi-automatic
Breech Type: Interrupted screw
Muzzle Brake Type: Single baffle
Traverse: (°):
- Left: 40
- Right: 40
- Total: 80

Elevation (°) (-/+): -5/+75°

Auxiliary Weapon:
Caliber, Type, Name: .50 (12.7x99) heavy machinegun, M2HB
Mount Type: Cupola AA mount
Direct Fire Range (m): INA
Max Effective Range (m):
- Day: 1000
- Night: INA

Fire on Move: Yes
Rate of Fire (rpm): 450-550 (cyclic)

FIRE CONTROL
Indirect Fire: Digital Panoramic Telescope
Direct Fire: Trunnion mounted telescopic sight
Collimator: INA
Gun Display Unit: None
Fire Control Computer: None

VARIANTS
None

MAIN ARMAMENT AMMUNITION
Caliber, Type, Name:
155-mm Frag-HE, M1 HE
- Indirect Fire Range (m):
  - Minimum Range: 3000
  - Maximum Range: 30,000
- Complete Projectile Weight (kg): 8.7
- Muzzle Velocity: 897 m/s
- Fuze Type: PD M841

155-mm Frag-HE BB, M1 HE
- Indirect Fire Range (m):
  - Minimum Range: INA
  - Maximum Range: 39,000
- Complete Projectile Weight (kg): 8.7
- Muzzle Velocity: 895 m/s
- Fuze Type: PD M841

Other Ammunition Types: See NOTES
For other ammunition, see pg 7-71.

South African 155-mm Self-Propelled Howitzer G6 continued_____

NOTES

The G6 is a three-axle, six-wheeled, heavily armored system mounting a modified version of the G5 cannon. The G6 is fully compatible with NATO standard 155-mm ammunition and has a direct fire range of 3000 meters (using a Frag-HE round). The rigid chassis is actually divided into two parts, a driver's/engine compartment and a crew compartment. In order to distribute its weight and to maintain mobility over sand and soft terrain, the G6 employs large 21x25 run-flat tires. The driver controls a central tire-inflation system to vary the ground pressure. The system can also be used to maintain some degree of tire pressure in case of air leakage from small punctures. The G6 is equipped with an electronically controlled hydraulic flick rammer that provides an initial rate of fire of 3 rounds per minute.

The vehicle hull and turret provide protection against 7.62-mm small arms fire and artillery shrapnel. The frontal 60° arc provides protection against 20-mm type ammunition. Additionally, the shape and armor thickness of the chassis hull allows it to withstand at least three mine detonations (against TM46 antitank landmine or equivalent) before being immobilized. The separation of the driver/engine compartment from the crew compartment also facilitates survival against mines. The connection between the two is perforated with blowout holes to direct the force of the blast upwards, away from any personnel compartments. The separation also allows the driver to be beyond the detonation point before the mine is activated. The driver also has bullet-resistant glass windows that can be further protected by armored shutters, although it limits him to the use of a periscopic viewing port. The vehicle commander has limited steering and braking capability if the driver becomes a casualty. The crew compartment has four firing ports (two each side) so the crew can engage targets without exposing themselves to return fire.

A 45-hp (34 kw) Auxiliary Power Unit (APU) provides power for turret operations, recharging the batteries, and the driver/crew compartment air conditioning system. A wide range of optional subsystems is available to increase the efficiency of the G6 and its crew. They include the following:

- Inertial navigation and laying or back-up laying systems
- Night vision equipment
- Barrel cooling and thermal warning systems
- Fire control computer interface
- Muzzle velocity analyzer
- Explosion control for fuel tanks

Artillery Weapons: Rocket Launchers

Compared to cannon, rocket launchers (RLs) are relatively uncomplicated, easy to operate and maintain, and are highly mobile. Single-tube RLs vary from 107 mm (Type 85) to 544 mm (Luna-M/FROG-7). Single-tube RLS of 122-mm or less are man-portable for use by dismounted troops.

The majority of RLs are multiple rocket launchers (MRLs). The OPFOR categorizes MRLs as medium-caliber (100 – 220 mm), and large-caliber (220 mm and larger). The OPFOR uses MRLs to deliver heavy fire on important targets at decisive moments in a battle. They offer an economical means to deliver massive, destructive fires on an area-type target in a very short period of time. The principal disadvantage of some MRLs is that excessive dispersion does not permit direct, close support to maneuver elements. For sudden massive strikes, MRLs may execute salvo fire from the launchers. These flexible assets may fire as battery and battalion groups or as platoons or autonomous weapons. MRLs can provide the initial area coverage fires, while cannons and mortars either maintain fire at a steady volume or attack high-value point targets. MRLs are also excellent weapons for counter-battery fire, especially when the enemy uses large-area dispersion for survivability.

The MRL is an excellent area coverage weapon, and its rapid ripple fire is an excellent delivery system for high-explosive (HE), volumetric explosive (VEX), and smoke projectiles; chemical agents; and submunitions. The OPFOR often dedicates some MRLs with scatterable mines to lay on-demand mine fields. Improved munitions, e.g., guided projectiles enable MRLs to fire multiple salvos strikes from autonomous platoons or launchers, with lethal results against point targets or small target nodes.

Chinese 107-mm Multiple Rocket Launcher Type 63

Type 63 launcher

Improvised launcher

Weapons &Ammunition Types	Typical Combat Load
107-mm rocket	**12**
Frag-HE Type 63II	
HE Incendiary Type 63	
Jamming Rocket	

SYSTEM
Alternative Designations: Also called BM-1, Haseb (IR)
Date of Introduction: IOC 1963
Proliferation: At least 20 countries. Iran, Turkey, and North Korea also produce launchers and rockets.

Description:
Crew: 5 (includes ammunition bearers)
Combat Weight (kg):
Loaded: 602
Unloaded: 376
Length (m): 2.9
Width (m): 1.65
Height (m): 0.91
Emplacement and Displacement Times (min): 0.5

ARMAMENT
Launcher:
Caliber, Type, Name: 107-mm, Towed, Type 63
Number of Tubes: 12
Launch Rate: 12 rockets in 7-8 sec (<1 sec per rocket) max rate
Loader Type: Manual
Reload Time: 3 min
Traverse (°): 32 without moving carriage, 360 for single salvo
Left and Right: 16
Elevation (°): +3/+57°

FIRE CONTROL
Indirect Fire: Optical Sight, MS-2 or similar

VARIANTS
A variety of variants have been produced by various countries.
The rockets have been used as improvised weapons, including propellant motors attached to larger munitions, to form improvised rocket assisted munitions (IRAMs), aka: "flying IEDs". Local versions of launchers and rocket models differ. **Pack** version for airborne troops (281kg) can be dismantled for manpack loads.

Haseb: Iranian lightweight version and Iranian rocket name. Iran has single and double launchers with optics and remote fire.

Iranian two launcher configuration

Type 63-1: Lighter version with spoked wheels, 4 banks x 3 rockets

Type 85 is a single tube man-portable launcher of 22.5 kg, which can be dismantled for carry. A remote firing device is included.

The North Korean version uses 8,500 m rockets, and may use a four-legged lightweight pedestal mount.

Type 81Chinese SP MRL. National War College Photo

MAIN ARMAMENT AMMUNITION
Caliber, Type, Name:
107-mm Frag-HE, Type 63 spin-stabilized rocket, original rocket
Indirect Fire Maximum Range (m): 8,000
Warhead Weight (kg): 18.8
Rocket Length: (m): 0.84
Maximum Velocity (m/s): 372
Fuze Type: PD
Effects: 1,600 steel balls

107-mm Controlled Frag-HE, Type 63 II SS rocket (widely fielded)
Indirect Fire Maximum Range (m): 8,500
Warhead Weight (kg): 18.84
Effects: Lethal radius 18.5 m with 1,214 fragments

107-mm HE Incendiary, White Phosphorus, Type 63 SS rocket
Indirect Fire Maximum Range (m): 8,500
Warhead Weight (kg): 18.74
Effects: Lethal radius 21 m and 1,600 fragments

107-mm Type 81 DP, DPICM rocket (Chinese)
Indirect Fire Maximum Range (m): 8,000
Warhead Weight (kg): 8.4
Effects: Submunitions with HE effects and 80-mm penetration

Other Ammunition Types:
Jammer round: Duration 15 min, range 7,800 m.
T-107: Turkish rocket to 11+ km. TRB-107 has steel balls, prox fuze.
Type 63 III SS: Frag-HE to 10 km with electronic fuze option.

NOTES
The MRL has been mounted on a variety of vehicles. The Type 81 mounts the launcher on a short bed. North Korea has several versions with one, two, or three launchers mounted at the rear of VTT tracked APC chassis. Iran mounts the launcher on a 4x4 tactical utility vehicle.

Russian 122-mm Multiple Rocket Launcher 9A51/PRIMA

Weapons & Ammunition Types	Typical Combat Load
122-mm rocket	**50**
Frag-HE	

SYSTEM
Alternative Designations: 9A51
Date of Introduction: 1988
Proliferation: At least 2 countries
Description:
Crew: 3
Chassis/Carriage: Ural 4320 6x6 wheeled
Combat Weight (mt): 13.9
Chassis Length Overall (m): 7.35
Height Overall (m): 2.50
Width Overall (m): 2.50

Automotive Performance:
Engine Type: KAMAZ-740, 210 hp, diesel engine
Cruising Range (km): 990
Speed (km/h):
- Max Road: 85
- Max Off-Road: 40
- Cross-Country: INA
- Max Swim: N/A

Fording Depths (m): 1.5
Emplacement Time (min): 3
Displacement Time (min): 3

Radio: R-173M FM-VHF

Protection:
Armor, Front (mm): None
Armor Side (mm): None
Armor Roof (mm): None
Self-Entrenching Blade: No
NBC Protection System: No
Smoke Equipment: No

ARMAMENT
Launcher:
Caliber, Type, Name: 122-mm, Prima
Number of Tubes: 50
Launch Rate:
- Full Salvo Time: 50 rounds in 30 seconds
- Single Rocket Interval: 0.6 seconds per rocket (est)

Loader Type: Transloader, crane hoist
Reload Time: 10 minutes
Launcher Drive: Electric
Traverse: (°):
- Left: 58
- Right: 58
- Total: 116

Elevation (°): -0/+55°

FIRE CONTROL
Indirect Fire: PG-1M Panoramic Telescope (PANTEL)
Collimator: K-1
Fire Control Computer: None
Position Location System: None

VARIANTS
None

MAIN ARMAMENT AMMUNITION
Caliber, Type, Name: 122-mm Frag-HE, 9M53F
Indirect Fire Range (m):
- Min Range: 5,000
- Max Range: 20,500

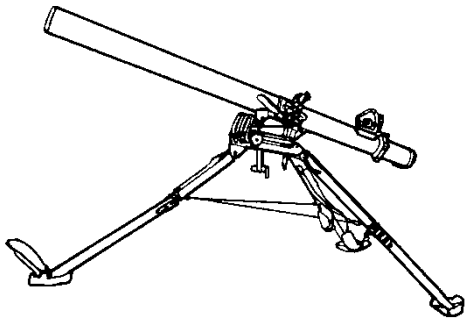
Warhead Weight (kg): 26
Rocket Length: (m): 3.03
Maximum Velocity: INA
Fuze Type: Prox

Other Ammunition Types: All standard 122-mm rockets, as well as Prima rocket, see pg 7-71.

NOTES
The 9A51 Prima launcher assembly incorporates 50 launch tubes, a thermal shroud, and a remote electronic fuze setter. The remote fuze setter increases the ease with which the crew can adjust to changing target situations. Small boxes on the upper right surface of the exit end of the launcher tube contain the fuze setter for each rocket. The launch tubes are arrayed from top to bottom: 11-11-11-10-7. A 51ST tube in the center of the fourth row is blocked and used for electronics. The elevating arms are mounted in the center of the bottom row (like the 9P138) in order to reduce the height of the system. The 9A51 Prima is capable of firing older 122-mm rockets as well as the newer 122-mm rockets. The new rockets are equipped with a separating, parachute-retarded warhead that has more lethality. The launcher vehicle and the 9T232M ammunition resupply vehicle constitute the 9K59 rocket complex.

Both the 9A51 Prima and the 9T232M-ammunition resupply vehicle are based on the same Ural-4320 5-ton, 6x6 truck used for the BM-21-1. The 9A51 Prima is equipped with manually emplaced hydraulic firing jacks to enhance firing stability. The 9T232M ammunition resupply vehicle carries 50 rockets arranged in racks on the vehicle's rear deck. The crew manually reloads the launcher. The 9A51 Prima is capable (under optimum conditions) of firing a 50-rocket salvo that covers an area of 190,000m^2.

Russian 122-mm 1- Round Rocket Launcher 9P132



Weapons &Ammunition Types	Typical Combat Load
122-mm rocket	**1**
Frag-HE	

SYSTEM
Alternative Designations: DKZ-66, BM-21P, Grad-1P, 9K510
Date of Introduction: Mid to late 1960's
Proliferation: At least 5 countries

Description:
Crew: 4-5 (includes ammunition bearers)
Combat Weight (kg):
Loaded: 101
Unloaded: 55
Length (m): 2.50
Width (m): 1.53
Height (m): 1.00
Emplacement Time (min): 2.5
Displacement Time (min): 2

Radio: R-107M

ARMAMENT
Launcher:
Caliber, Type, Name: 122-mm, 9P132
Number of Tubes: 1
Launch Rate: 1 round per minute
Loader Type: Manual
Reload Time: .67 minutes (approximately 40 seconds)
Traverse (°):
Left: 7
Right: 7
Total: 14
Elevation (°) (-/+): +10/+40°

FIRE CONTROL
Indirect Fire: PG-1M Panoramic Telescope (PANTEL)
Collimator: K-1

VARIANTS
None

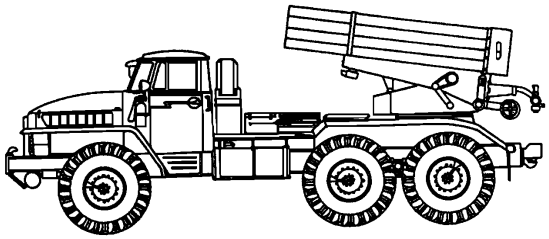
MAIN ARMAMENT AMMUNITION
Caliber, Type, Name:
122-mm Frag-HE, 9M22M
Indirect Fire Range (m):
Minimum Range: 3,000
Maximum Range: 10,800
Warhead Weight (kg): 19.4
Rocket Length: (m): 1.90
Maximum Velocity (m/s):: 450
Fuze Type: PD

Caliber, Type, Name:
122-mm Illuminating Rocket Projectile, 9M42
Indirect Fire Range (m):
Minimum Range: 1,000
Maximum Range: 5,000
Rocket Weight (kg): 27
Rocket Length: (m): 1.90

Other Ammunition Types: Smoke

NOTES
The 9P132 is a lightweight, man-portable rocket launcher used by guerrilla, special purpose forces, or other light forces. The 9P132 is only effective as a harassment or interdiction weapon. When used to fire a new illumination rocket (9M42) the system has been referred to as the 9K510. The 9P132 is broken down for manpack transport into two one-man loads – the tube (27 kg) and the tripod sight assembly with a remote firing device (27 to 28 kg). The tripod legs also fold for ease of handling. Each 9M22M rocket is broken down into two one-man loads for transport. It takes approximately 2 minutes for assembly of the rocket. When assembled, the launcher has three course elevation positions, with the final elevation set by means of an elevation screw. The crew uses an electrical remote control with an electrical impulse generator and battery to fire the launcher. The 9P132 is incapable of firing the 9 foot version rockets of the BM-21 and similar 122-mm systems.

Russian 122-mm Multiple Rocket Launcher BM-21



Weapons & Ammunition Types	Typical Combat Load
122-mm rocket	
Frag-HE	**40**

SYSTEM
Alternative Designations: BM-21 GRAD (Hail) MRL
Date of Introduction: 1963
Proliferation: At least 50 countries
Description:
Crew: 5 (8 with 9K51 Complex)
Chassis/Carriage: Ural 375-D 6x6 wheeled
Combat Weight (mt): 13.7
Chassis Length Overall (m): 7.35
Height Overall (m): 3.09
Width Overall (m): 2.40

Automotive Performance:
Engine Type: URAL-375D, 180 hp water-cooled, V-8 gasoline engine
Cruising Range (km): 450 km
Speed (km/h):
- Max Road: 75
- Max Off-Road: 35
- Cross-Country: INA
- Max Swim: N/A

Fording Depths (m): Unprepared: 1.5
Emplacement Time (min): 3
Displacement Time (min): 2

Radio: R-123M

Protection: Armor, Self-Entrenching Blade, NBC Protection System, and Smoke Equipment are unavailable. Many MRLs are on regular truck chassis undistinguishable as MRLs when covered with tarps.

ARMAMENT
Launcher:
Caliber, Type, Name: 122-mm, 9P132
Number of Tubes: 40 (4 rows of 10 tubes)
Launch Rate:
- Full Salvo Time: 40 rounds in 20 seconds
- Single Rocket Interval: .5 seconds per rocket

Loader Type: Manual
Reload Time: 10 minutes
Launcher Drive: Electric
Traverse: (°):
- Left: 102
- Right: 70
- Total: 172

Elevation (°) (-/+): - 0/+55°

FIRE CONTROL
Indirect Fire: PG-1M Panoramic Telescope (PANTEL)
Collimator: K-1
Fire Control Computer: No. Some variants (right) use automated fire control. Modular GPS/notebook-based FCS for upgrading existing MRLs are likely to be available by the Near Term.
Position Location System: None. See variants with GPS.

VARIANTS
BM-21-1: Upgrade on more mobile URAL-4320 chassis.
BM-21V: Russian 12-tube version for airborne divisions
BM-21B/Grad-1: Russian 36-tube MRL on a 6x6 ZIL-131 chassis
Grad-P: Russian 1 round rocket launcher
BM-11: North Korean 30-tube version
BM-21K: Ukrainian upgrade on KrAZ-260 truck with onboard nav, FCS and thermal shield. Its (40) 40-km rockets can launch in 20 sec.
RM-70: Czechoslovakian 40-tube version with onboard reload
Firos 25/30: Italian commercial MRL ranges 34 km; may fire Grad.
Sakr: Egyptian 40- tube MRL with 18/36/45-km rockets
Type 81: Chinese BM-21 copy. **Type 85** has 40rocket auto-reload.
PHZ 89: Chinese tracked 80-rocket MRL with auto-reload.
Type 90: Chinese MRL with automated FCS. **Type 90A** has GPS.
T-122 Sakarya: Turkish indigenous launcher and 40km rockets.
GRADLAR: Israeli upgrade package with improved FCS. Converts MRLs to launch modules of 122-mm Grad or LAR rockets to 45 km. Romanian converted APR-21 MRLs are called **LAROM**.
LAR: Israeli 160-mm rocket with 45-km range.
Lynx: Israeli truck chassis, with two modular launchers. Each module can launch: 20 x Grad rockets, 13 x 160-mm LAR rockets or **AccuLAR** (with GPS fuze kit to 40 km, 10 m CEP), or 4 x 300-mm **EXTRA** artillery rockets (10-m CEP to 150 km), or 1 x **Delilah-GL** 250-km cruise missile. The system is fielded and has been exported.

MAIN ARMAMENT AMMUNITION
Caliber, Type, Name:
122-mm Frag-HE, 9M22U
Indirect Fire Range (m):
- Minimum Range: 5,000
- Maximum Range: 20,380

Warhead Weight (kg): 18.4 (M21OF)
Rocket Length: (m): 2.87
Fuze Type: MRV-U (PD)

122-mm Frag-HE, 9M28F
Indirect Fire Range (m):
- Minimum Range: 1,500
- Maximum Range: 15,000

Warhead Weight (kg): 21.0
Rocket Length: (m): 2.87
Fuze Type: MRV-U (PD) or AR-6 (proximity)

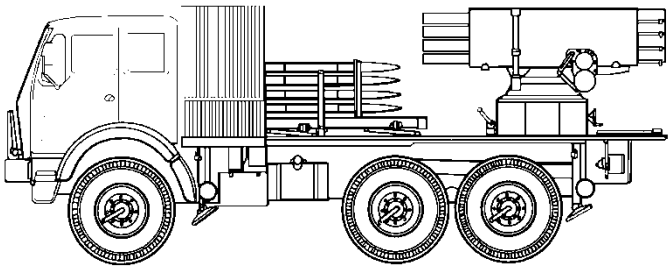
122-mm Frag-HE, Type 90A (Chinese)
Indirect Fire Range (m):
- Minimum Range: 12,700
- Maximum Range: 32,700

Warhead Weight (kg): 18.3
Rocket Length: (m): 2.75
Fuze Type: PD

Other Ammunition Types: Smoke, Incendiary, Chemical, RF Jammer, Illumination, Antitank and, Antipersonnel mines (pg 7-73)

NOTES
BM-21 is unquestionably the world's most widely used MRL. The launcher and supporting equipment are called complex 9K51. A special generator powers the launcher. The 9V170 firing device is cab mounted. Rockets can be fired with a remote-firing device and a 64-m long cable.

Yugoslav 128-mm Multiple Rocket Launcher M77



Weapons &Ammunition Types	Typical Combat Load
128-mm rocket	**32**
Frag-HE	

SYSTEM
Alternative Designations: M-77 Oganj
Date of Introduction: Early 1970's
Proliferation: At least 4 countries
Description:
Crew: 5
Chassis/Carriage: Modified FAP-2026 BDS/AV 6x6 wheeled
Combat Weight (mt): 22
Chassis Length Overall (m): 8.40
Height Overall (m): 3.10
Width Overall (m): 2.50

Automotive Performance:
Engine Type: Model 2F/002A, 200 hp water-cooled, 8-cylinder diesel engine
Cruising Range (km): 600
Speed (km/h):
- Max Road: 80
- Max Off-Road: 35
- Cross-Country: INA
- Max Swim: N/A

Fording Depths (m): Unprepared: 1.2
Emplacement Time (min): 3
Displacement Time (min): 2

Radio: R-123M

Protection:
Armor, Front (mm): None
Armor Side (mm): None
Armor Roof (mm): None
Self-Entrenching Blade: No
NBC Protection System: No
Smoke Equipment: No

ARMAMENT
Launcher:
Caliber, Type, Name: 128-mm
Number of Tubes: 32 (4 rows of 8 tubes)
Launch Rate:
Full Salvo Time: 32 rounds in 25.6 seconds
Single Rocket Interval: 8 seconds per rocket
Loader Type: Hydraulic
Reload Time: 2 minutes
Launcher Drive: Electric
Traverse: (°):
Left: 180
Right: 180
Total: 360
Elevation (°) (-/+): 0/+50°

FIRE CONTROL
Indirect Fire: PG-1M Panoramic Telescope (PANTEL)
Collimator: K-1
Fire Control Computer: None
Position Location System: None

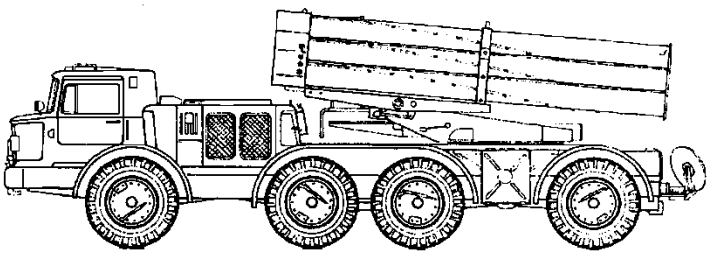
VARIANTS
128-mm Single Tube Launcher

MAIN ARMAMENT AMMUNITION
Caliber, Type, Name:
128-mm Controlled Frag-HE
- Indirect Fire Range (m):
  - Minimum Range: 1,000
  - Maximum Range: 20,600
- Warhead Weight (kg): 20
- Rocket Length: (m): 2.60
- Maximum Velocity (m/s): INA
- Fuze Type: PD

Other Ammunition Types: DPICM

NOTES
The M77 is configured and operated in the same manner as the Czechoslovakian 122-mm (40 round) multiple rocket launcher RM-70. The launcher is mounted over the rear axles with the reloader located behind the cab. During reloading, the launcher is rotated to the rear, two hydraulic cylinders raise the reloader, and then the rockets are pushed into the launcher. Unlike the RM-70, the M77 uses hydraulic cylinders rather than a sprocket and chain drive mechanism. The modified FAP2026 truck has four hydraulically emplaced firing jacks to provide firing stability. The rockets can be fired from inside the cab or with a remote-firing device. The M77 MRL is capable of mounting an antiaircraft machinegun for protection.

Russian 220-mm Multiple Rocket Launcher 9P140



Weapons & Ammunition Types	Typical Combat Load
220-mm rocket	**16**
Frag-HE	

SYSTEM
Alternative Designations: 9P140 Uragan
Date of Introduction: 1977
Proliferation: At least 7 countries
Description:
Crew: 4
Chassis/Carriage: ZIL-135LM 8x8 wheeled
Combat Weight (mt): 20.0
Chassis Length Overall (m): 9.3
Height Overall (m): 3.2
Width Overall (m): 2.8

Automotive Performance:
Engine Type: 2 each - 177 hp, 8 cylinder, 4-stroke gasoline engines
Cruising Range (km): 500 km
Speed (km/h):
- Max Road: 65
- Max Off-Road: INA
- Cross-Country: INA
- Max Swim: N/A

Fording Depths (m): Unprepared: 1.2
Emplacement Time (min): 3
Displacement Time (min): 3

Radio: R-123M

Protection:
Armor, Front (mm): None
Armor Side (mm): None
Armor Roof (mm): None
Self-Entrenching Blade: No
NBC Protection System: No
Smoke Equipment: No

ARMAMENT
Launcher:
Caliber, Type, Name: 220-mm, 9P140
Number of Tubes: 16 (2 rows of 6 tubes and 1 row of 4 tubes)
Launch Rate:
- Full Salvo Time: 16 rounds in 20 seconds
- Single Rocket Interval: 1.25 seconds per rocket

Loader Type: Manual
Reload Time: 15-20 minutes
Launcher Drive: Electric
Traverse: (°):
- Left: 30
- Right: 30
- Total: 60

Elevation (°) (-/+): -0/+55°

FIRE CONTROL
Indirect Fire: PG-1M Panoramic Telescope (PANTEL)
Collimator: K-1
Fire Control Computer: None
Position Location System: None

VARIANTS
None

MAIN ARMAMENT AMMUNITION
Caliber, Type, Name:
220-mm Frag-HE, 9M27F
- Indirect Fire Range (m):
  - Minimum Range: 10,000
  - Maximum Range: 35,000
- Warhead Weight (kg): 100
- Rocket Length: (m): 4.8
- Maximum Velocity: INA
- Fuze Type: Electronic timing (ET)

220-mm DPICM, 9M27K
- Indirect Fire Range (m):
  - Minimum Range: 10,000
  - Maximum Range: 35,000
- Warhead Weight (kg): 90
- Rocket Length: (m): 5.1
- Maximum Velocity: INA
- Fuze Type: Electronic timing (ET)

220-mm Antitank, 9M27K2
- Indirect Fire Range (m):
  - Minimum Range: 10,000
  - Maximum Range: 35,000
- Warhead Weight (kg): 90
- Rocket Length: (m): 5.1
- Maximum Velocity: INA
- Fuze Type: Electronic timing (ET)

Russian 220-mm Multiple Rocket Launcher 9P140 continued

MAIN ARMAMENT AMMUNITION (continued) **Caliber, Type, Name:** 220-mm Antipersonnel, 9M27K3 Indirect Fire Range (m): Minimum Range: 10,000 Maximum Range: 35,000 Warhead Weight (kg): 90 Rocket Length: (m): 5.1 Maximum Velocity: INA Fuze Type: Electronic timing (ET)	220-mm Antitank, 9M59 Indirect Fire Range (m): Minimum Range: 10,000 Maximum Range: 35,000 Warhead Weight (kg): 90 Rocket Length: (m): 5.1 Maximum Velocity: INA Fuze Type: Electronic timing (ET) **Other Ammunition Types:** None

NOTES
The 9P140 Uragan (previously referred to incorrectly as BM-22 or BM-27) is the world's first modern fin and spin-stabilized heavy rocket system. Essentially a scaled-up version of the BM-21, the 9P140 use many of the same design features. The launcher, 9T452 transloader, rockets, and support equipment constitutes the 9K57 complex.

The 9P140 and its transloader are both based on variants of the gasoline-powered ZIL-135LM 8-ton 8x8 chassis. The truck is unusual in that it uses two engines, each driving the wheels on one side of the truck, and only the front and rear axles steer. The 9P140 cab has a blast shield that is raised during firing, and the vehicle is stabilized during firing by two manually emplaced hydraulic jacks at the rear of the chassis.

The launcher has electrically powered traversing and elevating mechanisms. During travel, the launcher assembly is oriented rearward and a light sheet metal cover over the muzzle end of the tubes prevents foreign material from entering the tube. This is a safety feature that is designed for travel when loaded. There is no such cover for the muzzle end of an unloaded launcher.

Iranian 240-mm Multiple Rocket Launcher Fadjr-3

Weapons & Ammunition Types	Typical Combat Load
240-mm rocket	**12**
Frag-HE	

SYSTEM
Alternative Designations: INA
Date of Introduction: 1996
Proliferation: At least 1 country and Hezbollah Units
Description:
Crew: 5
Chassis/Carriage: Mercedes Benz 6x6 wheeled
Combat Weight (mt): 15.0
Chassis Length Overall (m): 10.45
Height Overall (m): 3.34
Width Overall (m): 2.54

Automotive Performance:
Engine Type: 280 hp, V-8 liquid-cooled, diesel engine
Cruising Range (km): INA
Speed (km/h):
- Max Road: 60
- Max Off-Road: 25 (est)
- Cross-Country: INA
- Max Swim: N/A

Fording Depths (m): INA
Emplacement Time (min): INA
Displacement Time (min): INA

Radio: INA

Protection:
Armor, Front (mm): None
Armor Side (mm): None
Armor Roof (mm): None
Self-Entrenching Blade: No
NBC Protection System: No
Smoke Equipment: No

ARMAMENT
Launcher:
Caliber, Type, Name: 240-mm, Fadjr-3
Number of Tubes: 12 (2 rows of 6 tubes)
Launch Rate:
- Full Salvo Time: 12 rounds in 48 seconds (est)
- Single Rocket Interval: 4 seconds per rocket (est)

Loader Type: Transloader, crane hoist
Reload Time: 12 to 15 minutes (est)
Launcher Drive: Manual
Traverse: (°):
- Left: 90
- Right: 100
- Total: 190

Elevation (°) (-/+): -0/+57°

FIRE CONTROL
Indirect Fire: INA
Collimator: INA
Fire Control Computer: None
Position Location System: None

VARIANTS
None

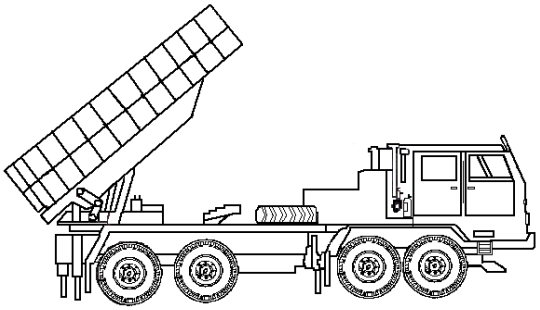
MAIN ARMAMENT AMMUNITION
Caliber, Type, Name: 240-mm Frag-HE, Fadjr-3
Indirect Fire Range (m):
- Min Range: INA
- Max Range: 43,000

Warhead Weight (kg): 90
Rocket Length: (m): 5.2
Maximum Velocity: INA
Fuze Type: PD

Other Ammunition Types: INA

NOTES
The system is stabilized by 2 firing jacks mounted on the rear of the vehicle and 2 more located behind the cab. The system has a dedicated resupply vehicle with a crane to assist in reloading. Shahid Bagheri Industries of Iran developed the system with possible technical assistance from North Korea.

Chinese 273-mm Multiple Rocket Launcher WM-80



Weapons & Ammunition Types	Typical Combat Load
273-mm rocket	**8**
Frag-HE	

SYSTEM
Alternative Designations: None
Date of Introduction: INA
Proliferation: Ready for production
Description:
Crew: 5
Chassis/Carriage: TA 580 8x8 wheeled
Combat Weight (mt): 34
Chassis Length Overall (m): 9.55
Height Overall (m): 3.30
Width Overall (m): 3.06

Automotive Performance:
Engine Type: 525 hp air-cooled, diesel engine
Cruising Range (km): 400 km
Speed (km/h):
- Max Road: 70
- Max Off-Road: INA
- Cross-Country: INA
- Max Swim: N/A

Fording Depths (m): Unprepared: INA
Emplacement Time (min): 3 to 5
Displacement Time (min): 3 to 5

Radio: INA

Protection:
Armor, Front (mm): None
Armor Side (mm): None
Armor Roof (mm): None
Self-Entrenching Blade: No
NBC Protection System: No
Smoke Equipment: No

ARMAMENT
Launcher:
Caliber, Type, Name: 273-mm,
Number of Tubes: 8 (2 rows of 4 tubes)
Launch Rate:
- Full Salvo Time: 8 rounds in 5 seconds
- Single Rocket Interval: .5 seconds per rocket

Loader Type: Manual
Reload Time: 5-8 minutes
Launcher Drive: Electric
Traverse: (°):
- Left: 20
- Right: 20
- Total: 40

Elevation (°) (+/+): +20/+60°

FIRE CONTROL
Indirect Fire: INA
Collimator: INA
Fire Control Computer: None
Position Location System: None

VARIANTS
None

MAIN ARMAMENT AMMUNITION
Caliber, Type, Name:
273-mm Frag-HE, WM-80
Indirect Fire Range (m):
- Min Range: 34,000
- Max Range: 80,000

Warhead Weight (kg): 150
Rocket Length: (m): 4.58
Maximum Velocity (m/s): 1,140
Fuze Type: WJ-6A (PD)

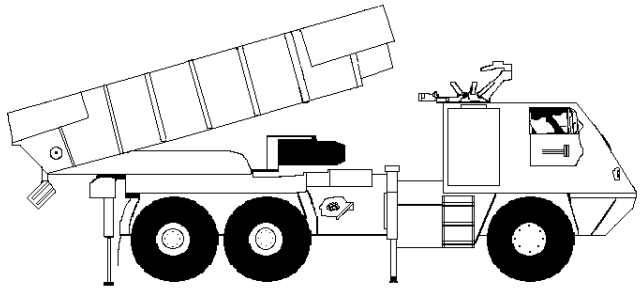
273-mm DPICM, WM-80
Indirect Fire Range (m):
- Min Range: 34,000
- Max Range: 80,000

Warhead Weight (kg): 150
Rocket Length: (m): 4.58
Maximum Velocity (m/s): 1,140
Fuze Type: MD-23A (proximity)

Other Ammunition Types: None

NOTES
The WM-80 is currently being advertised heavily on the open market by NORINCO Industries. The WM-80 Rocket System is composed of the multiple rocket launcher, the ammunition transloader, fire command and control vehicles, and the maintenance vehicles. The fire command and control is composed of a brigade/regiment command vehicle, battalion command vehicle, surveillance/spotting radar, and meteorological radar.

Brazilian 127-mm, 180-mm, & 300-mm Multiple Rocket Launcher ASTROS II _____



Weapons & Ammunition Types	Typical Combat Load
127-mm rocket Frag-HE	**32**
180-mm rocket Frag-HE	**16**
300-mm rocket Frag-HE	**4**
.50 Cal. M2 HB MG	**INA**

SYSTEM
Alternative Designations: ASTROS II AV-LMU
Date of Introduction: 1983
Proliferation: At least 6 countries
Description:
Crew: 3
Chassis/Carriage: TECTRAN 10-ton 6x6 wheeled
Combat Weight (mt): 20.0
Chassis Length Overall (m): 8.0
Height Overall (m): 2.6
Width Overall (m): 2.4

Automotive Performance:
Engine Type: 280 hp, water-cooled turbocharged, diesel engine
Cruising Range (km): INA
Speed (km/h):
- Max Road: 70
- Max Off-Road: 40
- Cross-Country: INA
- Max Swim: N/A

Fording Depths (m): Unprepared: 1.0
Emplacement Time (min): INA
Displacement Time (min): INA

Radio: INA

Protection:
Armor, Front (mm): None
Armor Side (mm): None
Armor Roof (mm): None
Self-Entrenching Blade: No
NBC Protection System: No
Smoke Equipment: 6 smoke grenade launchers

ARMAMENT
Launcher:
Caliber, Type, Name: 127-mm, 180-mm, 300-mm, ASTROS
Number of Tubes: 127-mm (32), 180-mm (16), 300-mm (4)
Launch Rate:
- Full Salvo Time: INA
- Single Rocket Interval: INA

Loader Type: Manual
Reload Time: INA
Launcher Drive: Electric
Traverse: (°):
- Left: INA
- Right: INA
- Total: INA

Elevation (°) (-/+): INA

Auxiliary Weapon:
Caliber, Type, Name: .50 (12.7x99) heavy machinegun, M2HB
Mount Type: Cab AA mount
Direct Fire Range (m): INA
Max Effective Range (m):
- Day: 1000
- Night: INA

Fire on Move: Yes
Rate of Fire (rpm): 450-550 (cyclic)

FIRE CONTROL
Indirect Fire: INA
Collimator: INA
Fire Control Computer: FIELDGAURD Radar or the FILA System
Position Location System: INA

VARIANTS:
None

MAIN ARMAMENT AMMUNITION
Caliber, Type, Name:
127-mm Frag-HE, SS-30
- Indirect Fire Range (m):
  - Minimum Range: 9000
  - Maximum Range: 30,000
- Warhead Weight (kg): INA
- Rocket Length: (m): 3.9
- Maximum Velocity: INA
- Fuze Type: INA

Other Ammunition Types: None

Caliber, Type, Name:
180-mm Frag-HE, SS-40
- Indirect Fire Range (m):
  - Minimum Range: 15,000
  - Maximum Range: 35,000
- Warhead Weight (kg): INA
- Rocket Length: (m): 4.2
- Maximum Velocity: INA
- Fuze Type: INA

Other Ammunition Types: DPICM, HE-Incendiary, Antitank mines, Antipersonnel mines, Runway Denial

Brazilian 127-mm, 180-mm, & 300-mm Multiple Rocket Launcher ASTROS II continued

Caliber, Type, Name:	
300-mm Frag-HE, SS-60 Indirect Fire Range (m): Minimum Range: 20,000 Maximum Range: 60,000 Warhead Weight (kg): INA Rocket Length: (m): 5.6 Maximum Velocity: INA Fuze Type: INA **Other Ammunition Types:** DPICM, HE-Incendiary, Antitank mines, Antipersonnel mines, Runway Denial	300-mm Frag-HE, SS-80 Indirect Fire Range (m): Minimum Range: 22,000 Maximum Range: 90,000 Warhead Weight (kg): INA Rocket Length: (m): 5.6 Maximum Velocity: INA Fuze Type: INA **Other Ammunition Types:** DPICM, HE-Incendiary, Antitank mines, Antipersonnel mines, Runway Denial

NOTES
The ASTROS (Artillery SaTuration ROcket System) II is a modular multiple rocket launcher capable of firing three different caliber wrap-around fin rockets (for improved accuracy) using several types of warheads. The universal modules enable the system to accomplish fire missions with ranges from 9 to 90 kilometers.

The ASTROS II system consists of the following vehicles: Universal Multiple Launcher (AV-LMU), Ammunition Supply Vehicle (AV-RMD), Command and Control Vehicle/Fire Control Unit (AV-VCC), Mobile Workshops (for field maintenance), and the Optional Electronic Fire Control Unit (AV-UCF). All of the ASTROS II vehicles use the Tectran Enginharia 10 ton, 6x6, wheeled vehicle chassis.

A typical firing battery consists of six AV-LMU launchers, six AV-RMD ammunition supply vehicles, and one AV-VCC fire control unit. A AV-VCC command and control unit and two mobile workshops are found at battalion level. The battalion level AV-VCC can coordinate and direct fire missions for three ASTROS batteries. The AV-RMD ammunition supply vehicle carries two complete loads for each launcher.

Russian 300-mm Multiple Rocket Launcher 9A52-2 _____

Weapons & Ammunition Types	Typical Combat Load
300-mm rocket	**12**
Frag-HE	

SYSTEM
Alternative Designations: 9A52-2 Smerch-M
Date of Introduction: 1989
Proliferation: At least 4 countries, with 2 more under contract
Description:
Crew: 4 (7 with 9K58 Complex)
Chassis/Carriage: MAZ-543M 8x8 wheeled
Combat Weight (mt): 43.7
Chassis Length Overall (m): 12.1
Height and Width Overall (m): 3.05

Automotive Performance:
Engine Type: 518 hp, V-12 diesel engine
Cruising Range (km): 850 km
Speed (km/h):
- Max Road: 60
- Max Off-Road: 35
- Cross-Country: INA
- Max Swim: N/A

Fording Depths (m): Unprepared: 1.1
Emplacement/Displacement Time (min): 3

Radio: R-123M

Protection:
Armor, Front, Side or Roof (mm): None
Self-Entrenching Blade: No
NBC Protection System: No
Smoke Equipment: No

ARMAMENT
Launcher:
Caliber, Type, Name: 300-mm, 9A52
Number of Tubes: 12 (3 rows of 4 tubes)
Launch Rate:
- Full Salvo Time: 12 rounds in 38 seconds
- Single Rocket Interval: 3 seconds per rocket

Loader Type: Transloader, crane hoist
Reload Time: 36 minutes
Launcher Drive: Electric
Traverse: (°):
- Left and right: 30
- Total: 60

Elevation (°) (-/+): -0/+55°

FIRE CONTROL
Indirect Fire: PG-1M Panoramic Telescope (PANTEL)
Collimator: K-1
Fire Control Computer: Baget-41 notebook for automated FCS
Position Location System: GPS navigation

VARIANTS
9A52-2T: New Russian launcher mounted on a Tatra 816 truck chassis, and weighing 38.4 mt fully loaded.
9A52-4/Tornado: Russian developmental "**Smerch-Light**" for export or domestic use on a Kamaz 8x8 cross-country chassis with replaceable or reloadable 6-rocket module. With a newer FC computer, (like Baget-41), response time is reduced to 3 minutes. Modules for 122 mm and 220 mm rockets are in development.
9A53: Russian universal MRL on a larger MZKT-7930 8x8 chassis for rocket modules of 24x122 mm (**Tornado-G**), 15x220 mm (**Tornado-U**), or 12x300 mm (**Tornado-S**). It is in testing, with possible fielding in 2015 for 220 mm and 300 mm versions.
A-100: Chinese variant on indigenous chassis and 10-tube launcher, with 120 km range and 8-minute prep time. Exported to Pakistan.
PHL03/AR-2: Recent Chinese 12-tube launcher, ranging to 150 km.

MAIN ARMAMENT AMMUNITION
Caliber, Type, Name: 300-mm Frag-HE, 9M55F
Indirect Fire Range (m):
- Min Range: 20,000
- Max Range: 90,000

Warhead Weight (kg): 258
Rocket Length: (m): 7.6
Maximum Velocity: INA
Fuze Type: Electronic timing (ET)

Caliber, Type, Name: 300-mm DPICM, 9M55K
Indirect Fire Range (m):
- Min Range: 20,000
- Max Range: 90,000

Warhead Weight (kg): 235
Rocket Length: (m): 7.6
Maximum Velocity: INA
Fuze Type: Electronic timing (ET)

Caliber, Type, Name: 300-mm Sensor-fuzed (MOTIV-3M), 9M55K1
Indirect Fire Range (m):
- Min Range: 20,000
- Max Range: 90,000

Warhead Weight (kg): 233
Rocket Length: (m): 7.6
Maximum Velocity: INA
Fuze Type: Electronic timing (ET)

Ammunition Note: All of the above warheads fit on an inertially course-corrected rocket, with time-fuze adjustment. These provide greatly improved accuracy, with error of 0.019 percent of range.

Other Ammunition Types: Smoke, Incendiary, Chemical, Leaflet, 9M55SThermobaric explosive, 9M534 with expendable R-90 UAV

NOTES
9A52-2 launcher with all support equipment (including 9T234-2 transloader, and 1K123 Vivary Fire Control System) is called complex 9K58. Currently, the more commonly associated fire control complex is MP-32M1 on a Tatra chassis, with GLONASS/NAVSTAR GPS navigation.

Israeli Lynx Rocket/Missile Launcher with Extra and Delilah Missiles _____

Lynx Rocket/Missile Launcher Vehicle with LAR-160 rockets

Weapons & Ammunition Types	Typical Combat Load
Rocket/missile Modules	**2**
Grad-type rocket	40
LAR/AccuLAR rocket	26
EXTRA missile	8
Delilah cruise missile	2
Mixed loads on modules	½ each module

SYSTEM
Alternative Designations: Lynx is both the launcher module which can fit on various mounts, and the Israeli launcher vehicle name.
Date of Introduction: By 2007. Delilah cruise missile used in combat in 2006.
Proliferation: At least 3 countries. Two others are testing versions of the system and adaptations of rockets and/or missiles. Others are looking at adopting TCS to their MRLs.

Description: Because the launcher can launch a variety of rockets (122 mm of various, 160 mm Israeli LAR, with or without TCS), and either EXTRA or Delilah-GL missiles, it is likely that the primary munition mix will depend on organization level of the launcher. If it is at tactical level, it is likely to be used primarily to launch rockets, with a few maybe designated for EXTRA missiles. Those launchers at the operational/strategic level are more likely to launch missiles, and perhaps AccuLAR (LAR-160 with TCS) rockets.

Primary Components:
Transporter-erector-launcher (TEL) and Mobile Command Post (MCP) van. Reload modules will be transloaded at a TL point from a transloader truck with four modules, to service two launchers.

ARMAMENT
Transporter-Erector-Launcher
Name: Mercedes 3341
Crew: 3
Chassis: 6x6
Range: 500 km (estimated)

Protection:
Armor Protection: None. The LAROM and perhaps other variants are armored.
NBC Protection System: INA

Launcher Performance
Land Navigation: GPS/inertial
Missiles per launcher: See the Loads above. They can use separate loads on the 2 modules (or launch pod containers, LPCs).
Total Emplace Time (min): 5
Reload time (min): 20

AMMUNITION
Name: **LAR-160 Rocket**
Type: Composite solid-propellant
Range (km):
Max. Launch Range: 45
Min. Launch Range: 10
Rocket Speed: 1,022 m/s
Dimensions:
Length (m): 3.48
Diameter (mm): 160
Weight (kg): 110
Warhead options: Frag-HE/PD or DPICM with time-fuze dispense

OTHER AMMUNITION
GRADLAR: Israeli upgrade package with improved FCS converts MRLs for modules of 122-mm Grad rockets and 21-45 km range. Any type of Grad 122-mm rocket can be used.

LAR-160 or LAR: 160-mm rocket (13 per module) with a 45-km range. The warhead is a canister; to carry Frag-HE, sub-munitions, or any 155-mm round.

Guided Rockets and missiles on Lynx and other MRLs/TELs can use the **Trajectory Correction System (TCS)**. TCS can control >12 rockets/missiles equipped for Inertial/GPS guidance, vs 12 separate targets. Accuracy is 10 m. India tested **TCS** on the Pinaka MRL, and uses it in the recently tested Prahaar SRBM.

AccuLAR rocket is a GPS fuzed variant of LAR-160, with 14-40 km range and 10 m CEP). At least 4 countries use these rockets.

EXTRA (Extended Range Artillery): The 300mm ballistic missile (4/launch module) ranges 150 km with a 10-m CEP. It has a 120-kg payload, and flies a ballistic trajectory, corrected with GPS. Various warheads are offered.

Delilah: This cruise missile has a length of 3.2 m, weighing 230 kg. It cruises at Mach 0.3-0.7, and 8,600 m altitude. It can be launched from ships, aircraft, and the Lynx ground launcher (GL) to 250 km, with programmable guidance, and multiple waypoints. **Delilah-GL** has launch assist. Air, ship, and helicopter versions are offered. The missile uses GPS homing, or can loiter and use a CCD/FLIR seeker to home to target.

VARIANTS
Lynx is both a vehicle, and a launcher to fit on vehicles. Ground launchers include tracked armored vehicles and 8x8 trucks. Israel markets the Lynx 6x6 truck (above). But the launcher fits on other user-preferred chassis. Other user countries have licenses for the conversion. Many of the customers have substantial supplies of 122-mm rockets.

Azerbaijan Lynx: Indigenous MRL/missile TEL with Lynx launcher on 8x8 Kamaz-6350 truck. With autonomous FCS, it launches 122/160 mm rockets, or EXTRA ballistic missiles

Naiza: Kazakh import/production MRL with Lynx for LAR-160 on Kamaz truck.

LAROM: Romanian 2-module MRL can launch 122-mm Grad or LAR-160 rockets

NOTES
The LAR-160 rocket offers a lethal effects area per rocket of 31,400 m^2. With TCS (e.g., AccuLAR), rockets perform a pitch-over for top attack and an optimized circular pattern for Frag-HE warhead effects or sub-munitions. Thus, AccuLAR rockets should have even greater lethal effects.

Artillery Weapons: Mortars and Hybrid Systems

Even in the modern era of fewer new military systems, there is much activity in development of mortars and hybrid systems. This is, in part, due to emphasis on weapons for beyond line-of-sight (BLOS) and non-line-of-sight (NLOS) engagements. It also emphasizes the need for small unit commanders to have organic deep fire capability on-hand for rapid response.

Compared to cannon systems, mortars generally sacrifice range. Their high-angle fire enhances fragmentation effects and permits attack of targets in defilade. They are ideal weapons for attacking targets on reverse slopes, in narrow gullies, in ditches, in cities, and in other areas that are difficult to reach with low-angle fire. Mortars are especially effective, with their high-angle trajectories, for smoke and illumination missions. Their light weight offers mobility to move with units and provide the small unit maneuver commander his own close and direct support. Although mortars feature high trajectories, they often are used at targets within line of sight. Thus most have sights with both direct-fire aiming and indirect-fire settings.

Most mortars in the world are man-portable or towed ground-mounted systems. In motorized infantry brigades and older Tier 3 and 4 mechanized brigades, each battalion has an organic mortar battery. In the OPFOR, motorized infantry and selected other battalions may also have 60-mm mortars at company level. Many forces around the world use man-portable 51-mm, 60-mm, 81-mm, and 82-mm mortars with dismounted conventional and special forces.

Most modern forces recognize the need for vehicle-mounted systems which can move with motorized/mechanized forces. A variety of configurations are in use. The widely fielded Russian 120-mm 2S12 (pg 7-53) is “porteed” - towable but truck-borne for rapid off-loading, emplacement/displacement, and reloading. Most vehicle systems are conventional mortars on a rotating base on the vehicle floor. Another design is the Wiesel 2 Mortar System with the light Wiesel tracked chassis, a breech-loaded motor hinged to the rear, and motorized ground spades. The semi-automated Super Rapid Advanced Mortar System (SRAMS) is light enough to mount on a light strike vehicle and fire 18 rounds per minute.

Several 120-mm mortar vehicles are turreted breech-loading systems. These include systems with semi-automated loaders (rounds delivered to loading trays), e.g., the British Armoured Mortar System modular turret, and the Patria NEMO on a wheeled 8x8 chassis. Mortar vehicle systems with autoloaders include the Czech PRAM-S on BMP chassis, and the AMOS, twin-barrel mortar system).

Hybrid Systems include combination guns that can fire fin-stabilized and rifled mortar projectiles, as well as specially designed howitzer projectiles. These are also called howitzers, gun-mortars, and cannon. They usually fire more mortar rounds than cannon rounds, due to the large inventories of mortar projectiles available, and the wider variety of mortar rounds for different roles. In the OPFOR, Tier 1 and 2 battalions have generally replaced battalion mortars with 120-mm combination guns. Russia (on following pages), China (with its PLL-05), and selected other countries have these systems. Precision mortar projectiles as well as precision cannon projectiles can be fired from these systems.

Other hybrid systems include automatic mortars, such as the 82-mm 2B9/Vasilek automatic mortar with a high rate of fire and direct-fire sights. There are also rifled mortars such as the MO-120RT (pg 7-51), which can fire lethal projectiles out to 13 km.

Traditionally, mortars have been area fire weapons due to their lack of accuracy. However, modern ammunition developments have led to the availability of precision munitions, as well as improved advanced mortar projectiles with terminal effects. These include semi-active laser-homing projectiles, IR-homing projectiles, GPS course-corrected projectiles, and projectiles with submunition fills.

French 120-mm Mortar MO-120-RT

Weapons & Ammunition Types	Typical Combat Load
120-mm mortar	**70**
Frag-HE	

SYSTEM
Alternative Designations: RT-61
Date of Introduction: 1961
Proliferation: At least 22 countries
Description:
Crew: 4-6
Prime Mover: VAB M120 4x4 wheeled
Combat Weight (mt): 13.0
Chassis Length Overall (m): 5.98
Height Overall (m): 2.06
Width Overall (m): 2.50
Combat Weight (kg): 582
Wheeled Carriage/Tube Support Mechanism (kg): 220
Baseplate (kg): 194
Length Overall (m): 2.70
Height Overall (m): 1.10
Width Overall (m): 1.55
Bipod (kg): N/A
Ground Clearance (m): 0.35

Automotive Performance:
Engine Type: Renault VI MIDS, 220 hp, diesel engine
Cruising Range (km): 1,000
Speed (km/h):
- Max Road: 92
- Max Off-Road: 60 (est)
- Cross-Country: 30 (est)
- Max Swim: N/A

Fording Depths (m): Amphibious
Emplacement Time (min): 1.5
Displacement Time (min): 2

Radio: INA

Protection:
Armor, Front (mm): INA
Armor Side (mm): INA
Armor Roof (mm): INA
Self-Entrenching Blade: No
NBC Protection System: Yes
Smoke Equipment: No

ARMAMENT
Main Armament:
Caliber, Type, Name: 120-mm, mortar, MO-120-RT
Rate of Fire (rpm):
Burst: 18
Normal: 10
Sustained: INA
Loader Type: Manual
Traverse: (°):
- Left: 7.5
- Right: 7.5
- Total: 15

Elevation (°): +30/+85°

FIRE CONTROL
Indirect Fire: INA
Collimator: INA
Fire Control Computer: None
Position Location System: None

VARIANTS
120 2R2M: Mounted in light armored vehicles such as the MOWAG Piranha APC or the Turkish FMC-NUROL mortar vehicle.

MAIN ARMAMENT AMMUNITION
Caliber, Type, Name: 120-mm Frag-HE, PR14
Indirect Fire Range (m):
- Min Range: 1,100
- Max Range: 8,135

Complete Projectile (kg): 18.60
Maximum Velocity: INA
Fuze Type: M557 PD

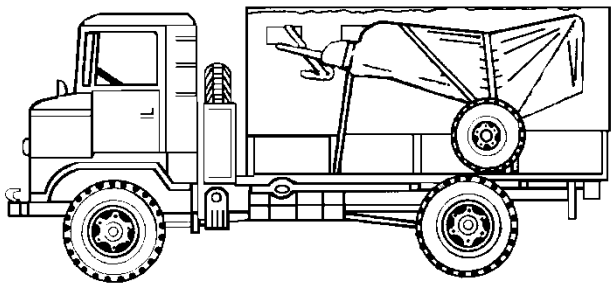
Caliber, Type, Name: 120-mm HE-RA, PRPA (Rocket Assist)
Indirect Fire Range (m):
- Min Range: 1,100
- Max Range: 13,000

Complete Projectile (kg): 18.60
Maximum Velocity: INA
Fuze Type: M557 PD

Other Ammunition Types: All standard 120-mm smoothbore mortar projectiles without fold-out fins (see pgs 7-59 -61 and -71).

NOTES
The RT-61 is a rifled mortar capable of firing pre-engraved spin-stabilized and smoothbore 120-mm mortar projectiles with or without rocket assist. However, it is not capable of firing smoothbore mortar projectiles with fold out fins (spring-loaded tail assemblies with straight fins). The RT-61 is a three-piece mortar system consisting of a rifled tube, a baseplate, and a wheeled carriage. Trigger firing is the normal method of firing for this mortar. Drop firing can be accomplished only with smoothbore mortar projectiles.

Russian 120-mm Self-Propelled Mortar 2S12



Weapons &Ammunition Types	Typical Combat Load
120-mm mortar	**48**
Frag-HE Smoke Illumination	

SYSTEM
Alternative Designations: 120-mm 2S12 Sani (Sled)
Date of Introduction: early 1980s
Proliferation: At least 1 country
Description:
Crew: 5
Vehicle Platform (chassis): GAZ-66
Combat Weight (mt): 3.64
Chassis Length Overall (m): 5.66
Height Overall (m): 2.44
Width Overall (m): 2.34
2B11 Mortar
Combat Weight (kg): 210 (firing) /297 (traveling)
Wheeled Carriage 2L81 (kg): 87
Baseplate (kg): 80
Bipod (kg): 55

Automotive Performance:
Engine Type: ZMZ-66, 115 hp V-8 water cooled gasoline
Cruising Range (km): 600
Speed (km/h):
- Max Road: 87
- Max Off-Road: 35
- Cross-Country: INA

Fording Depths (m): .80
Emplacement Time (min): 3 (est)
Displacement Time (min): 3 (est)

Radio: R-123M

Protection:
Armor, Self-Entrenching Blade, NBC Protection System, and Smoke Equipment are unavailable. As noted for some 122-mm MRLs (pg 7-50), the 2S12 is on a modified GAZ-66 chassis. In most cases when under canvas it can only be distinguished under close examination as a mortar system.

ARMAMENT
Main Armament:
Caliber, Type, Name: 120-mm, mortar, 2B11
Rate of Fire (rpm):
Burst: 15
Normal: 10
Sustained: 4 (est)
Loader Type: Manual
Traverse (°):
- Left: 5 (on bipod)/26 (moving the bipod)
- Right: 5 (on bipod)/26 (moving the bipod)
- Total: 10 (on bipod)/52 (moving the bipod)

Elevation (°) (-/+): +45/+80°

FIRE CONTROL
Indirect Fire: MPM-44M
Direct Fire: DF channel in the sight
Collimator: K-1
Gun Display Unit: None
Fire Control Computer: None

VARIANTS
None

MAIN ARMAMENT AMMUNITION
Caliber, Type, Name:
120-mm Frag-HE (3OF843B)
- Indirect Fire Range (m):
  - Minimum Range: 450
  - Maximum Range: 7,000
- Complete Projectile Weight (kg): 16.8
- Muzzle Velocity (m/s):: 325
- Fuze Type: GVMZ-7 PD

120-mm Smoke
- Indirect Fire Range (m):
  - Minimum Range: 1,000
  - Maximum Range: 6,800
- Complete Projectile Weight (kg): 16.7
- Muzzle Velocity (m/s):: INA
- Fuze Type: PD

120-mm Illumination, S-843
- Indirect Fire Range (m):
  - Minimum Range: 1,000
  - Maximum Range: 5,300
- Complete Projectile Weight (kg): 16.8
- Muzzle Velocity (m/s): INA
- Fuze Type: T-1 TSQ

Other Ammunition Types: All standard 120-mm mortar rounds, including Frag-HE-RA to 9,100m. See pgs 7-59-61, and -71.

NOTES
The 2S12 is a self-propelled version of the towed 120-mm mortar 2B11 (M-120) carried on the bed of GAZ-66 truck. The SP version provides greater mobility for this versatile mortar. The 2S12 has a special safety device to prevent double loading when the mortar round is not fired or removed from the tube. When a round is loaded, it trips a tab on the tube, preventing another round from being loaded. The tab shifts to the "ready" position when the round fires, allowing the 2S12 to be reloaded.

Russian 120-mm Towed Combination Gun 2B16

Weapons & Ammunition Types	Typical Combat Load
120-mm combination gun	**80**
Mortar rounds Rifled Mortar rounds Cannon rounds	
See pgs 7-61 and -71.	

SYSTEM
Alternative Designations: Nona-K
Date of Introduction: 1986
Proliferation: At least 4 countries
Description:
Crew: 5
Carriage: Split Trail, 2-wheel torsion bar suspension
Combat Weight (mt): 1.1
Chassis Length Overall (m):
Travel Position: 5.9
Firing Position: INA
Height Overall (m): 1.7
Width Overall (m):
Travel Position: 1.79
Firing Position: INA
Towing Speed (km/h):
Max Road: 80
Max Off-Road: 35
Max Cross-Country: INA
Fording Depths (m): .INA
Emplacement Time (min): 2
Displacement Time (min): 2

Prime Mover: GAZ-66 truck or equivalent

ARMAMENT
Main Armament:
Caliber, Type, Name: 120-mm, gun-mortar, 2A51
Barrel Length (cal): 24.2
Rate of Fire (rpm):
Burst: 8
Normal: 6
Sustained: 4
Loader Type: Semi-automatic
Breech Type: Vertical sliding wedge
Muzzle Brake Type: Multi baffle
Traverse: (°):
Left: 30
Right: 30
Total: 60
Elevation (°) (-/+): -10/+80°

FIRE CONTROL
Indirect Fire: MP46M Panoramic Telescope
Direct Fire: DF channel in the sight
Collimator: K-1
Gun Display Unit: None
Fire Control Computer: None

VARIANTS
None

MAIN ARMAMENT AMMUNITION
Caliber, Type, Name:
120-mm Frag-HE cannon (3VOF49)
Range (m): 15 - 8,850
Complete Projectile Weight (kg): 19.8
Muzzle Velocity (m/s): INA
Fuze Type: PD and proximity

120-mm HEAT (BK-19) cannon
Range (m): 40 – 1,000
Armor Penetration (mm): 600
Complete Projectile Weight (kg): 13.20
Muzzle Velocity (m/s): 560
Fuze Type: PD and proximity

120-mm Frag-HE rocket assisted cannon (OF-50)
Range (m): 1,700 - 12,800
Complete Projectile Weight (kg): 19.8
Muzzle Velocity (m/s): 367
Fuze Type: B35 PD

120-mm Laser-Guided Projectile, cannon (Kitilov-2, see pg 7-73)
Lethality mechanism: Frag-HE fill
Range (m): 500 - 9,000
Complete Projectile Weight (kg): 25
Muzzle Velocity (m/s): INA
Fuze Type: PD

120-mm Frag-HE mortar (OF-843B)
Range (m): 450 - 7,100
Complete Projectile Weight (kg): INA
Muzzle Velocity (m/s): INA
Fuze Type: PD and proximity

Other Ammunition Types: All standard 120-mm mortar rounds (e.g., smoke, illumination, etc.) and cannon rounds **(**OF-34, OF-51). See pgs 7-61 and -71.

NOTES
Gun and mortar Frag-HE ammunition for the 2B16 can employ proximity fuzes for air burst. The 2B16 is a towed version of the 2S9. It is towed in a tube-over-trails configuration. The 2B16 is a combination breech-loading rifled-bore indirect fire system capable of firing both cannon and mortar projectiles. Thus, it combines the properties of a light howitzer and a mortar. The split-trail carriage has a firing pedestal, a variable-length recoil system, and a manually activated projectile-ramming system.

Russian 120-mm Towed Combination Gun 2B16

NOTES continued

Additionally, the trails are automatically spread and closed with the assistance of a winch. More than likely the ramming device is used only when the 2B16 is firing at high elevation angles (greater than 600). The muzzle break absorbs approximately 30% of the recoil energy.

The 2B16 was designed and developed to support ground maneuver units based on the Russian Army's experiences in Afghanistan. Some Russian designers described the 2B16 as a "bad design". There is nothing to indicate what led to the unverified claims that the system was flawed. However, production of the combination gun ceased and the system was being withdrawn from service in the Russian Army until the towed combination gun was employed with units fighting in Chechnya during the 1990's. Based upon its successful employment and performance in Chechnya, the 2B16 has earned the distinction as the system of choice for fielding with mountain artillery units. The prime mover for the combination gun is a GAZ-66 or its equivalent. However, the manufacturer has indicated (in recent sales brochures) that a UAZ-469 or its equivalent can successfully tow the combination gun. The only drawback to the UAZ-469/2B16 towed configuration is the UAZ-469's lack of on-board cargo space for the transportation of ammunition.

Russian 120-mm Self-Propelled Combination Gun 2S9-1

Weapons &Ammunition Types	Typical Combat Load
120-mm combo gun Mortar rounds Rifled Mortar rounds Cannon rounds See pgs 7-61 and -71.	**40**

SYSTEM
Alternative Designations: Nona-S, 120-mm SP How M-1981
Date of Introduction: 1981 for original 2S9
Proliferation: At least 3 countries
Description:
Crew: 4, with 6-8 in section
Platform (chassis): Modified BTR-D APC
Combat Weight (mt): 8.5
Chassis Length Overall (m): 6.02
Height Overall (m): 2.6 Like the BTR-D, 2S9-1 can adjust height for mobility, reduced profile, and stability during firing.
Width Overall (m): 2.63

Automotive Performance:
Engine Type: 240-hp Diesel
Cruising Range (km): 500
Speed (km/h):
Max Road: 60
Max Off-Road: 35
Average Cross-Country: INA
Max Swim: 9
Fording Depth (m): Amphibious
Emplacement Time (min): 1 (est)
Displacement Time (min): 1 (est)

Radio: R-123

Protection:
Armor, Turret Front (mm): 10
Applique Armor (mm): N/A
Explosive Reactive Armor (mm): N/A
Mineclearing Equipment: N/A
Self-Entrenching Blade: N/A
Active Protective System: No
NBC Protection System: Yes
Smoke Equipment: No, but available

ARMAMENT
Main Armament:
Caliber, Type, Name: 120-mm, gun-mortar, 2A51
Barrel Length (cal): 24.2
Rate of Fire (rpm): Burst 10, normal 6, sustained 4
Loader Type: manual
Breech Type: combined semi-automatic breechblock with wedge locking mechanism and powder gases plastic obturator
Muzzle Brake Type: None
Traverse (°): Left 35, right 35, total 70
Elevation (°): -4/+80°

FIRE CONTROL
Indirect Fire: Collimator
Direct Fire: DF telescopic sight
Collimator: K-1
Gun Display Unit: None
Fire Control Computer: None

VARIANTS
2S9-1 offers improved ammo storage over the original **2S9**.

MAIN ARMAMENT AMMUNITION
Caliber, Type, Name:
120-mm Frag-HE cannon (3VOF49)
Range (m): 15 - 8,850
Complete Projectile Weight (kg): 19.8
Muzzle Velocity (m/s): INA
Fuze Type: PD and proximity

120-mm HEAT (BK-19) cannon
Range (m): 40 – 1,000
Armor Penetration (mm): 600
Complete Projectile Weight (kg): 13.20
Muzzle Velocity (m/s): 560
Fuze Type: PD

120-mm Frag-HE rocket assisted cannon (OF-50)
Range (m): 1,700 - 12,800
Complete Projectile Weight (kg): 19.8
Muzzle Velocity (m/s): 367
Fuze Type: B35 PD and proximity

120-mm Laser-Guided Projectile, cannon (Kitilov-2, see pg 7-71)
Lethality mechanism: Frag-HE fill
Range (m): 500 - 9,000
Complete Projectile Weight (kg): 25
Muzzle Velocity (m/s): INA
Fuze Type: PD

120-mm Frag-HE mortar (OF-843B)
Range (m): 450 - 7,100
Complete Projectile Weight (kg): INA
Muzzle Velocity (m/s): INA
Fuze Type: PD and proximity

Other Ammunition Types: All standard 120-mm mortar rds (e.g., smoke, illumination, etc.) and cannon rounds **(**OF-34, OF-51). See pgs 7-61 and -71.

NOTES
Gun and mortar Frag-HE ammunition for the 2S9-1 can employ proximity fuzes for air bursts.

Russian 120-mm Self-Propelled Combination Gun 2S23 _____

Weapons &Ammunition Types	Typical Combat Load
120-mm combo gun	**30**
Mortar rounds Rifled Mortar rounds Cannon rounds See pgs 7-61 and -71.	
7.62-mm MG	**2,000**

SYSTEM
Alternative Designations: 120-mm 2S23 Nona-SVK
Date of Introduction: 1990
Proliferation: At least 3 countries.
Description:
Crew: 4
Platform (chassis): Modified BTR-80 APC
Combat Weight (mt): 14.5
Chassis Length Overall (m): 7.50
Height Overall (m): 2.75
Width Overall (m): 2.90

Automotive Performance:
Engine Type: 260 hp V-8 water cooled diesel
Cruising Range (km): 600
Speed (km/h):
- Max Road: 80
- Max Off-Road: 60
- Cross-Country: 40
- Max Swim: 10

Fording Depths (m): Amphibious
Emplacement/Displacement Time (min): 1 (est)
Radio: R-173

Protection:
Armor, Turret Front (mm): Against 12.7-mm
Armor Turret Top (mm): INA
Armor Hull (mm): INA
NBC Protection System: Yes
Smoke Equipment: Six 81-mm smoke grenade launchers

ARMAMENT
Main Armament:
Caliber, Type, Name: 120-mm, gun-mortar, 2A60
Barrel Length (cal): INA
Rate of Fire (rpm): 10 burst, 6 normal, 4 sustained
Loader Type: autoloader
Breech Type: combined semi-automatic breechblock with wedge locking mechanism and powder gases plastic obturator
Muzzle Brake Type: None
Traverse (°): 35 left, 35 right, 70 total
Elevation (°) (-/+): -4/+80°

Auxiliary Weapon:
Caliber, Type, Name: 7.62-mm machinegun, PKT
Mount Type: Coax
Direct Fire Range (m): 1,500
Max Effective Range (m): 1,000 day, night N/A
Fire on Move: Yes
Rate of Fire (rpm): 650 (cyclic), 2-10 round bursts

FIRE CONTROL
Indirect Fire: INA
Direct Fire: DF telescopic sight
Collimator: K-1
Gun Display Unit: None
Fire Control Computer: None

VARIANTS
PLL05: Chinese SP combo gun fits a longer variant of the 2S23 cannon on 6-wheeled WZ-551 chassis (pg 3-26). It can fire ammo for the 2S23 but Chinese rounds include longer rounds for the newer Russian 2S31 (pg 7-61). It also mounts a 12.7-mm MG.

MAIN ARMAMENT AMMUNITION
Caliber, Type, Name:
120-mm Frag-HE cannon (3VOF49)
- Range (m): 15 - 8,850
- Complete Projectile Weight (kg): 19.8
- Muzzle Velocity (m/s): INA
- Fuze Type: PD

120-mm HEAT (BK-19) cannon
- Range (m): 40 – 1,000
- Armor Penetration (mm): 600
- Complete Projectile Weight (kg): 13.20
- Muzzle Velocity (m/s): 560
- Fuze Type: PD

120-mm Frag-HE rocket assisted cannon (OF-50)
- Range (m): 1,700 - 12,800
- Complete Projectile Weight (kg): 19.8
- Muzzle Velocity (m/s): 367
- Fuze Type: B35 PD

120-mm Laser-Guided Projectile, cannon (Kitilov-2, see pg 6-30)
- Lethality mechanism: Frag-HE fill
- Range (m): 500 - 9,000
- Complete Projectile Weight (kg): 25
- Muzzle Velocity (m/s): INA
- Fuze Type: PD

120-mm Frag-HE mortar (OF-843B)
- Range (m): 400 - 7,100
- Complete Projectile Weight (kg): INA
- Muzzle Velocity (m/s): INA
- Fuze Type: PD and proximity

Other Ammunition Types: All standard 120-mm mortar rds (e.g., smoke, illumination, etc.) and cannon rounds **(**e.g., OF-34, OF-51). See pgs 7-61 and -71.

NOTES
2S23 has a device for loading projectiles from the ground. During traveling the device is externally attached on the right side near the side door. Gun and mortar Frag-HE ammunition for the 2S23 can employ proximity fuzes for air bursts.

Mortar Tables

The following tables reflect mortars which the US soldier is "most likely" to encounter on today's battlefields. A wide variety of other mortars and rounds are proliferated.

50/60-mm Mortars

Mortar	Cal (mm)	Origin	DOI	Range (Max/Min) (meters)	Munition Types	Rate of Fire (rpm)	Crew	Round Weight (HE)(kg)	Elevation/ Traverse (degrees)	Muzzle Velocity (m/s)	Mount Type	Weight (kg)	Emplace/ Displace (min)	Remarks
M-8	50.8	Bosnia Yugo		Max: 480 Min: 135	HE	25-30	1-2		E: 45-85		Hand-supported	7.3	1/1	One crewman carries the mortar, the other carries ammo.
Al-Jaleel Commando Mortar (M70)	60	Iraq Yugo (M70)		Max: 2537	HE Illum Smoke	25-30	1-2		E: 45-85		Hand-supported	7.6	1/1	Iraqi version of the Bosnian M70 Commando mortar.
Al-Jaleel Infantry Mortar (M57)	60	Iraq Yugo (M57)		Max: 2500	HE Illum Smoke	25-30	1-2		E: 45-85		Bipod & Base-plate	22	1/1	Iraqi version of the Yugo M57 60-mm infantry mortar (based on US M2 60-mm mortar) Easily separated from bipod and baseplate and used.
M70 Commando	60	Bosnia		Max: 2537 Min: 100	HE Illum Smoke	15	1-2		E: 45-85		Hand-supported	10	1/1	Widely copied and proliferated
Brandt Commando	60	France		Max: 1050 Min: 100	HE Illum, Smoke Incendiary	15	1-2		E: 45-85		Hand-supported	8.9	1/1	Widely proliferated (20+ countries) Fires same ammo as CH Type 63 but reduced charge. One crewman carries mortar, the other carries ammo
T1 Commando	60	Iran		Max: 1050 Min: 100	HE	15	1-2		E: 45-85		Hand-supported	6	1/1	Appears to be Iranian version of the Brandt Commando T2 mortar has a round base and shorter range- 800 m.
Hadib Infantry	60	Iran		Max: 2500 Min:	HE	30	1-2		E: 43-85		Bipod & Base-plate	Firing: 17.5 Baseplate: 6.5 Tube: 6 Site: 1 Bipod: 4	11/1	Appears to be Iranian version of the Yugo M57 class 60-mm mortar.
Type 63-1	60	China	1970s	Max: 1550 Min: 95	HE Illum, Smoke	15-20	2-3	1.3	E: 40-80 T: 8	141	Bipod & Base-plate	Firing: 11.5	1/1	Widely proliferated. Small rectangular base-plate and carrying handle on the tube.
Type 85/ W85	60	China	1985	Max: 2700 Min: 145	HE HE Blast Illum, Smoke Incendiary	30	5	1.3	E: 45-80 T: 8	203	Bipod & Base-plate	Firing: 12.7		Replaced Chinese Type 63-1
Type 90/ W90	60	China	1990	Max: (ext) 5700 Min: 130	HE HE Blast Illum Smoke Incendiary	30	2-3	2.3	E: 45-80 T: 7		Bipod & Base-plate	Firing: 21.5		Replaced Chinese Type 85

81/82-mm Mortars

Mortar	Cal (mm)	Origin	DOI	Range (Max/Min) (meters)	Munition Types	Rate of Fire (rpm)	Crew	Round Weight (HE) (kg)	Elevation/ Traverse (degrees)	Muz Vel (m/s)	Mount Type	Weight (kg)	Emplace/ Displace (min)	Remarks
Hadid	81	Iran		Max: 5200 Min:	HE	20			E: 43-85		Bipod & Base-plate	Firing: 50.5 Base: 17.5 Tube: 18 Site: 1.5 Bipod: 13.5		
L16/A1/A2 M252 (US) C3 (Can)	81	UK US Can Japan	Mid 1960s (L16)	Max: 5650 Min:	HE Smoke Illum WP	15	5	4.3	E: 45-80 **T: INA**	255	Bipod & Base-plate	Firing: 35.3 Base: 11.6 Tube: 12.7 Bipod: 12.3 Site: 1.25		Widely proliferated (+39 counties)
W87	81	China	1987	Max: (ext) 5700 Min: 120	Frag HE HE Blast Smoke, Ill Incendiary Ext range	20	5-7	4.2	E: 45-80 T: 7	312	Bipod & Base-plate	Firing: 39.7		Replaced Type 67. Similar to Type 84
2B14-1	82	FSU	1983	Max: 4270 Min: 80	Frag-HE Illum Smoke	20	4	3.1	E: 45-85 T: 8		Bipod & Base-plate	Firing: 39		Podnos Muzzle loaded, smoothbore, manpack
2B9 Type 99 Automatic Mortar	82	FSU (2B9) China (Type 99)	1983	Max: 5000 4270 Min: 100 800	Frag-HE HEAT Smoke Illum ~~Incendiary~~	120 sustain : 40-60	3-4	3.2	E: -1 to 85 T: 30/30	270	Split rail carriage w/ emplace jack	635	1/5	Breech-loaded, recoil-operated mortar using 4-round clips. Towed by Light Truck
Al-Jaleel	82	Iraq		Max: 4900 Min:	HE	10-15	4		E: 45-85		Bipod & Base-plate	Firing: 63	1/1	Copy of Yugo M69A
M37, M1937 (1942-43 ver) Type 53	82	FSU China (Type 53)	1943	Max: 3040 Min: 90	Frag-HE HE Illum Smoke Incendiary	15-25	**5**	3.5	E: 45-85 T: 10 total	HE: 210	Bipod & Base-plate	55.8		Old, but widely proliferated.
M69A	82	Yugo	Mid 1960s	Max: 6050 Ext Range: (M91=6700) Min: 160	HE Illum Smoke	10-15	4		E: 45-85 T: 3/3	HE: 330	Bipod & Base-plate	Firing: 54 Tube: Bipod: 14 Base: 15	1/1	Widely proliferated.
Type 67	82	China	1971	Max: 3040 Min: 85	HE, Illum, Smoke Incendiary	10-15	3-4	3.16	E: 45-85 T: 6	HE: 211	Bipod & Base-plate	Firing: 35 Tube: 13 Bipod: 10 Base: 12		Widely proliferated. In service since 1971. Replaced Type 53 (copy of Sov M-37). Triangular baseplate with handle. SP variant mounted in a Chinese YW-304 APC
Type 84	82	China	1984	Max: (ext) 5700 Min: 120	Frag HE HE Blast Smoke, Ill Incendiary Ext range	20	5-7	4.2	E: 45-80 T: 7	HE: 265	Bipod & Base-plate	Firing: 39.7 Tube: 15.5 Bipod: 8.7 Base: 15.5		Similar to Chinese W87 81-mm Mortar.

Note:
Proximity fuzes are available for use with 81-mm and 82-mm HE projectiles, providing air burst capability.

100/120-mm Mortars

Mortar	Cal (mm)	Origin	DOI	Range (Max/Min) (meters)	Munition Types	Rate of Fire (rpm)	Crew	Round Weight (HE)(kg)	Elevation/ Traverse (degrees)	Muz Vel (m/s)	Mount Type	Weight (kg)	Emplace/ Displace (min)	Remarks
Type 71	100	China	Early 1970	Max: 4700 Min: 170	HE Illumination Smoke	15-20	7	8	E: 45-80 Total: 4/4	250	Bipod & Base-plate	Firing: 75 Tube: 28 Bipod: 21 Base: 25.5		
Type 89	100	China	Early 1989	Max: (ext) 6400 Min: 215	HE Illumination Smoke	15-20	7	8	E: 45-80 Total: 4/4	215	Bipod & Base-plate	Firing: 73 Tube: 29 Bipod: 16 Base: 28		Light. Designed for light infantry, mountains, and jungle environs, Manportable
2B11 **Aka: M120** **2S12**	120	FSU		Max: (ext) 9100 Min: 450	Frag-HE and more. See pg 6-63	10-15	5	16	E: 45-80 Total: 5/5	325 (ext)	Bipod & Base-plate. Trailer	Firing: 210 Travel: 297 Bipod: 55 Base: 80	3/3	2S12 includes the GAZ-66 light truck. Mortar is usually porteed, rather than towed.
Al-Jaleel	120	Iraq		Max: 5400 Min:	HE Illumination Smoke	5-8			E: 45-85		Bipod & Base-plate	148		
M1943 **M-43** **M120** **Type 53**	120	FSU NK China (Type 53)	1943	Max: (ext) 7200 Min: 450	Frag-HE and more. See pg 7-73	4-9	6	15.4	E: 45-85 T: 4/4	272	Bipod & Base-plate. Trailer	Firing: 270 Travel: 522 Bipod: 80 Base: 95	5/3	Old, but widely proliferated. Old, but widely proliferated. Replaced by the newer 2B11/2S12 (FSU)
M74	120	Yugo		Frag-HE: Max: 5400 Min: 275 Extend: 6464 RAP: 9056	HE DPICM Smoke Illum Chemical ICM	5-12	4					Firing: 120 Travel: 208 Bipod: 25 Base: 49	2/.5	Similar to the M75. Lighter designed for mountain use
M75	120	Yugo		Frag-HE: Max: 5374 Min: 275 Extend: 6464 RAP: 9056	HE DPICM Smoke Illum Chemical ICM	4-6	4		E: 45 to 85 T: 6 total	307 (RAP)	Bipod & Base-plate. Trailer	Firing: 178 Travel: 261 Bipod: 25 Base: 87	<1/<1	
MO-120-RT **Towed** **Mortar**	120	France	1961	Max: 8135 RAP: 13000 Min: 1100 See pg 6-63	Frag HE HE-RA	10	4-6	18.60	E: 30 to 85 T: 15 total		towed split trail	582	1.5/2	Widely proliferated (22+ countries including Iraq). Rifled mortar Towed by light truck/TUV Can fire all standard s 120-mm smoothbore rounds w/o fins.
SL	120	Spain		Max: 5700 Min: 600	HE Smoke	3-5			E: 45 to 85 T: 6 total	295	Bipod & Base-plate. Trailer	Firing: 112 Travel: 250 Base: 50	3/3	Lighter version of the L w/lighter base plate and shorter range.

Note:
Proximity fuzes are available for use with 120-mm HE rounds, and are used in DPICM projectiles, providing air burst capability.

100/120-mm Mortars (continued)

Mortar	Cal (mm)	Origin	DOI	Range (Max/Min) (meters)	Munition Types	Rate of Fire (rpm)	Crew	Round Weight (HE) (kg)	Elevation/ Traverse (degrees)	Muz Vel (m/s)	Mount Type	Weight (kg)	Emplace/ Displace (min)	Remarks
Type 55/ M-55	120	China	Late 1950s	Max: 5520 Min: 450	HE Smoke Illumination	15	6		E: 45-80 T: 4/4	272	Bipod & Base-plate Trailer	Firing: 275 Travel: 550		Improvement of the Chinese Type 53 (Clone of Russian M1943)
Type 86/ W86	120	China	mid 1980s	Max: 7700 Min: 400	HE Frag-HE Smoke Illumination Incendiary Chemical	20			E: 45-85 T: 04 left 04 right	341		Firing: 206 Travel: 291 Tube: 88 Bipod: 27 Base: 91		SP versions carried on Type 86 and Type 63 APCs

Note:
Proximity fuzes are available for use with 120-mm HE rounds, and are used in DPICM rounds, providing air burst capability.

160/240-mm Mortars

Mortar	Cal (mm)	Origin	DOI	Range (Max/Min) (meters)	Munition Types	Rate of Fire (rpm)	Crew	Round Weight (HE) (kg)	Elevation/ Traverse (degrees)	Muzzle Vel (m/s)	Mount Type	Weight (kg)	Emplace/ Displace (min)	Remarks
M-160	160	FSU	1953	Max: 8040 Min: 750	HE	3	6-7	41	E: 50-80 T: 25 total	343	Base-plate & wheels	Firing: 1314 Travel: 1470	?/7	Towed by light truck. Breech loaded. Barrel is 4550mm in length Replaced M-43
M-43 Type 56	160	FSU China (Type 56)	1943	Max: 5150 Min: 630	HE	3	4-8	40.8	E: 45-80 T: 25 total		Base-plate & wheels	Firing: 1170		Widely proliferated (+20 countries) Towed by light truck. Replaced by the M-160
2S4 SP M1975	240	FSU	1975	Max: 9700 HE Ext: 20000 Min: 80 Max 9.2	HE Nuclear Chemical Laser-Guided			130	Limited Traverse	362 (HE	Tracked SP chassis			Replaces M-240. Mod SA-4 Ganef chassis. Short range is problem for Nuclear rounds LGP requires laser designator.
M-240 (Towed) M-53	240	FSU	1952	Max: 9700 Ext: 20000 Min: 800	HE Nuclear Chemical	1	8-9	130	E: 45-70 T: 17 total	362 (HE)	Base-plate & wheels	Firing: 3610 Travel: 4240	varies	Short range is problem for Nuclear rounds

Note:
Proximity fuzes are available for use with 160-mm HE projectiles, providing air burst capability.

Combination Guns

Mortar	Cal (mm)	Origin	DOI	Munition Types (Fuze Types) Maximum Range (meters)	Round Weight (kg)	Rate of Fire (rpm)	Crew	Elevation/ Traverse (degrees)	Mount Type	Weight (kg)	Emplace/ Displace (min)	Remarks
2S31 **(Vena)** **Tracked SP Combo Gun**	120	FSU	1996	New Family 120-mm Howitzer Ammunition: Frag-HE-RA (RAP) (PD/Time/Prox) 18000 Frag-HE (PD/Time/Prox) 13000 DPICM (PD/Time) 13000 Also fires all munitions listed below. See also pg 7-73.	Frag-HE: 16 Also fires munitions below.	10	4	E: -4 to 80 T: 360/	Mod BMP-3 amphibious chassis	19500	1/1 est	Rifled gun 2A80. 70 rounds carried onboard
2S9-1 (Nona-S) **Tracked SP** Combo Gun	120	FSU	1981	Howitzer: Frag-HE-RA (RAP) 13000 Frag-HE PD/Prox 8800 DPICM 12000 Flechette 1000 HEAT 1000 (armor penetration 600mm) Kitolov-2 (laser-guided) 9000 Mortar: Frag-HE-RA (RAP) 9000 Frag-HE PD/Prox 7100 Incendiary (White Phosphorus) 6010 Smoke 5850 Illum 5850 Chem INA Strix (IR-homing) 8000 Gran (laser-guided) 9000 Rifled Mortar (French): Frag-HE-RA (RAP) PD/Prox 13000 Frag-HE PD/Prox 8100 Also other 120-mm rifled mortar rounds See also pg 6-63.	HE-RA: 20 **Frag-**HE: 20 HEAT: 13 Laser Gd: 25 Frag-HE (mortar) 17.2	6	6-8 Total Mortar Crew 4	E: -4 to 80 T: 360/70 total	Mod BTR-D/ BMD amphibious chassis	8500	1/1	Rifled gun 2A51. 40 rounds carried onboard WEG page 6-56
120 SP **Wheeled SP Combo Gun**	120	China	2001		HE-RA: 20 **Frag-**HE: 20 HEAT: 13 Laser Gd: 25 Frag-HE (mortar) 17.2	HE: 6-8 HEAT 4-6 Mortar 10	4	E: -8 to 80 T: 360/	WZ-551 amphibious chassis			Similar to 2S23. Exported 2001
2S23 **(Nona-SVK)** **Wheeled SP Combo Gun**	120	FSU	1990		HE-RA: 20 **Frag-**HE: 20 HEAT: 13 Laser Gd: 25 Frag-HE (mortar) 17.2	10	4	E; -4 to 80 T: 360/70 total	Mod BTR-80 APC amphibious chassis	14500	1/1	Rifled gun 2A60. 30 rounds carried onboard. WEG page 6-57
2B16 **(Nona-K)** **Towed Combo Gun**	120	FSU	1986		HE-RA: 20 **Frag-**HE: 20 HEAT: 13 Laser Gd: 25 Frag-HE (mortar) 17.2	6	5	E: -10 to 80 T: 60 total	Towed split trail carriage. Can be porteed on amphibious chassis.	1100	2/2	Rifled gun 2A51 Towed by light truck, TUV, or APC WEG page 6-54

NOTE: Combination guns are actually howitzers that can also fire 120-mm mortar rounds. Therefore, they are also referred to as 120-mm howitzers, and as gun-mortar systems. They can fire all standard 120mm rifled cannon, 120mm rifled mortar, and 120mm smoothbore mortar ammunition. The howitzer rounds can be fired in a direct-fire role (0 meters-Flechette, 40 meters-HEAT, others >100 meters minimum safe distance). Mortar rounds have a shorter range than howitzer rounds. However, the system can fit more mortar rounds, can fire to higher angles. High angle fires can be more easily used in higher defilade terrain and in urban areas, and can impact at angles closer to 90°, for more lethal area effects. The addition of mortar rounds also makes available to the weapon a wider array of specialized and precision munitions for different applications.

ARTILLERY AMMUNITION OPTIONS

A wide variety of ammunition types are available for use in artillery. In addition to standard ammunition, there are various types in the special munitions and artillery-delivered high-precision munitions (ADHPM). "Advanced Munitions" is an umbrella term for modern munitions, and includes a variety of technologies among the types listed above.

STANDARD MUNITIONS

Standard munitions are lethal area munitions, as well as supporting munitions, such as white phosphorus rounds.

Frag-HE. The default standard artillery munition is fragmentation high-explosive (Frag-HE) with a point-detonating/delay, time, or proximity fuze. Other developments include extending range using *rocket assist*. Limitations of RAP (rocket-assist projectiles) include larger size and increased error versus unassisted rounds. When the target is dug-in troops, vehicles, and equipment, they are engaged with a 50-50 mix of point-detonating and short-delay-fuzed Frag-HE projectiles. Dug-in targets are assumed to have overhead cover for personnel positions and hull-down positions for vehicles. Frag-HE with a 25-75 mix of airburst and point-detonating projectiles is the preferred engagement when the target is unidentified troops and equipment.

Extended Range Full-Bore (ERFB). With "Gerald Bull" artillery technology a new family of rounds called ERFB has been developed. The larger and more streamlined rounds have less drag on cannon barrels, resulting in longer ranges with more precision and larger explosive fills. A companion development is replacement of RAP technology with *base-bleed (BB) units*. These units require little stowage area and can be attached as needed and extend range of rounds without increased error.

Flechette Rounds. These artillery projectiles are as much as five times as lethal as conventional Frag-HE projectiles against personnel. They can produce effectiveness kills against materiel targets, and all targets with large numbers of personnel, excluding personnel in armored vehicles, bunkers, and field fortifications with overhead cover. Because of the shape, distribution density, and terminal velocity of flechettes, they are useful against personnel wearing woven-fabric body armor and against personnel in shallow trenches and positions without overhead cover. Flechette projectiles require adjustment due to their use of mechanical time fuzes, and their effects are very sensitive to burst height.

Direct-Fire Munitions. These are designed for artillery self-defense. Some have shaped charge AT warheads.

Improved Conventional Munitions (ICM). Modern larger rounds are often designed as canisters (or "buses") for various fills and uses. Among these are dispensing ICM - lethal bomblets or submunitions with blast and fragmentation effects, with proximity fuzes for airbursts and even lethality effects over a large area. An extension of ICM is dual-purpose ICM (DPICM – scatterable submunitions each of which has both anti-personnel and shaped-charge armor penetrator effects). A DPICM round is a good general-purpose munition for most targets. Targets engaged by cannon-delivered DPICM have to be located to accuracies of no less than 200 m for group targets and 150 m for point targets. Targets engaged by MRL-delivered DPICM have to be located to accuracies no less than 350 m for group targets and 250 m for point targets. MRL engagements are normally by platoon or battery. Known as "steel rain" in Desert Storm, their high dud rate leaves the duds as surface mines.

Enhanced Blast/Aluminized RDX. Another *advanced munition* category is *enhanced blast*. Technologies include aluminized explosive, especially aluminized RDX. The spread of aluminum flakes extends the round's lethal blast radius. Other technologies include fuzing propellant to supplement a round's main charge detonation.

Volumetric Explosives (VEX). This is another enhanced blast category, and includes two different technologies with the same effects - fuel-air explosives (FAE), and *thermobaric* explosives (TBX). FAE warheads dispense a cloud that is detonated in-flight. Thermobaric explosive is a slurry mix which can be placed in grenades, shells,

rockets, missiles, and other munitions. Artillery VEX is primarily in rockets with diameters greater than 160 mm. These warheads are used against any target with a target-location error less than 500 m, but primarily soft-skinned vehicles, personnel, and equipment with a large surface area (e.g., radars, bridging equipment, frame buildings, and aircraft). VEX warheads are not used (except as a last resort) on targets that contain numerous armored vehicles or troops in extensive enclosed fortifications. Engagement with VEX warheads is normally by battery. The maximum target size for a battery strike can be 25 to 36 hectares, depending on the hardness of the target. VEX warheads can also be targeted against minefields that use simple, single-impulse-detonated mines. Increasing the accuracy of the delivery system can enhance VEX warhead effectiveness. For example, a course-corrected rocket can reduce dispersion in the target area. Additional discussion is in Chapter 12.

SPECIAL MUNITIONS

Special munitions are usually handled as a separate issue from regular rounds, because of control or usage issues, and limited supply. A few smoke and illumination rounds may be issued to each artillery piece in with the standard issue. But the majority of those rounds are stowed in a separate supply point or vehicle for critical times and battle phases. White phosphorus rounds can be used both as smoke and illumination rounds.

Smoke Munitions. Artillery (including mortars) can deliver various types of smoke rounds. Seven to 10 percent of all artillery fire may be smoke rounds. Traditionally these were mostly WP and plasticized white phosphorus (PWP), which have a moderate degrading effect on thermal imagers and a major one on lasers. Modern Tier 1 and Tier 2 systems also use improved smoke compositions, which can block IR sensors and degrade thermal sights. For discussion of artillery obscurant munitions, see Chapter 13.

Chemical, Biological, Radiological, and Nuclear (CBRN) Weapons. The OPFOR might use CBRN Weapons to deter aggression or as a response to an enemy attack. The OPFOR has SSMs capable of carrying chemical, biological, radiological, or nuclear warheads. Additionally, it can employ aircraft systems and cruise missiles to deliver a CBRN strike. While the majority of OPFOR artillery (152-mm and above) and large-caliber MRLs are capable of firing nuclear munitions only select units will be issued the nuclear or chemical munitions. The majority of artillery and MRL units can fire chemical munitions. However, continued improvements in conventional munitions (especially precision munitions) increase the likelihood that the OPFOR can deliver lethal fires and strikes at the desired location and time without resorting to CBRN weapons.

Artillery-Delivered Mines. Although very different in effects, antipersonnel scatterable mines (APSM) and antitank scatterable mines (ATSM) are nearly always dispensed together to make mine-clearing operations more difficult. These mixed minefields can be dropped on the target directly or can be emplaced to retard traffic, either anticipated or confirmed. Target locations provided by radar or signals reconnaissance must be known with a location error of not more than 650 m for MRL scatterable mines and 350 m for cannon-delivered mines.

MRL engagements normally take place by battery or battalion, with antitank mine densities of 0.005 to 0.01 mine/m^2 for an area minefield, or 1 mine per meter of frontage for a linear minefield. A common mix is one or two antipersonnel mines per every seven to nine antitank mines. The desired method of engagement is mixed minefields. Moving columns may be engaged by MRL firing ATSM.

Cannon engagements invariably take place by battalion due to the large number of mines emplaced. A special munitions unit that is assigned the mining mission for a specific time is most likely to deliver cannon-delivered mines. This unit may constitute the commander's emergency scatterable mine capability, because of the cannon unit's ability to deliver mines in a wide variety of conditions.

One technique used to increase the effectiveness of advanced top-attack munitions is to immobilize the target first with mines. Against enemy howitzers or MRLs using "shoot-and-move" tactics, on-call mining missions by either cannon or MRL units can stop the target with scatterable mines, for subsequent engagement by top-attack munitions. This type of attack can enhance the effectiveness of both types of munitions. The last-minute or surprise use of scatterable mines from MRLs or cannon artillery (or from minelayers, helicopters, or

aircraft) increases the effectiveness of the minefield. The sudden introduction of minefields into areas thought to be clear can either delay the enemy or canalize him into other minefields or kill zones. Enemy forces in such a case would have little to no intelligence as to the existence of these mines until it was too late and would have little time to organize clearing efforts. This makes it harder for the enemy to locate the separate fields and delays his mineclearing efforts. Repeated encounters with smaller minefields can cause him more attrition and confusion than a single, long minefield that he only needs to breach once. This method can break up attacking formations and cause loss of morale and momentum. Breaching multiple minefields also can cause increased expenditure of mineclearing means. Additional discussion of artillery-delivered scatterable minefields can be found at page 8-6.

Other Special Munitions. Artillery can be used to deliver specialized munitions. For instance, 9A152-2 300-mm MRL can launch an R-90 rocket which expels a UAV downrange in seconds for RISTA support to artillery missions. Several small UAVs have demonstrated launch from mortar tubes.

Another special munition type is RF jammer rounds, which can be delivered by guns, mortars and rockets. The rounds provide short-term (jamming of the target node). Other information warfare rounds (e.g., grid attack and others) can be delivered by artillery.

Incendiary munitions have been around for some time. White Phosphorus is the most versatile. They can be considered as lethal munitions, smoke to blind and mark targets, or to illuminate targets. Another role is for anti-personnel and anti-materiel incendiary effects, which can generate wide area fires. Because incendiary effects are wildly inconsistent, most munitions have other main effects, then include incendiary as a secondary one. Even FAE and TBX munitions, which use flame in their detonation, have so much blast effect that they are treated more like Frag-HE. However, there are still rockets delivered with napalm fill. This is a true flame weapon. In some environments, incendiary and flame munitions can be effective.

Concrete-piercing (CP) rounds can be used against a variety of targets, including vehicles. But they are usually issued in small numbers or held aside for use against buildings, bunkers, and structures. Some forces use HEAT rounds instead of CP rounds for those roles.

ARTILLERY-DELIVERED HIGH-PRECISION MUNITIONS

ADHPM include two categories: course-corrected munitions, and precision munitions. Increased use of ADHPM can revolutionize the way artillery operates. Precision weapons have enabled the OPFOR to shift from delivery of massed fires against area targets to multiple quick and devastating strikes against sub-targets, target nodes, and point targets. These can be integrated, coordinated and executed at critical points on the battlefield at critical times, and simultaneously reduce ammunition expenditure and mission time. Reconnaissance fire (defined later in this chapter) is an effective form of precision weapon engagement. It is sometimes called a “unified precision weapon system,” because it links the highly accurate weapon to an automated reconnaissance and control system. A variety of countermeasures (Ch 14) have been developed to counter ADHPM.

With the shift from area fires to annihilation of smaller targets comes the greater need for both centralized and decentralized planning, integrated use of all available RISTA (including artillery and non-artillery assets), integrated fires and strikes with non-artillery weapon systems, and use of methods and technologies to protect weapons from enemy counter-battery operations. Among RISTA assets, use of UAVs has become particularly critical for inclusion of timely acquisition and direction of fires and strikes against fleeting and covert targets. Integration includes the use of the Integrated Fires Complex and other arrangements, such as *artillery sniper attacks* and *autonomous weapon attacks* against mobile and stationary targets. Increasingly, artillery small unit formations such as split batteries, dispersed platoons, roving guns, and autonomous weapons will employ shoot-and-move tactics and ADHPM to incorporate dispersion and precision strikes. Critical equipment requirements for these organizations are artillery vehicles, UAVs, or man-portable artillery-accompanying fire control systems with laptop computers, autonomous navigation, digital longer range comms (encrypted, possibly directional or satellite), and precise target location systems (e.g., GPS-based laser range-finders, and/or laser target designators).

There are also light vehicle/ATV mounted versions that can accompany artillery. Other critical assets are becoming widespread among modern (Tiers 1 and 2) forces. The less expensive versions and workaround arrangements are available to upgrade artillery in older forces (Tiers 3 and 4). Most forces will employ a mix of massed fires and precision strikes based on battle planning, battle phases, and conditions of the fight.

Course-Corrected Munitions (CCM). These are designed to defeat area targets with reduced errors and fewer rounds expended. Original CCM were 5-10 times more accurate than conventional projectiles or rockets over long range. Some modern more expensive CCMs offer precision of <5 meters. CCM compare actual flight path to calculated flight path and change the trajectory to compensate for errors. With their focus on a programmed hit point, they are used against stationary targets. CCM use various tracking schemes and actuators for course correction. Most common guidance is inertial, GPS, external radar or radio transponder tracking (active and passive). Actuators include fins, thrusters, drag brakes, shifting mass, and nose fuze.

The least expensive arrangement is a CC fuze, which replaces the projectile nose fuze. That fuze has GPS and internal wind vanes to steer. Thus at little cost existing munitions can be converted into precision munitions. Other CCM are more expensive munitions with inertial (gyroscopic) and GPS CC, and wings to extend range of older cannons to 50+km. For CCM, the firer may have to add a computer-based electronic programmer, to program the fuze prior to firing or in-flight.

A CCM is flexible, since it does not care about target signature; but warhead effects must match the target. Lethal payloads include Frag-HE, DPICM, sensor-fuzed submunitions (SFSM), and terminally homing munitions. CCM size limit does not allow for shielding the electronics; thus, they are vulnerable to electronic attack. With More expensive CCMs (inertial/GPS), even if the GPS is jammed, the inertial will maintain course. Severe winds in target area can also affect the accuracy of CCM. Of course, CCM do not correct for inaccurate or untimely target location Use of CCM against stationary targets can significantly reduce the total numbers of rounds expended. Generally, cost is considerably less than most other choices.

Precision Munitions. Other advanced munitions fall into the category of *precision munitions*, which have a guidance or homing element. The OPFOR defines a *precision weapon* as one capable of delivering guided conventional munitions with a high probability (60+ %) of a first-round hit (which is greater Ph than that for use with most CCM). A few expensive CCM may meet or exceed the criterion. Ability to deliver precision munitions transforms a weapon into a precision weapon. Precision munitions are primarily designed to effectively defeat armored vehicles; SP artillery systems; MRLs; C2 and RISTA centers; defensive fortifications; and bridges.

Some precision weapon systems must incorporate a target acquisition and tracking subsystem and/or munition guidance subsystem. Others are unmodified artillery or mortars which deliver precision munitions with autonomous homing or sensor fuzing. With use of remote designators, artillery does not need fire control changes for effective delivery. Precision munitions delivered by mortars and artillery include:

- Guided, e.g., semi-active laser-homing (SAL-H) cannon and mortar projectiles, and rockets,
- Sensor-fuzed artillery munitions or submunitions, and
- Terminally homing rockets, submunitions, and mortar projectiles.

Laser Guided Projectiles. The most common type of guided munition uses a laser target designator (LTD) to point the munition to a target, and a seeker in the munition nose to home on the laser "splash". The LTD can be mounted on a vehicle, aircraft, UAV, vessel, or on shoulder/tripod mount. The LTD operator can be an artillery FO, RISTA OP, or other asset with an LTD, and who can link to artillery shooters. Because LGPs (pg 7-75) employ an operator in the guidance loop, they offer a high hit probability, can be used against moving targets, and can avoid hitting already-killed targets. Artillery assets with LTDs can also direct compatible SAL munitions from combat vehicles, ATGM launchers, aircraft, naval vessels, etc. There are mechanisms and methods to further reduce those error possibilities. Because the seeker can surveil a large area (up to 5+ km^2), there is a large margin for error in location/delivery precision. The seeker homing ability can eliminate errors. An artillery delivery system may have its own LTD for direct fire against targets out to the limit of line-of-sight (up to 10 km).

Most LGP have a Frag-HE warhead vs HEAT, in order to service a wider variety of targets on the battlefield, including combat vehicles. Against even heavy armored vehicles such as tanks, a hit is likely to cause a kill, or heavy damage which will render the target ineffective. Even in case of a close miss, Frag-HE lethality is likely to damage or kill the target. On the other hand, a near miss with HEAT is just a miss.

Some forces have developed laser countermeasure (CM) technologies such as laser warning receivers and false target generators. However, FTGs are not always effective; and an easy counter-tactic to the CM is use of a laser offset procedure. The LTD operator lazes an alternate offset point (15 to 20 m from the target). The shifting of the laser beam from the offset point to the target is 2 to 3 seconds prior to the terminal phase of projectile flight. The offset procedure process takes a total of 6 to 8 seconds. A support mechanism is a timer which alerts the operator to lase the targets seconds before impact, and before target CM can effectively deploy.

Sensor-Fuzed Submunitions (SFSM). Although SFSM can be used against a wide variety of targets, armored vehicles of various types are the primary targets. These munitions have a relatively small search area and a kinetic-energy kill mechanism. Because of the accuracy of the delivery system and the small footprint, cannon-delivered SFSM can be used against targets 2 km or more from friendly ground forces. The engagement is normally by platoon or battery, with each unit firing at a specifically targeted area.

Modern GPS and laser range-finders (LRFs) can greatly reduce target location errors of man-portable acquisition systems from 200+ m to less than 5m. But moving targets can challenge artillery fire calculations. Therefore, timely and precise reports and movement adjustments, coupled with use of obstacle systems to fix targets will greatly support use of lethal SFSM. Other CMs against these munitions include IR decoys, IR-suppressive and radar reflective materials, and other technologies and tactics (see Chapter 16).

Terminal-Homing Mortar Projectiles (THMP). Current fielded THMP use IR-homing seekers, against targets within 1-8 km range. They are employed against vehicles of all types. However, due to limited fielding, they will generally be reserved for high value targets (combat vehicles in surprise attacks, ATGM launcher vehicles, engineer vehicles, artillery/mortar vehicles, etc.). Although these munitions have a secondary fragmentation effect, they generally are not used against personnel. The current best example of a fielded THMP is the 120-mm Strix.

THMP could be fired in platoon or battery salvos to maximize the number of engagements that occur in a relatively clean environment. Each platoon in the battery fires 2+ mortar projectiles at each vehicle when vehicles are deployed in fighting positions and in columns with a spacing of 50 m or more. Vehicles that are tightly grouped (less than 50 m) or congested columns are engaged with several battery salvos. Each firing unit could fire up to 3-4 rounds per tube to ensure that the target area is covered. In a complex environment, platoons/individual mortars will be assigned to deliver THMP into beyond line-of-sight (BLOS) mined kill zones, and will often be linked to FOs with line of sight to the target. If the targeted force is employing countermeasures such as thermal decoys or infrared-suppressive materials (that the firing unit considers effective), that firing unit uses the next-best munition that is available. It does not use THMP if the target vehicles have negligible thermal signatures (engines not running or otherwise in low contrast with background or vehicles under trees).

Other terminal-homing munitions (THM) and submunitions (THSM) have been developed. But costs, challenges in providing timely and accurate target data, and the fielding of CM to degrade these munitions have reduced their utility. Another factor is the increased accuracy of CC munitions, which permit them to approach the hit probabilities of the precision munitions/submunitions against stationary targets.

The below table indicates relative priorities for selecting advanced munitions, for employment against generic target types. A dash indicates that a munition type is not appropriate for a given target. The default munition in every case is Frag-HE.

Targeting Priority Matrix for Advanced Artillery Munitions

Target Type	Munition Type							
	DPICM	***LGP***	***APSM***	***ATSM***	***THMP d***	***SFSM d***	***Flechette***	***VEX***
SP Artillery	4	3*b*	6	5	2	1	—	7
Towed or Unidentified Artillery	1	3*b*	5	6	—	—	2*e*	4
Lightly Armored Vehicle Column	3	4*b*	6	5	2	1	—	7
Heavy Armored/ Mixed Vehicle Column	4	3*c*	6	5	1	2	—	7
Electronics or Radar Sites *a*	2	3*b*	5	6	1	7	4	1
Armored CPs	4	3*b*	5	6	2	1	—	7
Unarmored CPs	3	4*b*	7	8	6	5	1	2
Prepared Fighting Position with Armored Vehicles	2	1*c*	6	5	4	3	—	7
Armored Missile or Rocket Launcher	4	3*b*	7	6	5	2	—	1
Unarmored Missile or Rocket Launcher	2	4*b*	8	7	6	5	3	1
Exposed Troops	2	4*b*	5	—	—	—	1	3
Dug-In Troops and Equipment	4	1*b*	5	—	—	—	2*e*	3
Field Logistics Site/Port *a*	2	3*b*	4	5	7	8	6	1
Airfield/FARP *a*	2	3*b*	4	5	7	8	6	1

a ATSM, THMP, and SFSM are only effective if vehicles are present.
b LGP with Frag-HE warhead is preferred, if available.
c LGP with HEAT warhead is preferred, if available.
d Targeting data for these munitions should be less than 5 minutes old for mobile targets.
e Flechette is second choice only if artillery is known to be towed or open-mount, or if dug-in troops or equipment lack overhead cover.

COMMON AMMUNITION FOR SELECTED ARTILLERY

Artillery units, as with other combat and combat support units on the modern battlefield, will often have a mix of ammunition to support any missions required of them. Because the forces have accumulated ammunition for many years prior to a conflict, the ammunition mix may include older and newer ammunition. The mix may include ammunition designed for a specific artillery piece and rounds for use by various systems.

The OPFOR equipment spectrum, including artillery, permits scenario writers to organize forces realistically and flexibly, to reflect modern forces or older forces. Like equipment in other branches, artillery equipment can be categorized into capability tiers (see tables below and Chapter 15). It is generally expected that more modern capable systems are likely to have more modern and capable ammunition. Older systems may be part of a force updated to modern standards; or selected systems have been given "niche technology" updates to support those older forces. One good choice for an upgrade is improved ammunition for selected artillery systems.

The following tables illustrate rounds available to common artillery, with ***standard rounds*** available to systems listed in the Chapter 15 Tier Tables. A variety of other rounds are listed and available in the tables which follow them, for use in OPFOR training simulations.

122MM CANNON AMMUNITION

System	Ammunition	Range (km)	System	Ammunition	Range (km)
Tier 1/2	Frag-HE, OF-81	15.3	Tier 3/4	Frag-HE, OF-81	15.3
D-30, 2S1	Frag-HE-RA	21.9	D-30, 2S1	Frag-HE-RA	21.9
	Frag-HE-ERFB-HB	21.0		Frag-HE-ERFB-HB	21.0
Standard	HEAT, BK-6M	1.0	Standard	HEAT, BK-6M	1.0
	Flechette	15.3		Flechette	15.3
Special	Smoke/Incendiary (WP)	17.4	Special	Smoke/incendiary (WP)	17.4
	Illumination, S-462	15.3		Illumination, S-462	15.3
	Chem, various	15.3		Chem, various	15.3
	Scatter Mines	15.3		Scatter Mines	15.3
	Jammer round, various	15.3		Jammer round, various	15.3
ADHPM	LGP, Kitolov-2M	14.0	ADHPM	LGP, Kitolov-2M	14.0

LGP = Laser-Guided Projectile
HB = Hollow base (Base bleed-capable round without the BB unit)
ERFB = Extended-range full-bore
WP = White Phosphorus

152MM CANNON AMMUNITION

System	Ammunition	Range (km)	System	Ammunition	Range (km)
Tier 2	Frag-HE, OF-45	24.7	Tier 2	Frag-HE, OF-45	24.7
2A65	Frag-HE-BB, OF-61	29.0	2S19	Frag-HE-BB, OF-61	29.0
	DPICM, 3O23	21.0		DPICM, 3O23	21.0
Standard	DPICM-BB, EKK	28.2	Standard	DPICM-BB, EKK	28.2
	HEAT, BP-540	1.0		HEAT, BP-540	1.0
	Flechette	24.0		Flechette	24.0
Special	Concrete Piercing	24.0	Special	Concrete Piercing	24.0
	Smoke	24.0		Smoke	24.0
	Illumination	24.0		Illumination	24.0
	Chem	24.0		Chem	24.0
	Scatter Mines	24.0		Scatter Mines	24.0
	Jammer round, RB30	22.0		Jammer round, RB30	22.0
ADHPM	LGP, Krasnopol	20.0	ADHPM	LGP, Krasnopol	20.0
	Sensor-fuzed, MCS-E1	24.0		Sensor-fuzed, MCS-E1	24.0
Tier 3	Frag-HE, OF-29	28.2	Tier 3	Frag-HE, OF-25	17.4
2A36,	Frag-HE-BB, OF-59	30.5	2S3M	Frag-HE-BB, OF-22	20.5
2S5	Frag-HE-RA, OF-60	37.0		Frag-HE-RA, OF-64	24.4
	DPICM, 3O23	26.0		DPICM, 3O13	14.5
Standard	DPICM-BB, EKK	28.2	Standard	DPICM-BB, EKK	20.5
	HEAT, BP-540	1.0		HEAT, BP-540	1.0
	Flechette	28.4		Flechette	17.2
Special	Concrete Piercing	28.4	Special	Concrete Piercing	17.2
	Smoke	28.4		Smoke	17.2
	Illumination	28.4		Illumination	17.2
	Chem	28.4		Chem	17.2
	Scatter Mines	28.4		Scatter Mines	17.2
	Jammer round, RB30	22.0		Jammer round, RB30	17.2
ADHPM	LGP, Krasnopol	20.0	ADHPM	LGP, Krasnopol	20.0
	Sensor-fuzed, MCS-E1	24.0		Sensor-fuzed, MCS-E1	17.2
Tier 4	Frag-HE, OF-25	17.4			
D-20	Frag-HE-BB, OF-22	20.5			
	Frag-HE-RA OF-64	24.4			
Standard	DPICM, 3O13	14.5			
	DPICM-BB, EKK	20.5			
	HEAT, BP-540	1.0			
	Flechette	17.2			
Special	Concrete Piercing	17.2			
	Smoke	17.2			
	Illumination	17.2			
	Chem	17.2			
	Scatter Mines	17.2			
ADHPM	LGP, Krasnopol	20.0			

LGP = Laser-Guided Projectile

155MM CANNON AMMUNITION

System	Ammunition	Range (km)	System	Ammunition	Range (km)
Tier 1/2	Frag-HE, ERFB	30.0	Tier 1/2	Frag-HE, LU 111 HB	23.3
G5, G6,	Frag-HE ERFB-BB,	40.0	AU-F1,	Frag-HE, LU 111 BB	28.0
GH N-45	Frag-HE Velocity		AU-F1T	Frag-HE-BB, OE 155 F1	30.4
Standard	Enhanced, VLAP	54.0	Standard	Frag-HE-RA, H3	31.5
	DPICM ERFB,	39.0		DPICM, OGRE	28.5
	DPICM ERFB-BB,	39.0		Frag-HE Direct-fire	2.0+
	Frag-HE Direct-fire	3.0			
Special	Illumination, -BB, Denel	39.0	Special	Illumination, OECL	21.2
	Smoke BE, ERFB-BB	39.0		Smoke-BB, LU 114	28.0
	Smoke	22.0		Scatterable mine, OMI	18.0
ADHPM	LGP, Krasnopol 155	22.0	ADHPM	LGP, Krasnopol 155	22.0
	Sensor-fuzed, Bonus	27.0		Sensor-fuzed, Bonus	27.0

LGP = Laser-Guided Projectile
HB=Hollow base (Base bleed-capable round without the BB unit)
ERFB=Extended-range full-bore

122MM ROCKET LAUNCHER AMMUNITION

System	Ammunition	Range (km)	System	Ammunition	Range (km)
Tiers 1/2	Frag-HE, 9M521	40.0	Tier 3	Frag-HE, 9M521	40.0
Prima	Frag-HE, 9M522	37.5	BM-21	Frag-HE, 9M522	37.5
MRL	(separating whd)		MRL	(separating whd)	
	DPICM, 9M218	30.0		Frag-HE, Type 90A	32.7
Standard	Frag-HE, 9M53F	20.5	Standard	Frag-HE, 9M22U	20.4
	(separating whd)			Frag-HE, 9M28F	15.0
Special	Smoke, 9M43	20.5		DPICM, 9M218	30.0
	Illumination	20.5	Special	Smoke, 9M43	20.5
	Chem	20.5		Illumination	20.5 est
	Scatter Mines, 9M28K	13.4		Chem	20.5
	Jammer round, 9M519	18.5		Scatter Mines, 9M28K	13.4
	LGP, Ugroza	32.0		Jammer round, 9M519	18.5
ADHPM	Sensor-fuzed, 9M217	33.0	ADHPM	LGP, Ugroza	32.0
				Sensor-fuzed, 9M217	33.0
Tiers 1-4					
9P132					
Single Lchr					
Standard	Frag-HE, 9M22M	10.8			
Special	Smoke	10.8			
	Illumination, 9M42	5.0			

LGP = Laser-Guided Projectile

120MM MORTAR AND COMBINATION GUN AMMUNITION

System	Ammunition	Range (km)	System	Ammunition	Range (km)
Tiers 1/2	Cannon Rounds			Mortar Projectiles	
2S9-1, 2S23	Frag-HE-RA (RAP)	12.8	2S9-1, 2S23	Frag-HE-RA (RAP)	9.0
Combo Gun	Frag-HE PD/Prox	8.8	Standard	Frag-HE PD/Prox	7.1
	DPICM	12.0	Special	Incendiary (WP)	6.0
Standard	HEAT	1.0		Smoke	5.9
	Flechette	1.0		Illum	5.9
ADHPM	LGP, Kitolov-2	9.0		Chem, est	5.9
	* **		ADHPM	THMP, Strix	8.0
				LGP, Gran	9.0
Tiers 1/2	Cannon Rounds			Mortar Projectiles	
2B16	Frag-HE-RA (RAP)	12.8	2B16	Frag-HE-RA (RAP)	9.0
Combo Gun	Frag-HE PD/Prox	8.8	Standard	Frag-HE PD/Prox	7.1
	DPICM	12.0	Special	Incendiary (WP)	6.0
Standard	HEAT	1.0		Smoke	5.9
	Flechette	1.0		Illum	5.9
ADHPM	LGP, Kitolov-2	9.0		Chem, est	5.9
	* **		ADHPM	THMP, Strix	8.0
				LGP, Gran	9.0
Tier 3	Rifled Mtr Projectiles			Mortar Projectiles	
MO-120-RT	Frag-HE-RA (RAP)	13.0	MO-120-RT	Frag-HE-RA (RAP)	9.0
Rifled	PD/Prox		Standard	Frag-HE PD/Prox	7.1
Mortar	Frag-HE PD/Prox	8.1	Special	Incendiary (WP)	6.0
Standard	Frag-HE Anti-Armor	8.1		Smoke	5.9
	(hvy frag),			Illum	5.9
Special	Smoke	8.1		Chem, est	5.9
			ADHPM	LGP, Gran	9.0
Tier 3	Mortar Projectiles		Tier 4	Mortar Projectiles	
2S12 Mtr	Frag-HE-RA (RAP)	9.0	M1943 Mtr	Frag-HE-RA (RAP)	7.2
Standard	Frag-HE PD/Prox	7.1	Standard	Frag-HE, OF-843B	5.7
Special	Incendiary (WP)	6.0	Special	Incendiary (WP)	5.7
	Smoke	5.9		Smoke	5.7
	Illum	5.9		Illum	5.7
	Chem, est	5.9		Chem, est	5.7
ADHPM	THMP, Strix	8.0	ADHPM	LGP, Gran	9.0
	LGP, Gran	9.0			

THMP=Terminally-Homing Mortar Projectiles
LGP = Laser-Guided Projectile
Mortar rounds are smoothbore if not stated as rifled.
*** Combo guns can also fire rifled mortar rounds for MO-120-RT.

OPFOR Special Munitions Chart for Training Simulation

WEAPON	SMOKE (km)	SCATTERABLE MINES (km)	CHEMICAL (km)
122-MM: 2S1 SP, D-30 TOWED HOWITZER	15.3	N/A	15.3
152-MM: 2S3M SP, D-20 TOWED HOWITZER	17.2	N/A	17.2
152-MM: 2S19 SP, 2A65 TOWED HOWITZER	24.0	N/A	24.0
152-MM: 2S5 SP, 2A36 TOWED GUN	28.4	N/A	28.4
122-MM: BM-21 MRL	20.5	13.4	20.5

REMARKS: Currently, Russia has developed and is testing 122-mm rockets with various warheads (Frag-HE, AT/AP mines, jammers, and sensor-fuzed munitions) achieving firing ranges between 32-35 kilometers.

Foreign Course Corrected Rocket Programs

NAME	COUNTRY	CALIBER (mm)	WEIGHT (kg)	LENGTH (mm)	WARHEAD TYPE	GUIDANCE SYSTEM	ACCURACY (CEP, m)	RANGE (km)	STATUS/ PROLIFERATION
9M55-series	Russia	300	~800	7,200	Varies - ICM, SFM, HE, thermobaric, scatterable mines	Inertial	150 @ max range (0.21% of range)	70	Fielded 2 countries
9M5xx-series	Russia	300	~800	7,200	Varies - ICM, DPICM, SFM, HE, thermobaric, scattererable mines	Inertial	171@ maximum range (.19% of range)	90	Production/ Exported 2 countries
AccuLAR	Israel/Romania	160	120	3,700	DPICM, SFM	RF Ground Track	90-135	45	Late development IOC 2003
MLRS-TCS	Israel	227	307	3,970	DPICM SFM	RF Ground Track	25	45	Fielded 1 country
Angel-100	China	300	~800	7,200	Varies - ICM, SFM, HE	Inertial	210 @ max range (0.21% of range)	100	Development IOC 2005-7
CORECT	Switzerland-Germany	227	308	3,940	DPICM, AT-4 mines	GPS+Inertial and magnetometer	50 (independent of range)	32	Late development IOC 2003-5
MARS-NAW	Germany	227	308	3,940	DPICM, SMArt-155	GPS+Inertial	50	65-70	Late development IOC 2003-2005
LT-2000 Mk45	Taiwan	227	308	3,940	DPICM	GPS+Inertial	50	75	Development IOC 2008
Diehl RM-70 Upgrade	Germany, France, Slovakia	122	77	3,220	DPICM, Multimode (HEAT, HE, Incendiary)	GPS+Inertial	50	36	Development IOC2008

Other countries with course corrected rocket development programs: Indonesia, South Africa, India, Ukraine, Brazil, Iraq.

Foreign Course Corrected Projectile Programs

NAME	COUNTRY	CALIBER (mm)	WEIGHT (kg)	LENGTH (mm)	WARHEAD TYPE	GUIDANCE SYSTEM	ACCURACY (CEP, m)	RANGE (km)	STATUS/ PROLIFERATION
TCM (Excaliber)	Sweden	155	48	970 Fuzed	Varies (DPICM, SFM, HE)	Inertial+GPS	10-30	60	Limited Production
Diehl GPS Geschoss	Germany	155	47	955	Varies (DPICM, SFM, HE)	Inertial+GPS	10	40	Development
Poleaxe	UK	155	54	1,650	DPICM, SFM	Inertial+GPS	50	80	Development
Pelican	France	155	50	1,350	DPICM, HE, SFM	Inertial+GPS	50-80	80	Development
BWB GPS Fin-stabilized	Germany	155	55	1,650	DPICM, SFM, HE	Inertial+GPS	20-50	100	Development
Ramjet Projectile	Holland-Sweden	155	55	1,500	DPICM, SFM	GPS+Inertial	20-50	80	Research IOC 2018
BROMSA	Sweden	105/155	Fuze	N/A	Any Projectile	GPS or MVV RF tracker	2-4X improvement over ballistic projectiles	25-30	Development
SAMPRASS	France	105/155	Fuze	N/A	Any Projectile	GPS	2-6X improvement over ballistic projectile	25-40	Development
STAR	UK	105/155	Fuze	N/A	Any Projectile	GPS	2-6X improvement over ballistic projectile	25-40	Development

Other countries with course corrected projectile development programs: Israel, South Africa, Ukraine, and others.

Advanced Artillery Munitions: Laser-Guided Projectiles

NAME	COUNTRY	CALIBER	WEIGHT (kg)	LENGTH (mm)	TYPE WARHEAD	GUIDANCE SYSTEM	TARGET DESIGNATION RANGE (km) [1]	RANGE (km) MIN	RANGE (km) MAX	STATUS / PROLIFERATION
BUSSARD	Germany	120-mm mortar	17	1,050	Tandem (precursor and main charge); 800+ mm RHA penetration	IR Focal plane array (3-5μ terminal homing), semi-active laser homing (SAL- 1.06μ)	3-5	.8	12	Developmental
Terminally Guided Mortar Bomb	Ukraine /Poland	120-mm mortar	18	1,200 (+)	HEAT; 550-mm RHA	SAL (1.06μ)	3-5	.5	7	Testing
Kitolov-2	Russia	120-mm combo gun	25	1,220	Frag-HE	SAL (1.06μ)	3-5	.5	9	Limited production/ 1 country
Smel'chak	Russia	240-mm mortar	134	1,635	Frag-HE	SAL (1.06μ)	3-5	3.6	9.2	Limited production/ 1 country
Gran	Russia	120-mm mortar	27	INA	Frag-HE	SAL (1.06u)	3-5	1.5	9.0	Marketed, production 1 country (poss)
Kitolov-2M (KM-3)	Russia	122-mm howitzer	27	1,225	Frag-HE	SAL (1.06μ)	3-5	.8	14	Limited production/ 2 countries
Krasnopol	Russia	152-mm howitzer	51	1,300	Frag-HE, 6.5 kg AL/RDX	Inertial (middle stage of flight) SAL (final stage of flight)	3-5	5	20	Full production/ 14 countries
Krasnopol-M (KM-2)	Russia	155-mm howitzer	43.0	955	Frag-HE, 6.2 kg AL/RDX	Inertial (middle stage of flight) SAL (final stage of flight)	3-5	4	17	Full production/ 2 countries
Santimeter-1	Russia	152-mm howitzer	49.5	1,195	Frag-HE, 6.5 kg AL/RDX	SAL (1.06μ)	3-5	3	18	Limited production/ 3 countries
Aurora	Russia	152-mm howitzer	47 (+)	955	Frag-HE, 12.0 kg AL/RDX	SAL (1.06μ)	3-5	5	25	Ready for production, waiting for export customer
Ugroza [2]	Russia	122-mm rocket	65.5 (est.)	3,037 (est.)	Tandem HEAT dual main charge; 600-mm penetration	SAL (1.06μ)	3-5	1	20-32	Limited production/ 2 countries
Copperhead	United States	155-mm cannon	62	1,370	HEAT	Inertial (middle stage of flight) SAL (final stage of flight)	3-5	4	16	Production complete/ 1 country

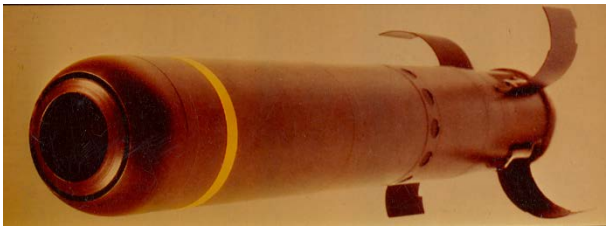
NOTES:
(1) The Target Designation Range column portrays an engagement of a tank size target moving at 10-15 km/h.

(2) The Ugroza's range is dependent upon the warhead being fitted on a rocket body containing either an older rocket motor (20 km) or new rocket motor (32 km).

Advanced Artillery Munitions: Sensor-Fuzed Munitions

NAME	COUNTRY	CALIBER DELIVERY SYSTEM	TARGETING SENSOR	SEARCH ALTITUDE	ARMOR PENETRATION	TYPE WARHEAD	RANGE (km)	STATUS/ PROLIFERATION
BONUS II	France/ Sweden	155-mm cannon	2-color IR sensor with laser altimeter	175	120-135-mm at 150 meter slant range (Est)	Tantalum EFP	27 (39-cal. cannon) 35 (52-cal. cannon)	Production
SMArt	Germany	155-mm cannon	94 Ghz MMW Sensor (Active and Passive), 3-5μ IR sensor	150	135-mm RHA penetration @ 150 meters	Tantalum liner, COMP-B fill with unique wave shaper	25	Production
Indian Sensor Fuzed Munition	India	120-mm mortar 155-mm cannon	MMW	100 (est)	50-70-mm RHA penetration @ 100 meters	Copper penetrator	7	Developmental
Israeli Top-Attack Sensing Submunition	Israel	227-mm rocket	Ka-Band (Active and Passive)	100 (est)	100-mm RHA penetration @ 100 meters	Copper penetrator	32	Developmental
Meteor	Poland	122-mm rocket	2 color IR sensor with laser diode altimeter	150	80-100-mm RHA penetration @ 100 meters	Copper penetrator	30	Developmental
Motiv-3M	Russia	300-mm rocket	2 color IR sensor	100 (est)	70-mm RHA penetration @ 150 meters and 30°	Copper penetrator, Ball slug	90	Full Production
Universal Submunition	Russia	120-mm mortar, 122-mm, 220-mm, and 300-mm rockets	W-band MMW Sensor (Active and Passive), 1-2μ and 8-14μ IR sensor	100 (est)	60-70-mm RHA penetration @ 100 meters and 30°	Copper penetrator, Ball slug	33 (122-mm) 35 (220-mm) 90 (300-mm)	Limited Production
MCS-E1	Russia	152-mm cannon	35 Ghz MMW (Active), 3-5μ IR sensor	100 (est)	90-mm RHA penetration	Copper penetrator, Ball slug	24	Developmental
MCS-E2, 152-mm	Russia	152-mm cannon	W-band MMW Sensor (Active and Passive), 1-2μ and 8-14μ IR sensor	150 (est)	80-mm RHA penetration @ 125 meters and 30°	Copper penetrator, Ball slug	20	Developmental,
MCS-E2, 155-mm	Russia	155-mm cannon	W-band MMW Sensor (Active and Passive), 1-2μ and 8-14μ IR sensor	150 (est)	80-mm RHA penetration @ 125 meters and 30°	Copper penetrator, Ball slug	25	Developmental,
SADARM	US	155-mm cannon	35 Ghz MMW Sensor (Active and Passive), 8-14μ IR sensor	130 (est) 165 (est) P3I	135-mm RHA penetration @ 100 meters	INA	24	Limited Production

Swedish 120-mm Terminal-Homing Mortar Projectile Strix



SYSTEM
Alternative Designations: NA
Producer: Bofors
Date of Introduction: 1994
Proliferation: At least 4 countries

Description:
Weight (kg): 17.6
Length Overall (m): 0.83
Range (km): 1-4 with special expulsion charge
1.7-8 with charge plus attachment of sustainer motor
Guidance System: IR seeker, 12 thruster rockets.
16-bit micro- processor retains path data and target identification data.
4 foil fins deploy on expulsion from the tube to help maintain course.
Acquisition Radius (m): 150
Lethality mechanism:
Type: Shaped-charge (HEAT)
Fuze Type: PD
Penetration: 600 (CE), top-attack.
In addition, unburned thruster propellant is ignited.
Probability of Kill Given a Hit (%): 90
Number per kill, Moving Target: 4-6 (P-hit 20% est)
Number per kill, Stationary Target: 1-2 (P-hit 75% est)

CM Vulnerability:
IR absorbing paint, camouflage material, or tenting can affect the seeker.
IR-suppressive smoke can affect the seeker.
Target can hide under dense tree canopy, building cover, etc.
Decoy targets such as heated plates may deflect the seeker.
Any challenge to location accuracy, such as smoke, dust, or target speed, may decrease the possibility that the target is within the seeker footprint.
If targets disperse when under attack, some may be able to avoid the footprint.

EMPLOYMENT
Crew: 1 additional member in mortar crew to load seeker data.
Loading Method: Hand-load or auto-load without sustainer motor
Hand-load only with sustainer motor
Equipment/Modifications Required: A computer (e.g., small 2-lb notebook type) is used to load target description data (from target library) into the round. Rounds may require less target detail if other hot systems are not in the area.
Support Required: A critical need is target location within 75 m. Modern (Tiers 1and 2) man-portable acquisition equipment for observation posts include GPS, LRF binoculars, LTDs (with LRF included, and precision scopes offer rapid acq within 5 m.
Other support required is a direct link to the OP to assure timing and accuracy, and to adjust fire
If a moving target must be stopped, mines or other obstacles must be laid. If the mortar or combination gun, or supporting artillery can fire DPICM rounds, the dud field can halt moving vehicles.
Employment Time (min): 1-5 est, depending on system
Rate of Fire (rpm): Up to 9, although most point targets will require 1-6 rounds.

Using systems: Any 120-mm smoothbore mortar and combination gun can fire the round. The Advanced Mortar System (AMOS) can fit on a variety of vehicle chassis, boats, and ships. It is advertised, as in the Patria vehicle version below, to be able to fire Strix.

Target Types: High-value target vehicles include approaching tanks, IFVs, SP artillery, scatterable mine launcher vehicles, ATGM vehicles, etc. Vehicles must be hot (sun or recent move). Stationary vehicle targets are preferred.

NOTES
Employment considerations affect fielding and use for terminal-homing munitions, in general, and this projectile in particular. THMP are fairly expensive, and so must be meted out for use when conditions are optimized, and when the targets are of high priority. The high priority usually means when the targets are a high threat to integrity of the force. When mortars/combination guns have laser target designators (LTDs) available with a field of view of the target, LGP are preferable for use against most targets, because of the higher assurance of a hit. However, conditions may limit LGP use. Those conditions include lack of LTDs in the area, short lines of sight, other LGP commitments, excessive lazing angles, dust and fog interference, etc. THMP can be launched by any mortars with accompanying computer to load data, as long as an observer is available. Note the discussion under EMPLOYMENT, above, and of THMP.

Chapter 8
Engineer

This chapter provides the basic characteristics of selected ***engineer equipment***. ***Engineer equipment*** covers, in order, land mines, minelaying systems, mineclearing systems, route-clearing systems, and gap-crossing systems.

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Land Mine Primer

The widespread use of landmines on today's battlefields is a result of a combination of mass produced, plastic mines, improved battlefield delivery systems, and development of sophisticated fuzing. Advances in mass-production techniques and the associated reduction in per-item cost along with its simplicity of manufacture and automated production make landmines extremely attractive for terrain denial. Another technological improvement affecting landmines is the widespread use of plastic. Metal detectors are ineffective for locating plastic-cased mines unless the manufacture intentionally places a mass of metal in the mine. Remotely delivered mines have expanded capability for changing the tempo of battle. Development of various fuze arming and triggering options has increased mine usefulness in warfare.

1. Types of Minefields. The five basic types of OPFOR minefields are antitank (AT), antipersonnel (AP), mixed, decoy, and antilanding. AT minefields are the primary types of OPFOR engineer obstacle and serve to destroy or disable armored vehicles. They are primarily established in belts consisting of multiple rows on avenues that are favorable for tanks in front of the forward edge and on the flanks. Where difficult terrain is available, minefield belts will be tied into terrain obstacles to reduce the mine requirement. The OPFOR sets up conventional AP minefields on the forward edge of friendly defensive positions, in front of AT minefields, or along dismounted avenues of approach. Mixed minefields consist of both AP and AT mines. Decoy minefields are a significant form of deception to slow movement or deceive as to true unit locations. Antilanding minefields prevent landings by amphibious, airborne, or heliborne assault forces.

Minefields can also be categorized by their technical method of activation—uncontrolled, controlled, and intelligent. Controlled minefields consist of landmines with electronic switches giving the operator (controller) control over the operational status of the minefield. The operator can change the status of the landmines either by a direct hardwire link or by radio. An entire minefield can be emplaced and turned on or off, as necessary to best support friendly operations. On a smaller scale, select passages in a conventional minefield can contain controllable landmines, allowing for the option of clearing safe lanes for friendly use. The addition of selectable, anti-removal, and self-destruct features to controlled mines enhance flexibility and overall effectiveness.

Intelligent minefields have advanced technology that allows minefields to switch on and off and to deactivate at a certain time. When used in conjunction with unmanned ground sensors (UGS) they can communicate via and communications link and be activated remotely. Other advancements include acoustic and infrared signature activated mines. While many of these concepts are in the developmental stage, the technological means are available and have the potential to deploy as needs arise. They will be composed of "wide area coverage" mines.

2. Types of Mines. Mines may be AT/anti-vehicle, AP, antihelicopter, or area mines. They may also be defined by the manner in which they are emplaced such as scatterable (remote), or side-attack (generally AT or anti-vehicle) or their area coverage. As noted earlier for minefields, the OPFOR makes distinctions between controlled mines (command-operated by hard wire or radio linkage) and uncontrolled mines.

Side-attack mines are autonomous weapons that attack targets from the side as they pass by. These include anti-vehicle, anti-personnel, and anti-helicopter mines. They vary among manufactured side-attack mines, side-attack improvised explosive devices, and mines created by attaching manufactured or improvised sensor units to anti-tank grenade launchers (ATGLs) and anti-tank disposable launchers (ATDLs). Some side-attack mines can be used for multiple roles. For instance, directional fragmentation mines and IEDs can be used against personnel and vehicles. Some like the MON-100 can tilt upward for anti-helicopter use.

Current developments in side-attack landmines use mature technology from other weapon programs. Since side-attack landmines have increased areas of coverage, the number required to hinder mobility of enemy forces is greatly reduced. Uses for these landmines include harassment throughout the area of operation and reinforcement of conventional minefields to make "cleared" lanes unsafe. SOF and security patrols can also use these mines to economically cover multiple avenues of approach, alert on enemy encroachments, and trigger time-sensitive kill zones.

a. Antitank. Conventional antitank mines, such as the TM-62 AT mine, are those that are emplaced either by hand or by mechanical means. These will continue to be the primary landmine threat throughout the foreseeable future. They are readily available to armies and insurgency groups worldwide and are cheap and effective. These mines are normally buried just below the surface of the ground but can be surface laid or buried with up to 30 cm of cover.

(1) Antitank mines can vary in size from as small as 1.4 kg for a scatterable mine (PTM-1S) to over 20 kg for a side attack mine (TM-83). The category of antitank mines includes side-attack and anti-vehicle mines.

(2). Side-attack antitank. Commonly called “off-route mines”, side-attack mines are an integral part of the adaptive battlefield and date back to the LGM trip-wire AT mines of the Vietnam War era. Today there are at least 18 different side-attack mines in use by 22 countries. Ten more side-attack mines are under development. Within the next few years these weapons will have proliferated to every combat environment. Some mines have been out fitted with acoustic and infrared signature detonation capabilities. The Polish Agawa comes in two variants, the legacy contact-fuzed MPB-ZK and the new non-contact, acoustic-activated MPB-ZN.

Some mines and IEDs have warheads which produce an explosively formed penetrator (EFP), a metal sabot which penetrates light to heavy armor, depending on design. Such mines include the Russian TM-83, and TEMP-30 sensor-fuzed mine. Sensor fuzed ATGL or ATDL-based mines can also be effective. A shoulder-fired AT weapon placed on a tripod and fitted with an IR sensor can kill moving targets up to 100 meters away. Current warhead technology in these weapons allows penetration of up to 950 mm of rolled homogeneous armor.

(3). Anti-vehicle. Many smaller antitank mines, or larger antipersonnel mines, have been developed (or modified) to severely damage or destroy vehicles other than tanks with a few pounds of high explosives or fragmentation. These may be either trucks, tactical utility vehicles such as UAZ-469, or light armored combat vehicles such as BTRs.

Side-attack sensor-fuzed mines such as Russian platter mines direct fragmentation to damage or destroy vehicles. Other mines and IEDs (e.g., PD Mi-Pk) initiate multiple EFPs for KE penetration. Blast effects from mines and IEDs can inflict kinetic energy damage by flipping over vehicles, bending metal, and tossing material about inside to kill or injure personnel.

b. Antipersonnel. Antipersonnel landmines injure by either blast or fragmentation. The small antipersonnel mine contains no more than a pound (usually only a few ounces) of high explosive. Blast injures by the force of the charge. The loss of a foot or a leg is the common result. Fragmentation mines contain hundreds to thousands of pellets. Plastic-cased landmines pepper their victims with small particles of plastic that are not detectable with x-rays, making complete cleansing of wounds extremely difficult and increasing the risk of infection and amputation. On the battlefield, the modern AP mine is used to—

- Inflict personnel casualties.
- Hinder soldiers in clearing AT minefields.
- Establish defensive positions.
- Deny access to terrain.

c. Anti-helicopter. The modern attack helicopter, with increasing agility and weapons payload, is able to bring enormous firepower to bear on enemy forces. To counter this threat, a new type of mine—the antihelicopter mine—was developed. By borrowing technologies from the side-attack and wide-area landmines, antihelicopter mines may make use of acoustic fuzing to locate and target potential low-flying targets at significant distances. Their multiple-fragment warheads are more than capable of destroying light-skinned, non-armored targets at closer ranges.

A simple antihelicopter mine can be assembled from an acoustic sensor, a triggering IR sensor, and a large directional fragmentation mine. More advanced mines use a fairly sophisticated data processing system to track the helicopter, aim the ground launch platform, and guide/fire the kill mechanism toward the target. As the helicopter nears the mines, the acoustic sensor activates or cues an IR or MMW sensor. This second sensor initiates the mine when the helicopter enters the lethal zone of the mine. A typical large fragmentation warhead is sufficient to damage soft targets, such as aircraft. Alternate warhead designs include high-explosive warheads and single or multiple explosively formed penetrators.

d. Area Coverage. The terms “area” and “wide area” mines are often confusing and misleading. Mines classified as area mines range from antipersonnel “bouncing Betty” mines to side-attack mines, directional fragmentation mines “claymores”, and possibly antihelicopter mines. Wide area coverage mines with sophisticated fuzing and possibly a limited communications capability are weapons of the future and have not been fielded. The Polish Agawa MPB-ZN is a wide area coverage AT mine with an acoustic activated target detection range of around 150m and its EFP is described as effective against 100 mm of rolled homogenous steel armor at distances of 50 m.

3. Emplacement or Delivery Methods. In the past landmines generally were placed manually one at a time. Mass mine delivery and distribution systems permit the rapid placement of large quantities of mines. Landmine emplacement vehicles are designed to automatically arm and bury a landmine every 3-10 meters. Landmines also may be placed with artillery, rockets, or aircraft at a rate of hundreds, even thousands, of mines per minutes.

Emplacement means may be manual, mechanical, or remote. Manual emplacement is not possible when there is little time or during high-speed maneuver operations. Therefore, mechanical and remote means are more prevalent.

a. Manual. The OPFOR manually emplaces minefields when—

- There is no contact with the enemy.
- Mechanical minelayers are unavailable.
- It is inadvisable to use mechanical minelayers because of terrain restrictions.

b. Mechanical. OPFOR engineers rely extensively on mechanized minelayers. These can bury or surface-lay AT mines. The layout of mechanically emplaced minefields is the same as those emplaced by hand. Mines can also be emplaced by helicopters or vehicles with the use of chutes (slides). Mine chutes can also be used to assist manual burial emplacement or to surface-lay mines.

c. Scatterable Mines. Known as "scatterable mines" in the US, other countries call them "remotely-delivered". They are landmines emplaced through a variety of means and are designed as such to be delivered by aircraft, tube artillery, multiple rocket launchers, missiles, ground vehicles, or they can be hand-thrown. Scatterable mines are not a standard item except in well-equipped armies of the world. While the number of countries possessing scatterable mines continues to increase, there will continue to be many areas of the world where scatterable mines are not a threat through the far term.

Minefield emplacement is progressing from manually and mechanically emplaced minefields to the more flexible and dynamic remotely, scatterable minefield. The ability to remotely deliver mines allows a rapid response with thousands of landmines at any point on the battlefield. Since many scatterable landmines feature self-destruct and antidisturbance fuzing, they are well suited for operations that deny terrain for a specific period. After the allotted time has expired, the terrain can once again be used by friendly forces. Scatterable mines may be delivered by the following methods:

(1) Artillery. Multiple rocket launchers are the primary means of remote minelaying. The principal advantage of MRL mine delivery is its ability to quickly emplace large minefields in a single volley, while minimizing exposure to enemy targeting and weapon systems. Both AP and AT mines can be delivered by artillery (which may include cannon and mortar rounds).

(2) Ground Vehicles. Within recent years the trend has been to mount scatterable-mine dispensers on ground vehicles. Both AP and AT mines can be launched from ground vehicles. This also gives the engineers the ability to re-seed or reinforce an obstacle without entering the minefield itself.

(3) Infantry. Lower level OPFOR infantry units may employ man-portable remote mine dispensers. These man-portable dispensers, weighing only a few pounds, are ideal for installing small, defensive, AP or AT minefields. Infantry-fired ground dispensers allow low-level units to remotely emplace minefields to protect their fighting positions, flanks, and boundaries between units, or to cover firing lines and gaps in combat formations. They can quickly close breaches in existing protective minefields and increase the density of mines on armor avenues of approach.

(4) Aerial. Both AT and AP minefields can be laid using aerial minelaying systems. Bombers and fighter-bombers can lay remotely delivered minefields in the operational depths. Ground-attack aircraft lay these minefields in the enemy's tactical depths.

Helicopter minelaying systems are used to emplace small mine belts or large barrier minefields in the execution of army or division offensive or defensive maneuver plans. This type of aerial minelaying is normally conducted over friendly territory—along flanks or in rear areas. When supporting an airborne or air assault landing, helicopters may lay mines on enemy territory. Helicopter mine chutes are a tool available to even low-technology helicopter forces for installation on a variety of helicopters by low echelon maintenance units and rapidly dispensing conventional anti-tank mines in areas inaccessible to even rapidly moving ground vehicles.

Placement of a limited number of side-attack or conventional AT/AP mines along likely movement routes allows the OPFOR to harass traffic, slow movement rates, cause casualties, and affect enemy morale.

4. Fuzes. Some types of fuzes, such as pressure fuzes, are used in both AT and AP mines while other fuzes tend to be linked to more specific types of mines. For example, acoustic sensors are generally used with antihelicopter and advanced off-route mines while magnetic, tilt-rod, or seismic fuzes are used with AT mines. Most AT mines are detonated by the pressure of a vehicle driving over a buried mine or by the movement of a tilt rod attached to the mine. Pressure and tilt-rod AT mine fuzes (contact fuzes) are being replaced or complemented by mines with magnetic, optical, seismic, and acoustic influence mines.

Some mines have a second fuze well to facilitate the installation of an antihandling fuze. Conventional antihandling devices and target-sensing fuzes have evolved into sophisticated booby traps, which virtually assure grievous injury or death to the de-miner. Some landmines may be detonated by metal detectors; others explode when their fuzes detect light when lifted from the ground. One version of the "Bouncing Betty" is activated by an array of seismic detectors.

Other mines, for example the US M18A1, will accommodate a variety of fuzes, including tripwire and command detonation. Other mines, especially antihelicopter mines use a combination of sensors/fuzes to acquire the helicopter and initiate the mine when the helicopter enters the lethal zone.

a. Pressure. The pressure fuze is the most common type of fuzes for both AT and AP mines. Also known as the contact fuze, it may require only a few ounces pressure to active the mine or as much as several hundred pounds.

b. Trip Wire. Also called pressure release, these fuzes may be attached to a thin wire stretched across a path or route. When the victim or vehicle passes and breaks the wire, the mine is detonated. Trip wires are used mainly with AP and side-attack mines.

c. Magnetic. Most armored vehicles contain a large quantity of steel and therefore create large magnetic disturbances that signal their presence to a magnetic influence fuzed landmine.

d. Optical. An optical fuze, using a small infrared or ultra-violet transmitting diode on a surface-placed landmine, sends a detonation signal with it senses light reflecting from the hull of a tank.

e. Radar. A small, micro-electronic radar can sense the underside of a tank by the magnitude and location of the radar reflection.

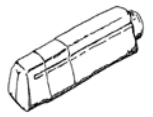
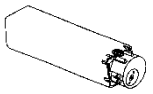
f. Seismic. Mines can be equipped with sensors that detect the vibrations caused by the weight and track movement of tanks or by the noise they make.

g. Acoustic. When a system approaches, antihelicopter or advanced off-route mines use an acoustic sensor to activate or cue an IR, seismic, or MMW sensor.

h. Infrared. IR sensors are generally used against vehicles, ground and aerial.

Proliferated land mines

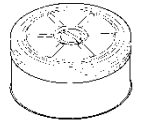
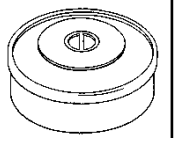
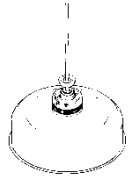
Antitank Mines

Name	Country of Manufacture	# of User Coun-tries	Emplacement Method Length (mm) Width (mm) Height (mm)	Armor Penetration (mm)/ Kill Mechanism	Effective Range (meter)	Detectability/ Composition	Anti-Handling	Fuze Type/ Self Neutralize	Explosive Type & Weight/Total Weight (kg)	Comment
Scatterable										
PTM-1S/ PGMDM	FSU	17+	remote-surface: UMZ, MRL, aircraft, PKM portable inf L: 320 mm W: 65 H: 75	track breaker on contact/ blast	1	visual plastic	no	contact, pressure neutralize: yes-0 to 24 hrs	PVV-12S liquid plastic: 1.4	 Anti-vehicle mine similar to German AT-1
PTM-3	FSU	12+	remote-surface: UMZ, helicopter, PKM portable inf L: 330 W: 84	70 mm: penetrates tank belly & destroys running gear	1	visual mine detectors cause detonation plastic	yes	proximity, magnetic self-destruct: yes-16 to 24 hrs	TG-40: 1.8 Total: 5	
Manual, Mechanical, and Chute Emplaced										
TM-57	FSU Bulgaria China Iraq	32+	manual mechanical chute D (max): 316 D (min): 204 H: 101	blast	1	easy sheet metal	yes	pressure (200/2.5/.5-6 kg) delay-armed, tilt rod, pull (booby trap) neutralize: no	TNT or TGA 60/24/16: 6.3 Total: 8.47	 limited underwater
TM-62M/ P/B/D	FSU Poland Bulgaria	30+	manual mechanical chute D: 315 H: 110	27 RHAE blast	1	varies: M: metal-easy P: plastic B: caseless D: wood	Not built in	pressure (200 kg) magnetic (flux) seismic	Trotyl, RDX & aluminum/9.5 Total: 10	 limited underwater
TM-46/ TMN-46	FSU North Korea (ATM-46) Germany Bulgaria Egypt (M/71) Israel (No. 6)	28+	manual mechanical D: 306 H: 94	blast	1	easy to detect sheet metal	TMN-46 yes	pressure (180/132 kg), tilt rod neutralize: no	TNT, amatol 2.9 Total: 5.7	 The TM-46 and TMN-46 are identical except for the additional fuze well

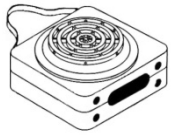
Antitank Mines (continued)
Manual, Mechanical, and Chute Emplaced (continued)

Name	Country of Manufacture	# of User Coun-tries	Emplacement Method Length (mm) Width (mm) Height (mm)	Armor Penetration (mm)/ Kill Mechanism	Effective Range (meter)	Detectability/ Composition	Anti-handling	Fuze Type/ Self Neutralize	Explosive Type & Weight/Total Weight (kg)	Comment
PMZ-40	FSU	18+	manual D: 280 H: 120	blast	contact	Easy steel	possible-no 2nd fuze well or AD features	pressure (225 AT or 68 AP) self-destruct or neutralize : no	TNT 3.6 Total: 9	 The AP/AT feature allows a single type mine to be used in a mixed minefield. Preferable in roadblocks. Replaced by the TM-41 AT mine
PT-Mi-Ba-III	Czech	17 + terrorist groups	manual mechanical chute D: 330 H: 108	blast defeats known belly armor	1	plastic /bakelite (metal in fuze only-2.9 gr)	yes with RO-4 fuze	pressure (200 kg) self-destruct or neutral: no	TNT 7.2 Total: 9.9	
Mk 7	United Kingdom	16+	manual D: 325 H: 130	blast	1	Easy detect metal	Yes	pressure (150 kg), tilt rod available	TNT 8.9 Total: 13.6	
TMD-B	FSU Namibia	16+	manual L: 315 W: 280 H: 160	blast	1	difficult with hand held detectors - wood	Possible	pressure (200-500 kg) self-destruct or neutral: no	TNT 9.0 kg Total: 9.7	
M19	US Chile Iran South Korea Turkey	13	manual L: 332 W: 332 H: 94	Blast	1	difficult with hand held detectors plastic	Yes	pressure (182 kg)	COMP B 9.5 Total: 12.6	
TMK-2	FSU	13+	manual D max: 301 D min: 75 H: 262 w/o Tilt-rod	250 RHAE belly attack plate charge	1	Easy Metal	Possible	tilt rod (8-12 kg) self-destruct or neutral: no	TG-50, TNT Total: 12.5	

Antitank Mines (continued)
Manual, Mechanical, and Chute Emplaced (continued)

Name	Country of Manu-facture	# of User Coun-tries	Emplacement Method Length (mm) Width (mm) Height (mm)	Armor Penetra-tion (mm)/ Kill Mech-anism	Effective Range (meter)	Detectability/ Composition	Anti-handling	Fuze Type/ Self Neutralize	Explosive Type & Weight/Total Weight (kg)	Comment
TMA-3	Former Yugoslavia	13	manual mechanical D: 262 H: 140 w/fuze H: 100 w/o fuze	blast	1	very difficult with hand held detectors plastic coating	Yes	pressure (180 kg) self-destruct or neutral: no	cast TNT 6.5 Total: 7.0	
PRB M3/ A	Belgium	12	manual L: 230 W: 230 H: 130	blast	1	very difficult with hand held detectors plastic	yes two secondary fuze wells	pressure (250 kg)	RDX/TNT 6.5 Total: 6.8	 aka PRB ATK-M3, waterproof
TM-41	FSU China North Korea Cambodia	10+	manual H: 145 D: 252	blast	contact	Metal	No	pressure (160 kg no)	TNT: 4 Total: 5.4	 Can be used underwater
Type 72	China S. Africa	10+	manual mechanical scatterable D: 270 H: 100	blast	contact	very difficult plastic	possible	pressure (300 to 800 kg) self-destruct or neutralize : no	TNT/RDX 5.4 Total: 6.5	 Very difficult to detect with hand held detectors underwater: yes
M15	US	7+	manual D: 334 H: 150	blast	0, typical with contact mine	Easy Metal	yes 3 fuze wells	pressure (159-340 kg) tilt-rod	COMP B 10.3 Total: 14.27	

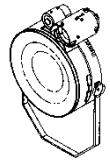
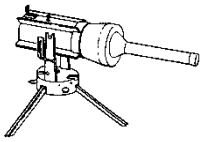
Antitank Mines (continued)
Manual, Mechanical, and Chute Emplaced (continued)

Name	Country of Manu-facture	# of User Coun-tries	Emplacement Method Length (mm) Width (mm) Height (mm)	Armor Penetra-tion (mm)/ Kill Mechanis m	Effective Range (meter)	Detectability / Composi-tion	Anti-handling	Fuze Type/ Self Neutralize	Explosive Type & Weight/Total Weight (kg)	Comment
M7A2	US	7+	manual L: 178 W: 114 H: 63	blast	see note	Easy metal	Yes 2 fuze wells	pressure (159-340 kg)	Tetryl 1.62 Total: 2.19	 Designed more as anti-vehicle (trucks and LAVs) For tanks 2–5 mines used
P2 Mk 3	Pakistan	6+	manual D: 262 H: 120	blast	0, typical with contact mine	very difficult plastic	probable 2nd fuze well	pressure (204-250 kg)	TNT 6.02 Total: 7.05	 Very difficult to detect w/hand held-detectors. Can also be used as very large AP mine
PT-Mi-K	Czech	6+	manual mechanical D 300 H: 106	blast	contact	easy detect metal	possible	pressure (200-400KG)	TNT: 4.9 Total: 7.6	
P2 Mk 2	Pakistan	5+	manual D: 270x270 H: 130	blast	0, typical with contact mine	very difficult plastic, only metal is spring, striker tip, and shear wire	probable- 2nd fuze well	pressure (180-300 kg)	6 Total: 6.5	 Very difficult to detect w/hand held-detectors. Can also be used as very large AP mine
PM-60 (K-1)	Former E. Germany	5+	manual D (max): 320 D (min): 237 H: 125	blast	0, typical with contact mine	somewhat difficult (only 20 gr metal) plastic	probable 2nd fuze well	pressure (200-500 kg)	TNT 9.9 Total: 11	 waterproof

Antitank Mines (continued)
Manual, Mechanical, and Chute Emplaced (continued)

Name	Country of Manufacture	# of User Coun-tries	Emplacement Method Length (mm) Width (mm) Height (mm)	Armor Penetra-tion (mm)/ Kill Mechanism	Effective Range (meter)	Detectability/ Compo-sition	Antihandling	Fuze Type/ Self Neutralize	Explosive Type & Weight/Total Weight (kg)	Comment
PT-Mi-Ba II	Czech	4+	manual L: 397 W: 230 H: 135	blast	1	difficult plastic or metal	probable-1 or 2 fuzes. Any disturbance detonates the mine after it has been emplaced.	Pressure (200 to 450 kg)	RO-7-II: 6.44 Total: 10.2	
UKA-63	Hungary	4+	manual mechanical scatterable chute D: 300 H: 75	explosively formed fragments	Plate charge. Track-attack; side-attack effective 0 to 50 meters (see note)	easy metal	Probable	pressure, seismic, magnetic, and electrically fired command detonated, tilt-rod neutralize: no	TNT 6 Total: 9	 Can operate as a belly-attack, track-attack, or side-attack mine. The plate-charge will probably have only limited success against tank armor in side-attack mode but is successful against lightly armored vehicles.
TMM-1	Yugoslavia	2+	manual mechanical D: 326 H: 90	blast	contact	easy to detect metal	probable- 2nd fuze well	pressure (130 w/pressure plate- 70 w/o plate) self-destruct or neutralize : no	TNT 5.6 Total: 8.7	 Commonly surface laid and use extensively in roadblocks. Limited underwater to .25 m
TM-89	FSU	15+	manual mechanical D: 320 H: 132	blast	proximity	Metal	Probable	pressure, magnetic, and electrically	TG-40 6.7 Total: 11.5	

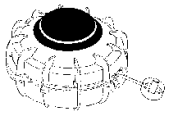
Antitank Mines (continued)
Side-Attack (Antitank and Anti-vehicle) Mines

Name	Country of Manufacture	# of User Coun-tries	Emplacement Method	Armor Penetration (mm)/ Kill Mechanism	Effective Range (meter)	Detectability/ Composition	Anti-Handling	Fuze Type/ Self Neutralize	Explosive Type & Weight/Total Weight (kg)	Comment
LMG	FSU	13+	manual	rocket propelled shaped-charge	27	visual metal	No	Tension (1 kg), tripwire neutralize: no	TNT: 3.2 Total: 10	
TM-83	FSU	13+	manual H: 440 L: 250	100 RHAE EFP (explosively formed penetrator)	50	visual case metal	possible	IR & seismic, or breakwire	explosive 9.6 Total: 20.4	
Panzer-faust 3	Germany	8+	manual L: 1,200 D: warhead 110	700 rocket propelled shaped-charge	150 target speed- 30-60 kmp	visual metal	No	IR & acoustic, seismic, break wire. Targets detected by acoustic which activates IR	HEAT MP-Frag BASTEG	 SIRA sensor package
PARM 1 (DM-12)	Austria Germany UK Sweden Finland	5+	manual L: 390 D: 128	600 rocket propelled shaped-charge	40	visual metal	No	neutralize: 20, 40, 60 days	Total: 10	
MIACAH F1	France UK (L14A1) Netherlands (# 29)	4+	manual L: 260 D: 200	70 RHAE @ 40 m shaped-charge	80	visual metal	No	breakwire, command, IR influence neutralize: no	Hexolite: 7 Total: 12	

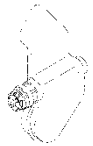
Antitank Mines (continued)
Side-Attack (Antitank and Anti-vehicle) Mines

Name	Country of Manufacture	# of User Coun-tries	Emplacement Method	Armor Penetration (mm)/ Kill Mechanism	Effective Range (meter)	Detectability/ Composition	Anti-Handling	Fuze Type/ Self Neutralize	Explosive Type & Weight/Total Weight (kg)	Comment
PD Mi-PK (Horizontal)	Czech	1+	manual L: 401 W: 125 H: 80	50 RHAE 5-EFPs	30	visual metal	possible	contact wire, command Can be linked to IR sensor	explosive: 5.5 Total: 12 (8.5 w/o stand)	
MPB-ZN/K	POL	1+	manual	EFP	50	visual metal	Yes	Acoustic and Infrared Contact (K Model)	TNT: 22(est.) Total: 45	

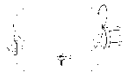
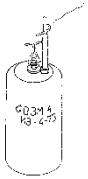
Anti-Personnel Mines

Name	Country of Manufacture	# of User Coun-tries	Emplacement Method	Kill Mecha-nism	Effective Range (m)	Detectability/ Composition	Anti-Handling	Fuze Type/ Self Neutralize	Explosive Type & Weight/Total Weight (kg)	Comments
Scatterable										
VS-50	Italy Singapore (SPM-1) Egypt (T/79)	14+	manual remote-surface D: 90x90 H: 45	blast	limited	Plastic difficult	yes, the VS-50AR variant	pressure- 10 kg self neutral: no	TNT: .075 Total: .185	 Designed to be scattered from helicopters. Countermeasure blast (fuel- air-explosive line charge)-resistant. Underwater 1 meter

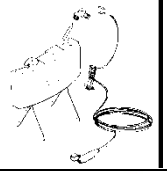
Anti-Personnel Mines

Name	Country of Manufacture	# of User Coun-tries	Emplacement Method	Kill Mecha-nism	Effective Range (m)	Detectability/ Composition	Anti-Handling	Fuze Type/ Self Neutralize	Explosive Type & Weight/Total Weight (kg)	Comments
Scatterable										
PFM-1S	FSU	12+	remote-surface (UMZ, MRL, helicopter, PKM portable) H: 120 W: 61	blast	1	Visual plastic	no	pressure (5 kg) Self-destruct: 85% over 40 hr	liquid plastic-VS-6D: .040 Total: .070	 copy of US BLU-43B
POM-1S	FSU	12+	remote-surface (UMZ, helicopter, PKM portable) Ball 80x80 mm	fragmen-tation	4	Visual	yes	tripwires, S=Self-destruct	.1 Total: .750	 copy of US BLU-42B
POM-2S	FSU	12+	remote-surface (UMZ, helicopter, PKM portable) cylinder: D: 60	fragmen-tation	16	visual, readily	no	tripwires (.2 kg) Self-destruct: 4 to 100 hr	TNT: .14 Total: 1.6	
SB-33	Italy, Spain Greece (EM-20), Portugal (M412)	10+	manual scatterable D: 85 H: 30	blast	contact	Plastic difficult w/handheld detectors	yes: antihandling SB-33/AR	pressure 10 kg	RDX: .35 Total: .140	 Countermeasure blast (fuel air/explosive line charge) resistant.

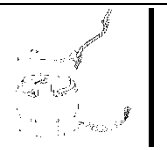
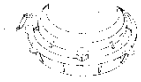
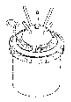
Anti-Personnel Mines (continued)
Manual, Mechanical, and Chute Emplaced

Name	Country of Manufacture	# of User Coun-tries	Emplacement Method	Kill Mechanism	Effective Range (m)	Detectability/ Composition	Anti-handling	Fuze Type/ Self Neutralize	Explosive Type & Weight/Total Weight (kg)	Comments
PMN	FSU China Iraq	35+	manual chute D: 112 H: 562	blast	1	readily-plastic case metal in fuze & cover	cannot be disarmed Fuze arm delay	pressure plate-very sensitive (8-25 kg) self-neutral: no	Trotyl: 0.20 Total: 0.55	 Most common AP mine in the world. waterproof
POMZ-2M	FSU China (Type 59) North Korea Germany	33+	stake mine manual D: 107 H: 60	fragmen-tation	Max: 8 Min: 0	visual, detection cast iron	possible	tripwire (1 kg force) self-neutralize: no	TNT: 75 Total: 1.7	 Normally emplaced on stake 30 cm above ground. Fuze delay arm Underwater: no
MON 100	FSU Bulgaria	27+	manual D: 220 H: 80	directional fragmen-tation 400 pieces	100 width of kill zone @ 100 m= 6.5-9.5	metal case	possible but not likely	electric command, tension-release (2 to 5 kg) self-neutralize: no	TNT: 2 Total: 5	 Also effective against lightly armored vehicles. At 100m 50% of frag will strike w/in 5 m of aim.
OZM-4	FSU	26+	manual D: 90 H: 140	bounding fragmen-tation (.6-.8 m above ground)	15	readily detectable case cast iron	possible	tripwire (2-5 kg), electrical, pressure, tension release self-neutralize: no	Total: 5	 Replaced the OZM-3
MON 200	FSU Bulgaria	25+	manual L: 431 H: 130	directional fragmen-tation 900 pieces	200 m width of kill zone @ 200 m= 10.5-14.5	visual metal case	possible but not likely	electrical, self-neutralize: no	TNT: 12 Total: 25	 Larger version of MON-100 Also effective against LAVs

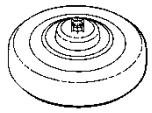
Anti-Personnel Mines (continued)
Manual, Mechanical, and Chute Emplaced (continued)

Name	Country of Manufacture	# of User Coun-tries	Emplacement Method	Kill Mechanism	Effective Range (m)	Detectability/ Composition	Anti-handling	Fuze Type/ Self Neutralize	Explosive Type & Weight/Total Weight (kg)	Comments
PP-Mi-Sr II	Czech	25+	manual D: 102 H: 152	bounding fragmen-tation	max: 20 m min: 0 bound height 1 m	Easy metal case and fragmentation	possible	tripwire (4 to 8 kg), pressure (3 to 6 kg) command detonated self-neutralize: no	TNT: .36 Total: 3.2	 Fielded in 1955. Exact copy of its predecessor the PP-Mi-Sr
PMD-6	FSU Namibia Serbia	24+	manual L: 196 W: 87 H: 50	blast	1	detectable wood metal in fuze	possible	pressure, tripwire (1 kg) self-neutralize: no	TNT: .20 Total: .40	 Probing for low pressure threshold fuze is dangerous
MON 50	FSU	23+	manual L: 220 W: 45 H: 105	directional fragmen-tation 485 pieces.	width of kill zone @ 50 m=45	visual plastic case	possible	electric cmd, tripwire, tension, tension release self-neutralize: no	RDX: .70 Total: 20	 Copy of US M18A1 claymore Chopped wire fragments (5x5mm).
M18A1/ Claymore	US, South Korea (K440) Pakistan (P5 Mark I) Iran, Chile S. Africa (No.2) FSU (MON-50)	22+	manual L: 216 W: 35 H: 83	directional steel fragments	50	visual plastic case (fiberglass)	possible	electric command, tripwire, tension, tension release	C4: .68 Total: 1.60	
OZM-72	FSU	21+	manual D: 105 H: 172	bounding fragmen-tation	max: 25 min: 0 bound height .66 m is adjustable	Easy Metal	possible no 2nd fuze well	tripwire (2 to 5 kg) or command detonated (electrical) or pressure self-neutralize: no	TNT: .70 Total: 5.0	 Successor to the OZM-4. Same chopped wire fragments (5x5mm) as in the MON-50 Not waterproof

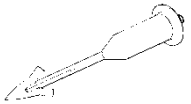
Anti-Personnel Mines (continued)
Manual, Mechanical, and Chute Emplaced (continued)

Name	Country of Manufacture	# of User Coun-tries	Emplacement Method	Kill Mechanism	Effective Range (m)	Detectability/ Composition	Anti-Handling	Fuze Type/ Self Neutralize	Explosive Type & Weight/Total Weight (kg)	Comments
M14	US India (M-14) Vietnam (MN-79 & MD 82B)	20+	manual D: 56 H: 40	blast	1 contact	very difficult with hand-held detector plastic body (only metal is steel striker tip)	possible	pressure (9-16 kg)	TNT: .029 Total: 1	
OZM-3	FSU	19+	manual D: 75 H: 120	bounding fragmentation	max: 25 lethal: 10 min: 0 bound height 1.5 to 2.4 m	Easy metal	possible no 2nd fuze well	tripwire (2 to 5 kg) or cmd detonated (electrical) or pressure self-neutralize no	TNT: .075 Total: 3	 not waterproof
PMN 2	FSU	16+	manual mechanical D: 125 H: 54	blast	limited	plastic easy-metal content	possible	pressure-15 kg self neutral: no	TG-40: .115 Total: .450	 Successor to PMN. Blast resistant
PPM-2	China Former E. Germany	15+	manual D: 125 H: 63	blast	0	Easy due to fuzing and detector foil plastic	possible	delay-armed (1 to 2 hr), pressure (12.5 kg) self-neutralize; no	TNT: 0.13 Total: 0.39	 Not waterproof
Type 72	China S. Africa	11+	manual D: 79 H: 39	blast	0 contact	very difficult for hand held detectors, plastic	very difficult plastic with rubber cover (see note for hand held detectors)	pressure (5 to 7 kg) self-neutralize: no Types B & C detonate if moved	TNT/TNT RDX (50/50): 0.05 Total: 0.14	 Also used as boobytrap. "Look-a-likes" Type 72B=boobytrap Type 72C=both AP and booby trap, Magnetic detector detonation limited to very shallow water use
Valmara 69	Italy S. Africa (# 69 Mk 1), Singapore	10+	manual D (Top):130 D: (Bottom) 107 H:205	bounding .45m frag	27	plastic case easy to detect: fragments are steel	probable, 2nd fuze well	pressure: 6, 10 kg tripwire self neutral: no	Comp B: .4 Total: 3.2	

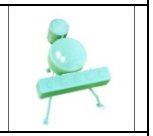
Anti-Personnel Mines (continued)
Manual, Mechanical, and Chute Emplaced (continued)

Name	Country of Manufacture	# of User Coun-tries	Emplacement Method	Kill Mechanism	Effective Range (meter)	Detectability/ Composition	Anti-Hand-ling	Fuze Type/ Self Neutralize	Explosive Type & Weight/Total Weight (kg)	Comments
DM-11	Germany Sweden (LI-II)	7+	manual D: 82 H: 34	blast	limited (typical for contact-fuzed blast-effect mines)	very difficult plastic	possible. no 2nd fuze well	pressure (5 kg)	TNT: 0.12 Total: 0.23	 waterproof
M16A1	US India	6+	manual D: 103 H: 203	bounding fragmen-tation	27 bound height 1	easy metal	possible no 2nd fuze well	tripwire, pressure (2, 5 kg) self-neutralize: no	TNT: 0.6 Total: 3.67	 not waterproof
M3	US Taiwan	5+	manual L: 76 W: 76 H: 134	fragmen-tation	4 increased when above ground	easy metal	probable 3 fuze wells	tripwire, (1.4 to 4.5) pressure (3.6 to 9.1)	TNT: 0.45 Total: 4	
PMP-7 ½	Former E. Germany	5+	manual Truncated cone D (top): 125 D (bottom): 60 H: 150	fragmen-tation	4	easy plastic due to metal fragments	possible	pressure (6 to 8 kg)	TNT: 0.1 Total: 1.25	 The lethality of the mine is relatively small because the mine is emplaced below the surface.
PROM-1	Former Yugoslavia	5+	manual D: 75 H: w/o fuze 178 H: w/fuze 260	bounding fragmen-tation	max: 22 min: 0 bound height .7	Easy Steel	possible	pressure (9 kg) tripwire (3 kg) self-neutralize; no	TNT: 0.43 Total: 3	 Delayed ejection and detonation by 1 to 2 seconds to ensure target is clear of the upward path.

Anti-Personnel Mines (continued)
Manual, Mechanical, and Chute Emplaced (continued)

Name	Country of Manufacture	# of User Coun-tries	Emplacement Method	Kill Mechanism	Effective Range (meter)	Detectability/ Composition	Anti-Hand-ling	Fuze Type/ Self Neutralize	Explosive Type & Weight/Total Weight (kg)	Comments
Type 69	China	5+	manual D: 60 H: w/o fuze 114 H: w/fuze 168	fragmen-tation iron body breaks into approx 240 fragments	max: 11 m min: 0 bound height 0 to 1.5 m	easy iron case	possible has detonator well	pressure (7 to 20 kg) tripwire (1.5 to 4) command detonated self-neutralize: no	TNT: 0.105 Total: 1.35	 Closely patterned after the OZM-4., waterproof
P2 Mk2	Pakistan	4+	manual D: 70 H: 38	blast	limited	difficult Plastic	Possible no 2nd fuze well	pressure (10 kg)	TNT: 0.05 Total: 0.14	
PRB M35	Belgium	4+	manual D: 64 H: 40	blast	0	plastic	possible	pressure (5 to 15 kg)	TNT/KN03: 0.1 Total: 0.58	
MI AP DV PIQUET (Picket) PIG 63 (Model 63)	France	2+	manual D: 35 H: 270	blast	limited (typical for contact-fuzed blast-effect mines)	very difficult plastic	yes-will detonate if pulled from the ground	pressure, anti-removal	Tetryl: .030 Total: .10	 waterproof
V	Italy	2+	manual D: 38 H: 394	fragmen-tation stake mine	14 m	visually detectable	possible metal	tripwire (2 to 3 kg)	TNT: .09 Total: .91	
MI AP ID 51	France	1	manual D: 70 H: 52	blast	limited	very difficult plastic-no metal content	possible no 2nd fuze well self-neutraliz e: no	pressure (14 to 24 kg)	PETN: .051 Total: .09	 waterproof

Anti-helicopter Mines

Name	Country of Manufacture	# of User Countries	Emplacement Method	Armor Penetration (mm)/ Kill Mechanism	Effective Range (meter) Maximum /Minimum	Detectability/ Composition	Target Velocity (m/s)	Fuze Type/	Warhead Type/Total Weight (kg)	Status
AHM-200	Bulgaria	1	manual	10 @ 100 m	max 200	visual		combined acoustic & Doppler SHF	Total weight: 90 kg	
HELKIR	Austria	1	manual	6 @ 50 m 2 @ 150 m		visual		dual acoustic & IR	Total weight: 43 kg	in production
TEMP-20	Russia	0	manual		detection 1,000 max 200	visual	100	dual acoustic & IR	Total weight: 12 kg	development
AHM	UK	0	manual remote		200/50	visual		dual acoustic & IR	multiple EFP	development

Russian Antitank Mine TM-62M/P/B/D

SYSTEM

Alternative Designations: None
Date of Introduction: 1960
Proliferation: Over 30 countries
Description:
Shape: Circular
Color: Olive Green
Case Material: (see VARIANTS)
Length (mm): 110
Height (mm): 101.8
Diameter (mm): 320
Total Weight (kg): 8.5

DETECTABILITY

Ready: Varies. The TM-62M (metal case) is readily detectable. Other variants are much more difficult. Of the TM-62 series antitank mines and fuzes, the TM-62P (plastic) is the most difficult to detect.

EXPLOSIVE COMPOSITION

Type: Trotyl, RDX and aluminum power
Weight: 7.5 to 8.3
Booster: Yes
Type: Pentryt
Weight (gr): 0.75

FUZE

Types: Pressure, seismic, magnetic
Safety Device: Delay arming, transport clip

Name: MVCh-62 (most common)
Type: Pressure
Actuation Force (kg): 200 /150 to 550
Resistant to Explosive Neutralization: Yes

Name: VM-62Z
Type: Seismic

Name: MVZ-62
Type: INA

Name: MVN-62
Type: INA

Name: MVN-80
Type: Proximity

Name: MVP-62
Type: Proximity

PERFORMANCE

Armor Penetration (mm): 27
Effect: Blast
Effective Range (m): 1
Emplacement Method: (see NOTES)
Manual
Mechanical
Chute
Burial Depth:
Maximum: 20
Minimum: None
Techniques of Employment: (see NOTES)
Controllable (remotely detonated): Yes, may use the Russian UMP-2 Controlled AT Minefield Set
Antihandling Device: Possible, however, no secondary fuze well or AD features. A special AD (MS-3) is used under AT mines.
Self-Destruct: No
Detonation Height: N/A
Underwater Emplacement: Limited duration capabilities when used underwater.

DELIVERY PLATFORMS (examples)

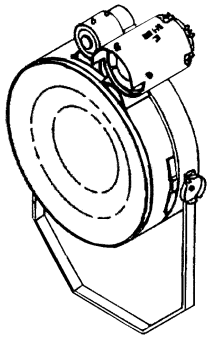
Tracked minelaying vehicle GMZ/GMZ-2/3
Towed mechanical minelayer PMR-3 and PMZ-4
Helicopter (with VMP-2 minelayer)

VARIANTS

TM-62M: Metallic case
TM-62P: Plastic case
TM-62B: Caseless
TM-62D: Wooden

NOTES
TM-62 mines can be emplaced in integrated explosive barriers or in homogeneous minefields. They may be employed singly or in groups as part of an explosive antitank barrier. TM-62 mines are placed in accordance with former Soviet doctrine, which dictates a normal density of one mine per meter of front.

Russian Side-attack Antitank Mine TM-83



SYSTEM

Alternative Designations: None
Date of Introduction: INA
Proliferation: At least 13 countries
Description:
Shape: Cylinder
Color: Olive green
Case Material: Metal
Length (mm): INA
Height (mm): 400
Diameter (mm): 250
Total Weight (kg): 20.4

DETECTABILITY

Ready: Visual

EXPLOSIVE COMPOSITION

Type: TG40/60
Weight (kg): 9.6
Booster: INA

PERFORMANCE

Armor Penetration (mm): 100
Effect: EFP, side-attack
Effective Range (m): 50
Emplacement Method: Manual
Controllable (remotely detonated): Yes, (100-m cable)
Antihandling Device: Possible
Self Destruct: 30 days

VARIANTS
None

FUZE

Types: 2-color IR sensor, seismic, or MVZ-7 breakwire
Number of Fuze Wells: 1
Actuation Force (kg): N/A
Resistant to Explosive Neutralization: Yes

NOTES
The TM-83 is a high-explosive antitank mine. It is basically a plate charge mounted on a stand. The mine uses seismic sensors to identify approaching targets and to turn on the dual IR sensor. When a valid target passes into the field of view of the sensor, the warhead is fired. The plate is formed into a slug, which is propelled by the explosive, destroying the target. The seismic sensor is stored on the back of the mine and is connected by an electronic cable. It can also be fired electronically. The mine may be mounted on a tripod, the storage box, or tree, etc.

Austrian Antihelicopter Mine HELKIR

SYSTEM

Alternative Designations: None
Date of Introduction: In current production
Proliferation: At least 1
Description:
Shape: Rectangular
Color: Green
Case Material: Metal
Length (mm): INA
Height (mm): INA
Diameter (mm): INA
Total Weight (kg): 43

DETECTABILITY

Ready: Visual

EXPLOSIVE COMPOSITION

Type: INA
Weight: 20

FUZE/SENSOR

Types: Dual, acoustic, and IR
Number of Fuze Wells: INA
Resistant to Explosive Neutralization: Yes

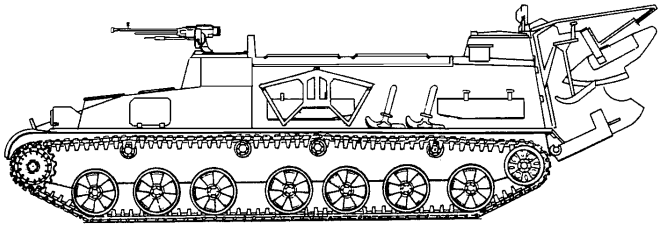
PERFORMANCE

Armor Penetration (mm): 6 @ 50 m or 2 @ 150 m
Effect: Directed fragmentation
Effective Range (m): 150
Target Speed (km/h): 250
Emplacement Method: Manual
Controllable (remotely detonated): Yes
Antihandling Device: Yes
Self-Destruct: INA

VARIANTS
None

NOTES
The HELKIR antihelicopter mine is designed to engage nap-of-the-earth targets. The sensor is a dual acoustic-IR. The acoustic sensor listens for a valid noise input and turns on the IR sensor. The IR sensor is located coaxially to the warhead. When a hot IR signature is detected, the warhead is functioned.

Russian Tracked Minelaying Vehicle GMZ-3



Mine Types	Typical Combat Load
Mines	**208**
TM-57 w/fuze MVZ-57	
TM-62 series w/fuzes	
TM-46	
TMD-B	
MV4-62	
MVP-62 & w/prox fuze	
MVN-80	
7.62-mm PKT MG	**3,000**

SYSTEM

Alternative Designations: INA
Date of Introduction: GMZ series-1963
Proliferation: Former Soviet Union

Description:
Crew: 3 (see NOTES)
Chassis: Based on the SA-4 (GANEF) SAM
Weight (mt): 28.5
Length (m): 8.62
Height (m): 2.7
Width (m): 3.25
Ground Clearance (mm): 470
Gradient (°): 30
Fording Depth (m): 1
Vertical Step (m): .7

AUTOMOTIVE

Engine: 4 cyl, 513 hp, multi-fuel diesel
Cruising Range (km): 500
Speed (km/h):
On Road: 60
Off Road: 30
Fuel Capacity (liters): INA
Night Driving Equipment: Yes, TVNE-4B for the driver and K-3A for the vehicle commander (and PKT)
Navigation Equipment: (see NOTES)
Radio: R-123
NBC Protection System: Yes
Smoke Screening System: VEESS, plus 6 81-mm launchers, 3 on each side.

MINELAYING EQUIPMENT

Operating Speed (km/h):
Burying: 6
Surface Laying: 16
In Snow: 10
Minelaying Pattern: Straight line or staggered
Mine Spacing (m): 5 and 10
Burial Depth (mm):
Ground: 120
Snow: 500
Length of Single-row Minefield (m):
Percussion Fuzes: 1,000
Proximity Fuzes: 2,000
Mine Capacity: 208
Mine Weight (kg): up to 12
Time Required to Load Minelayer with One Basic Mine Load (min) (7men): 15 to 20
Men required to Load Minelayer with Mines: 7 (squad)
Time Required to Load Minelayer with Crew Only (m): 60
Time from Travel to Operating Position (min):
Automatic: Up to 2
Manual: Up to 8

ARMAMENT
Some GMZ may be armed with either the 12.7 or the 14.5 machineguns.

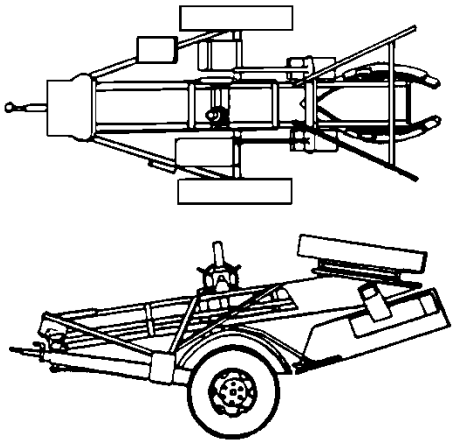
Main Armament:
Caliber, Type, Name: 7.62-mm PKT MG
Mount Type: Cupola (GMZ-3)
Max Effective Range (m):
Day: 2,000
Night: INA
Fire on Move: Yes
Rate of Fire (rd/min):
Practical: 250
Cyclic: 650

VARIANTS

GMZ: (shown above)
GMZ-2: (see NOTES)

NOTES
The crew of the GMZ-3 consists of three people—the vehicle commander, driver-mechanic, and the minelayer operator. The commander and driver are located in the forward section while the operator compartment is located in the rear portion of the vehicle. The vehicle commander operates the 7.62-mm PKT machinegun. The GMZ-3 has a digital navigation system allowing precise topographic tie-in of the minefield being laid. The previous model minelayer (GMZ-2) was not designed for the employment of mines with proximity fuzes.

Russian Towed Mechanical Minelayer PMR-3 and PMZ-4



Mine Types	Typical Combat Load
Mines TM-44 TM-46 TM-57 TM-62 Series TM-72 TMD-B	(varies, see **Prime Mover**)

SYSTEM

Alternative Designations: INA
Date Of Introduction: INA
Proliferation: At least 17 countries

Description:
Crew: 6 (commander, driver, four operators)
Weight (mt): 1.3
Length (m): 5.6
Height (m): 2.7
Width (m): 2
Prime Mover:
6x6 ZIL-131 truck (200 mines) or
4x4 URAL-375D (350 mines) or
BTR-152 (120 mines)

MINELAYING EQUIPMENT

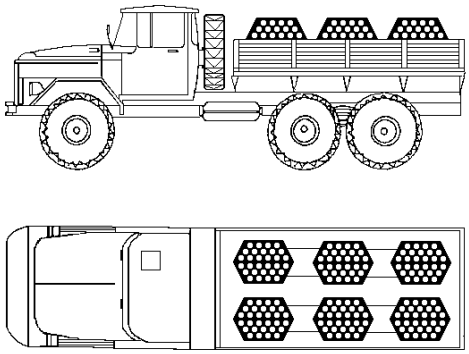
Operating Speed (km/h):
Burying: 2 to 3
Surface Laying: 4 to 10
In Snow: INA
Minelaying Rate (min): 10 to 12
Minelaying Pattern: Straight line
Mine Spacing (m): 3 to 4
Mine Capacity: Prime-mover dependent
Max Burial Depth (cm): 20

VARIANTS

PMZ-4: Lays controlled minefields; uses the same mines as the PMR-3 with the exception of the controllable minefield and cable-laying options; uses the UMP-2 Controlled AT Minefield Set

NOTES
The PMR-3, shown above, (and the similar PMZ-4) consists of a single chute and a plow attachment. Although both systems look similar at first glance, there are significant differences. Most notably, is the addition of a cable layer on the PMZ-4, used for the laying controlled minefields and the absence of the conveyer-belt chain drive on the wheels. Additionally, the PMZ-4 is more automated and must be hand loaded only. The towed-minelayers are used in sections of three or four and operate 20 to 40 meters apart with each minelayer laying a straight-line row. The mines in different rows are staggered with the distance between mines depending on whether the mines are pressure-initiated or full-width attack (influenced or tilt-rod fuzed).

Russian Scatterable Minelaying System UMZ



Mine Types	Typical Combat Load
Mines PFM-1 PFM-1/S POM-1 (S) POM-2S PTM-1S (PGMDM) PTM-3	(varies with type of mine—see below)

SYSTEM

Alternative Designations: Multipurpose Minelayer
Date of Introduction: INA
Proliferation: Former Soviet Union

Description:
Crew: 2 (driver and operator)
Chassis: ZIL-131 Truck (see VARIANTS)
Weight (mt):
Without Mine Load: 8.3
With Mine Load: 10
Length (m): 7.1
Height (m): 2.5
Width (m): 3
Ground Clearance (mm): 330

AUTOMOTIVE

Engine: V8, 150 hp, gas
Cooling: Water
Cruising Range (km): 525
Speed (km/h): 80
Gradient (°): 30
Fording Depth (m): 1.4
Vertical Step (m): .53
Night Vision Equipment: Yes, PNV-57E
Navigation Equipment: INA
Radio: R-159

MINELAYING EQUIPMENT

Operating Speed (km/h): 10 to 40
Distance Mines Launched from Vehicle (m): 30-60
Minefield (m):
Length: 1,000 to 1,200
Depth: 30 to 120
Max Length of Minefield with One Basic Load (m):
AP, PFM-1S: 3,200
AP, POM-2: 5,000
AT, PTM-3: 600
Length of Triple-Row Minefield (m): 150 to 1,500 depending on mine type
Mine Capacity: From 180 to 11,520 depending on the type of mine
Number of Mines in One Basic Load:
AP, PFM-1S: 11,520
AP, POM-2: 720
AT, PTM-3: 180
Time Required to Load Minelayer (hr) (2 men): 1.5 to 2
Time from Travel to Operating Position (min): 5

VARIANTS
Although primarily mounted on the ZIL-131, the UMZ minelaying system has been observed mounted on several different carriers such as a modified MTLB-U chassis or on a PT-S tracked amphibious personnel carrier.

NOTES
While the UMZ, scatterable mine system has been disclosed as the likely replacement for the GMZ-series, mechanical mineplanters, it probably will supplement the role formerly held by the GMZ. The UMZ consists of three launchers mounted on each side of the vehicle for a total of six mine launchers per vehicle. Each full turn launcher is hexagonally shaped and contains 30 launch tubes totaling 180. It can fire the mines to one or both sides, or to the rear. Both AP and AT mines are launched from the 140-mm launch tubes. The UMZ uses the same mine canisters as the PKM system. Depending on the position of the launch tubes, one-, two-, or three-lane mine fields can be laid.

Italian Mine Launching System Valsella Istrice-VS-MTLU-1

Mine Types	Typical Combat Load
Mines VS-MK2 EM-20 VS-50 TS-50 VS-1.6 VS-1.6/AR VS-1.6/AN VS-2.2	(varies, see **Prime Mover**)

SYSTEM
Alternative Designations: INA
Date Of Introduction: 1987
Proliferation: At least 17 countries
Description:
Crew: 2 (driver and operator)
Chassis: Iveco Fiat-90-PM
Weight (mt):
Without Mine Load: 8.3
With Mine Load: 10
Length (m): 7.1
Height (m): 2.5
Width (m): 3
Ground Clearance (mm): 330
AUTOMOTIVE
Engine: V8, 150 hp, gas
Cooling: Water
Cruising Range (km): 525
Speed (km/h): 80
Gradient (°): 30
Fording Depth (m): 1.4
Vertical Step (m): .53
Night Vision Equipment: INA
Navigation Equipment: INA
Radio: INA

MINELAYING EQUIPMENT
Magazine launcher size: 1.15 m x 0.86m
Operating Speed (km/h): 10 to 40
Distance Mines Launched from Vehicle (m): 30-60
Minefield (m):
Length: 3,200 to 5,000
Depth: 60 to 120
Max Length of Minefield with One Basic Load (m):
AP, VS-MK2: 3,200
AP, TS-50: 5,000
AT, VS-1.6, VS-2.2: 600
Length of Triple-Row Minefield (m): 150 to 1,250 depending on mine type
Mine Capacity: From 256 to 6,144 depending on the type of mine
Number of Mines in One Basic Load (A Series):
AP, VS-MK2: 6,144
AP, TS-50: 6,144
AT, VS-1.6: 512
AT, VS-2.2: 512
Number of Mines in One Basic Load (B Series):
AP, VS-MK2: 2,560
AP, TS-50: 2,560
AT, VS-1.6: 256
AT, VS-2.2: 256
Time Required to Load Minelayer (hr) (2 men): 1.5 to 2
Time from Travel to Operating Position (min): 5

UGV Primer

Unmanned Ground Vehicles or UGVs have been in service for close to forty years, detecting hazards, marking and clearing roads, and supporting the defeat of explosive devices such as mines, and explosive hazards. This mission traditionally was performed by combat engineers such a Sappers and explosive ordnance disposal (EOD), personnel and specialized police forces. The work can be extremely dangerous as it requires human contact with potentially lethal explosive devices, and hazardous materials. For this reason, UGVs have found a niche in identifying, disarming and disposing of explosives and other hazardous materials while providing combat engineers the standoff distance necessary to increase survivability. It is estimated that the global market for these types of devices will increase to $8.26 billion by the year 2020.

Figure 1: Inspector Mid-Sized Robot, Poland

UGVs are credited with reducing ground troop's exposure to danger through a combination of tactics, techniques, and procedures (TTP) used to leverage this new technology. Some of the new technology that is emerging from this sector includes UGVs that are self-aware, multi-functional, energy efficient, and can operate in a variety of terrain. There are a variety of systems on the market that are designed for explosive disposal ranging in size and capability. The categories are mini, mid, and large size UGVs. Most explosive disposal UGVs fall into the Mid-sized category, as they are easy to remotely control, have a small enough profile to provide access to an emplaced explosive device, while at the same time being large enough to manipulate the devices in order to disable them. Some larger UGVs are being used in other types of combat Engineer support activities such as route clearance, and logistics support. These UGVs can look like modified tractors or forklifts with a special sensors for identifying targets, rollers and scoops to defeat mines or remove obstacles.

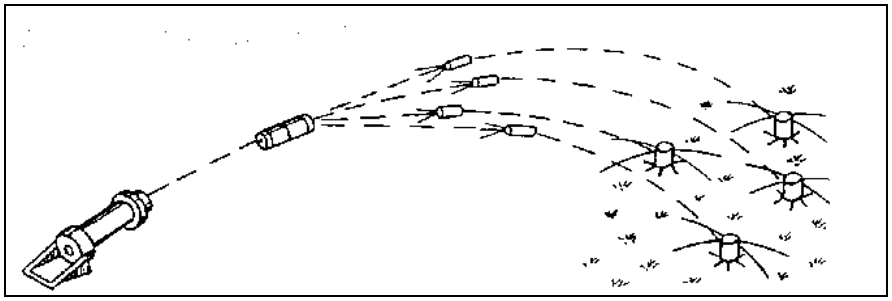
Many UGVs have tracked belt and wheel system for driving over complex terrain in all types of weather. UGV's that perform reconnaissance functions usually move with relatively large treaded wheels for speed and maneuverability. Usually logistical UGVs are have wheels in order to keep supplies close to maneuver units on the battle field. Legged robots like Boston Dynamics Legged Squad Support System, (LS3) otherwise known as Big Dog, attempt to achieve an all-terrain capability through the employment of a quadrupedal gait.

Challenges with UGVs are mainly with maintaining reliable command and control links between the device and the operator. This critical link, requires the operator to gaze into a computer screen while interpreting everything the UGV sees with its usually limited optical sensor. While the operator is engaged in controlling the UGV the Soldier is unable to perform other security duties and has limited situational awareness. One way to handle this problem is to make UGVs self-aware by installing automatic target recognition (ATR), algorithms that instruct the device on how to approach and defeat obstacles. Additionally the onboard data base is loaded with the most current map data and a satellite based navigation system in order for the device to move autonomously to its target. The link between robot and operator will not be completely severed in the near future as artificial intelligence is unable to build into the device's electronics the ability to make decisions in a complex combat environment, so operators will still be needed to have a way to give commands and establish control when necessary.

PKM man-portable infantry mine laying system

In the late 1980s, the Soviet Army began issuing the PKM, a man-portable infantry mine laying system, to its motorized rifle battalions. The original issue was three per battalion. One Russian map was found to portray a motorized rifle platoon strongpoint incorporating PKM-laid minefields in its defense. Regimental assets and defending soldiers have emplaced minefields, wire obstacles and an antitank ditch to the west of the position. The regiment's UMZ detachment has also laid two remotely-delivered minefields to the west of the position. In addition, the Russians have reinforced the platoon strong point with thirteen PKM-laid minefields both outside and inside the platoon strong point.

The PKM, portable, minelaying system consists of a mounting-base assembly, blasting machine, and wire communications link. The mine dispensing canister containing an internal framework or magazine holding one or more scatterable mines depending on type is loaded onto the mounting base. The internal magazine is then launched from the canister.



Depiction of PKM Mine-Scattering System

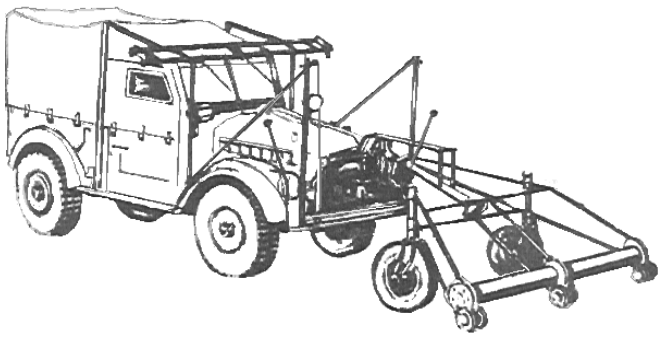
The PKM weights 2.63 kg (5.8 lbs.) without the mine canister and consists of a single launch tube with a base mount, a blasting machine and a reel of electric ignition wire. The operator loads a propelling charge and mine canister into the launch tube, mounts the tube on the edge of a trench or firing parapet, aims the tube, connects the wire to the tube, moves off a safe distance and connects the wire to the blasting machine and then cranks the blasting machine. The PKM propels the canister some 30-100 meters (depending on the type of mine) and lays an antipersonnel mine field of 10X20, 10X40 or 20X10 meters (again depending on the type of mine used). It takes a trained operator five minutes to set up the PKM and create a minefield. The POM-1S (*AP*) mine canister most likely produces the 10X20 meter field while the POM-2S (*AP*) mine canister most likely produces the 10X40 meter field. The PFM-S mine canister (*AP*) most likely produces the 20X10 meter field. The PKM can also be used to launch POM-2S AT mines and *PTM-1S and PTM-3 antitank mines*. Numbers of mines per canister are: 64 PFM-1S, 4 POM-2S, and 1 PTM-1S or PTM-3.

The portable minelaying set is capable of remotely laying a minefield with an area of 200-400 m^2 at a distance up to 100 meters from the position in any threatened sector, can be used in the course of battle to combat enemy infantry ahead of the FEBA or when it wedges into platoon flanks or gaps between squad positions.

Like the UMZ (the truck mounted mine scattering system), the Russians use the PKM to lay minefields to protect subunit positions, flanks and boundaries between subunits. PKM-laid minefields also cover firing lines and gaps in combat formations. The PKM can quickly close reaches in existing minefields and increase the density of mines on armor avenues of approach.

Weight of set, kg:	2.6
Dimensions for traveling, mm:	380X150X140
Laying method:	fire from cluster (remote)
Types of mines laid:	PFM-1S, POM-2, and PTM-3
Time required to prepare the set for laying mines:	up to 5 min

Russian Vehicle-Mounted Mine Detector DIM



SYSTEM

Alternative Designations: None
Date Of Introduction: Pre-1975
Proliferation: Widespread

Description:
Crew: 2
Prime Mover: UAZ-469/69 or other light 4x4 vehicles
Components:
- Detection system
- Pneumatic system
- Electronic system

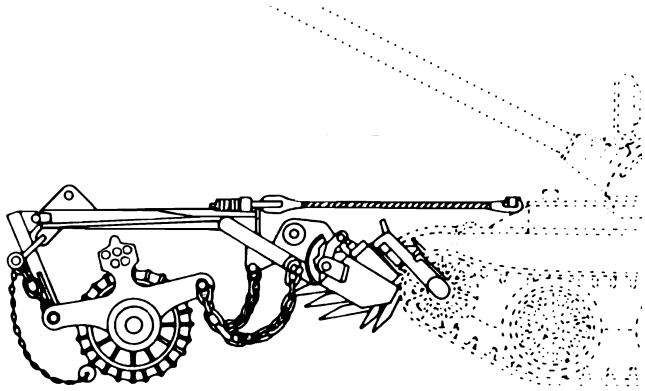
CAPABILITIES

Operating (scan) Speed (km/h): 10
Mounting/dismounting Time (min): Up to 7
Detection Ability: Can detect metallic mines in roadways, airfields, and other flat terrain.
Max Detection Depth (cm): 25
Max Detection Depth While Fording (cm): 70

VARIANTS
None

NOTES
The DIM is a large pulse-induction mine-detection device mounted to a light 4x4 truck. The detection element fastens to a frame on the front of the vehicle. When a mine is detected, the vehicle breaking system is engaged and the clutch is disengaged. The full-width detection head, located 2.6 meters from the vehicle's front wheels to provide stopping distance, is divided into six components to pinpoint mine location. The electronic system also displays which component of the mine-detector head the mine is under. It also has attached rollers so that the head does not come in contact with ground objects. Cross-country capability is very limited; therefore the DIM is generally used for clearing prepared surfaces. The detection equipment swings upward to ride on the top of the vehicle cab for traveling. When needed it is swung forward to rest on two wheels.

Russian Tank-Mounted Mineclearing Roller-Plow KMT-5



SYSTEM

Alternative Designations: INA
Date of Introduction: 1960s
Proliferation: At least 20 countries

Description:
Weight Total (kg): 7,500
Roller Section: 2,265
Plough: 420
Length (m): 3.2
Width (m): 4
Ditch Crossing (m): 2.5
System Components: Two plows (KMT-4) and two sets of three rollers

MINECLEARING EQUIPMENT

Type: Roller and plow
Platform: Mounted on T-54, T-55, T-62, other medium tanks
Form: 3 rollers x 2
Number of Rollers Per Set: 2
Total Number of Rollers: 6
Mine Removal Speed (km/h): 8-12
Cleared Lane Width, each (mm): 810 x 2
Mineclearing Track Width (mm): 810
Installation Time (min): 30 to 45

NOTES
The KMT-5M mine roller-plow is very flexible, since it allows for either the plows or the rollers to be used. The rollers function satisfactorily against mines equipped with simple pressure fuzes, but other mines will defeat this equipment. However, the roller-plow combination also allows the tank to counter more sophisticated fuzes with plows designed to uncover or push mines aside. The plows and rollers cannot work simultaneously.

The KMT-5M also includes a luminous lane-marking device for night operations. Because plows and rollers do not clear the area between them a “dog bone” or light chain with rollers is stretched between the roller sections to defeat tilt-rod mines. Quick disconnects allow the operator to drop either plows or rollers or both; otherwise, the crew can remove the system in 8 to 13 minutes. All current medium tanks have fittings for attaching mineclearing equipment.

There is one plow per tank platoon and one roller per company. For tanks newer than the T-55/62 the plows are no longer carried in the engineer company, but are permanently mounted on the tank. Therefore the engineers need only to transport the rollers. One KrAZ-255B truck (with KM-61 crane) or two ZIL-131 trucks can carry one KMT-5M.

Explosive Charge Minefield Breaching Systems

Minefield breaching explosive line charge systems are in use throughout the world. They provide the maneuver commander a method to expeditiously breach antitank or antipersonnel minefields. Once identified on the battlefield however, these systems generally become the priority target. Some systems, single or double line, are mounted on tanks while others are mounted on trailers, armored vehicles, and trucks. Some other systems are man-portable. The larger vehicle and trailer-mounted systems are designed to clear lanes through minefields/obstacles, large enough for the passage of ground combat vehicles. Man-portable (infantry) systems clear passage for at least one person to transit. The explosive filled lines are usually connected to a launcher by a cable, fired over a minefield (within which it lands) and then detonated to create a breach through the minefield. Standoff between the explosive charge and launcher varies. For instance, the Japanese CX has a standoff of 800 meters from the launcher.

Truck or Trailer Mounted Minebreaching Systems

Motorized and infantry units may have either wheeled or towed antitank minebreaching systems. While some of these systems can be dismounted, most are fired from the back of cargo trucks or from trailers. Minefield beaching systems are organic to the Combat Engineer Company of the Engineer Battalion. See FM 100-63, for additional information. A typical "truck-mounted explosive minefield breaching system" is the FSU UR-83P (below).

Name	**Country of Origin**	**Chassis**	**System (or Shell) Weight (kg)** Overall: Rocket: Explosive Explosive/m	**Range (m)**	**Length (m)**	**Standoff (m)**	**Effectiveness** Lane Width (m): Lane Length (m) Lane clearing time (min)	**Type Launcher / # Line Charges**	**Rocket Diameter (mm)**	**Operators**	**Explosive Type /#/ Notes**
UR-83P	FSU	Truck (ZIL-131) or trailer	**Dimensions (m)** (ready for launch) Length: 1.5 Width: 1.5 Height: 2.6 **Launcher Wt (kg):** Total: 230 Packaged: 360 Charge: 1,380	440	114		LL: 115 LW: 6 Assembly time by engineer squad (min): 90	Line UZP-83 charge		2	portable dismount able
Type 81	CH	EQ-240 Truck chassis	Loaded: 5,112 Unloaded: 4,082 Exp: unk Exp/m: unk	3,000	na	2,900 +	LL: 60+ LW: 10+	10 tube	2,530	3	HE, FAE ea round clears 18 m radius in AP.

The Type 81 mineclearing rocket system consists of a 10-tube launcher mounted on the rear of a modified EQ-240 chassis. Rockets are loaded manually by three persons. Although it is uncertain, warheads for this system are filled with conventional HE, FAE or a combination of both. The Chinese have stated that this system is effective against AP mines, but its effectiveness against AT mines is unknown. The range of this system is 3,000 meters, which provides the system with a maximum standoff of approximately 2,900 meters. Each round clears an 18-meter radius within an AP minefield. It is not known whether this is for the FAE or high-explosive warhead. The Type 1987 has 24 launch tubes and is mounted on a Type 59/69 tank chassis.

Tracked-Vehicle-Mounted Systems

Systems mounted on the rear of tanks increase the survivability of the platform and therefore increase the likelihood that it may be successfully employed prior to its destruction. The use of a tracked chassis as the launch carrier gives the system the same mobility and maneuverability on the battlefield as mechanized units; however, use of these systems does not allow tanks or mechanized vehicles to conduct a "Blitzkrieg" type rush across the minefield. Systems found in armor and mechanized divisions will generally be mounted on tracked vehicles due to mobility requirements. Although these minefield breaching systems may (or may not) be mounted on tanks they do not belong to the maneuver commander. They are engineer assets and are found in rather limited numbers. Two of these systems are in the Mineclearing Platoon, Mine Warfare Company, Division Engineer Company, and Engineer Battalion of a mechanized/armored division, engineer brigade, or Corps. Further information on these elements can be found in FM 100-60.

Tracked-Vehicle-Mounted Systems

Name	Country of Origin	Chassis	System (or Shell) Weight (kg) Overall: Rocket: Explosive Explosive/m	Range (m)	Length (m)	Standoff (m)	Effectiveness Lane Width (m): Lane Length (m) Lane clearing time (min)	Type Launcher /# Line Charges	Rocket Diameter (mm)	Crew	Explosive Type /#/ Notes
Type 84	CH	Tank or other armored vehicle	OA: 800 Rocket: unk Exp: 400 Exp/m: 5	300	80	200	LL: 60 LW: 5	1	unk	unk	Line charge
The Type 84 mounts in a box on the rear of a tank or other vehicle. Inside the box is a rocket in a launch rail attached to the box lid, an 80-meter-long explosive hose, and a drag chute. The rocket pulls the explosive hose over the minefield or other obstacle, arming the fuze in flight. After a short delay, the hose explodes leaving a cleared path. The box is automatically discarded after firing. With a published range of 300 meters and a length of 80 meters, the standoff of the system is estimated to be approximately 200 meters.											
Type 762	CH	Type 83, 152-mm tracked howitzer	OA: unk Rocket: 760 Exp: 400 Exp/m: 3	1,000	130	800-900	LL: 130 LW: 12-22	2	425	unk	line charge. 32 charges 12 kg ea
The Type 762 is a twin-rail rocket launcher mounted on a Type 83, 152-mm tracked howitzer chassis. It carries two 425-mm GSL 211 mineclearing rockets. The warheads on GSL 211 rockets contain an explosive line charge that is extracted during flight. The line charge is composed of 32 fixed-interval explosive charges, each weighing 12 kg. When the explosive charge is at a specific height above the minefield, specially designed detonation fuzes at the head and tail of the line charge activate and simultaneously detonate the charges. The system is equipped with an ordinary rangefinder with questionable accuracy; it is uncertain how the system will perform when deployed over a minefield.											
SVO	CZ	BMP-1	Shell size: Length (mm): 1,457 Dia (mm): 246 Weight (kg): 42				LL: 100-120 LW: 5 Time btwn rounds (sec): 2.5	24 explosive rockets			fuze initiation rod length (m): .3

The Czech Republics SVO is an armored, tracked, mineclearing vehicle used for combat breaches of AT and mixed minefields. The breach is conducted by the launching of mineclearing shells in a specific pattern in order to detonate all the mines along a pathway through the minefield. The entire system is contained in a modified BMP-1 chassis. The turret on the chassis has been removed and exchanged for a rocket firing platform. The firing platform contains 24 launch rods angled at different elevations and deflections in order to provide full warhead coverage for a path through the minefield. The front half of the compartment is for storing and launching the warheads, the other is the operator's position. The shells fit over the 24 launch rods and are projected into the air by the initiation of explosive cartridges. Piezoelectric fuzes located at the base of the fuze extension rods detonate the shells .3 meters above the ground. The SVO reportedly has a 95% probability of initiating single impulse, nonblast resistant, pressure-fuzed mines.											
UZ-67	FSU	2S1 mod	weight (kg): 2,400		93	200 and 350	LL: 75-80 LW: 6 Time: 3-5	2	unk	2	basic load of 2 line charges
UZ-77	FSU	2S1 mod	unk		93	200 & 500 water 200	LL: 80-90 LW: 6 Time: 3-5	2	unk	2	basic load of 2 line charges

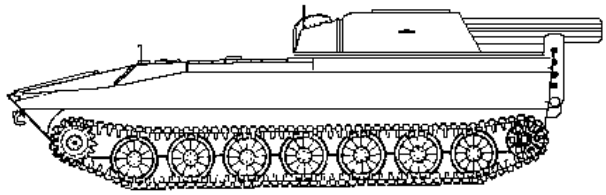
Man-Portable Rocket Propelled Line Charges

Many countries and some insurgent groups produce small (1 or 2 man-portable) explosive line charges with a wide variety of capabilities and performance. Mechanized infantry units normally do not have these since the tracked vehicles clear a way for the dismounted infantry. The basis of issue of these systems for use by dismounted (or regular) infantry units is generally three per infantry battalion; nine per brigade/regiment; 27 per division. They are used only in the primary avenue of attack (or as a deception). Battlefield employment dictates that the line is fired and detonated. The infantry then moves as quickly as possible (probably under fire) along the cleared path ensuring they do not step on any uncovered/ unexploded mines. The line charges may be carried by one or more soldiers therefore the overall weight of the charges is important. The bullet trap line charge delivery method realizes a significant weight savings by eliminating the additional weight of a rocket. The soldier simply uses his standard issue weapon to deliver the detonating cord/hose across the minefield. This places limitations on the length and weight of the delivered charge. A typical "infantry explosive minefield breaching system" is the FSU ZRP-2. It is a mine demolition charge designed to blast lanes through AP minefields. The ZRP-2 consists of a detonating cable, powder rocket engine, connecting cable, fuze, braking cord, launching table, launching device, anchor and carrying pack. The charge is launched into an AP minefield with the aid of launching device UP-60 from a position prepared on the ground surface. The charge is detonated remotely by a mechanical fuze. The charge is straightened in the minefield manually with the braking cord while the fuze retarder is burning.

ZRP-2 (FSU) Mine demolition charge	
Type	extended, single-line, made of detonating cable DKR-150A
Weight of set (kg)	50 packaged, 34 in pack
Crew, men	1 or 2
Length of charge (m)	60
Charge launching range (m)	140-160
Size of passage through AP minefield (m)	55 length x 0.4 width
Launch preparation time (min)	5

Infantry Line Charges				
Name	**Country**	**Delivery Method**	**Explosive Weight (kg/m)**	**Length (m)**
Type 73	China	Rocket	2.40	106
Type 74	China	Rocket	2.40	100
Type 81	China	Rocket	0.10	100
Type 84	China	Rocket	0.40	28
ODMIRA-60	Czech Rep	Rocket	NA	60
FATEH-1	Egypt	Rocket	0.42	120
Comet No 3001	Germany	Rocket	0.10	72
Comet No 3010	Germany	Rocket	0.57	53
Ladder 80	Germany	Rocket	NA	70
Unknown	Iraq	Bullet trap	NA	40
POMINS I	Israel	Bullet trap	0.27	50
POMINS II	Israel	Rocket	NA	50
Type 70	Japan	Rocket	1.41	136
Unknown	North Korea	Rocket	NA	180
Clap/M	Pakistan	Rocket	0.05	300
M/60	Sweden	Rocket	NA	150
Unknown	South Africa	Rocket	NA	35
Unknown	South Africa	Rocket	NA	120
RAMBS	UK	Bullet Trap	0.02	40
RAMBS 2	UK	Bullet Trap	unknown	60
ROMANS	UK	Rocket	unknown	50

Russian Tracked Mineclearing Vehicle MTK-2



SYSTEM

Alternative Designations: UR-77 mineclearing vehicle, M1979
Date of Introduction: 1981
Proliferation: FSU and former Warsaw Pact armies

Description:
Crew: 2 (commander-operator, driver-mechanic)
Chassis: Based on the 2S1
Weight (mt): 15.5
Length (m): 8.4
Height (m): 3.1
Width (m): 2.8
System Components: Vehicle and two mineclearing charges

AUTOMOTIVE

Cruising Range (km): 500
Speed (km/h):
On Road: 60
Off Road: 30
Water: 5
NBC Protection System: Yes
Smoke Screening System: No

MINECLEARING EQUIPMENT

Type: Explosive line
Charges Used: UZP-77, UZ-67
Length of Charge (m): 93
Length of Charge Feed (m):
UZP-77: 200 and 500
UZ-67: 200 and 350
Size of Lane in AT Minefield (m):
Width: Up to 6
Length (USP-77): 80-90
Length (UZ-67): 75-80
Breaching Time (min): 3 to 5

VARIANTS (INA)

NOTES
The MTK-2 clears lanes in minefields by using rocket-propelled charges. The charges are launched onto the minefield and then detonated by the vehicle commander-operator from within the vehicle. The charge can be fired on land or in the water.

Russian Armored Route-Clearing Vehicle BAT-2

SYSTEM

Alternative Designations: None
Date of Introduction: 1981
Proliferation: At least 2 countries.
Description:
Crew: 2+8
Engineer Capacity: 8
Chassis: MT-T
Weight (mt): 39.7
Length Overall (m): 9.64
Height Travel (m): 3.69
Width Overall (m): 4.2
Clearance (mm): 430
Gradient (°): INA
Trench Crossing (m): 2.7
Fording Depth (m): 1.3
Vertical Step (m): .8

AUTOMOTIVE

Engine: V-64-4 multi-fuel diesel, 700 hp
Cruising Range (km): 500
Speed (km/h): 60
Navigation Equipment: INA
NBC Protection: Yes
Radio: INA

BLADE

Width (m): Variable. Mounted vertically in front and over the crew cab when not in use.
Bulldozer Position: 4.5
Road Clearing/building: 4.2
Grading: 4.1-4.35

Operating Depth (solid and frozen soil) (m)**:** .5

Operating Speed (km/h):
Road Building:
Ground Unobstructed: 6-8
Ground with Trees $\leq$ 30 cm: 2-3
Snow: 8-15
Hourly Capacity (m^3/hr):
Ditch Digging: 200-250
Filling in Ditches, Craters, etc: 350-450

CRANE

Capacity (mt): 2
Boom Length (m): 7.3

WINCH

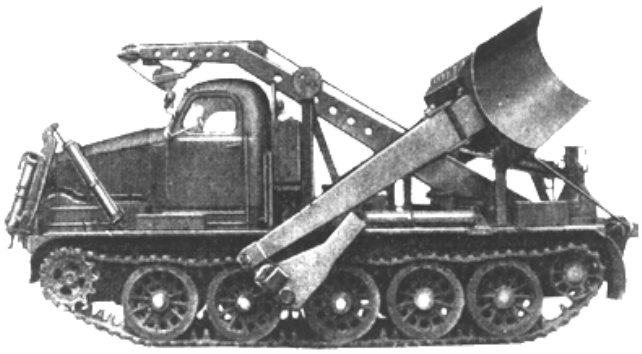
Capacity (mt): 25
Cable Length (m): 100

VARIANTS
None

NOTES
The BAT-2 is a follow-on to the BAT and BAT-M dozers, but better fits the classification of armored route-clearing vehicle rather than that of a high-speed armored dozer. Its cab is fully armored and it is designed to operate in the forward areas of the battlefield. The windows in the front, sides, and rear are bullet-proof further enhancing battlefield survivability.

The ability to carry an eight-man engineer squad facilitates its role in the movement support detachment. Other BAT-2 missions include road building, obstacle, (stone and wood) removal, and snow removal operations. The vehicle is also designed to operate in urban terrain and as an NBC vehicle. Storage areas for engineer supplies have been designed into the vehicle. The BAT-2 has a crane, a ripper, and a winch.

Russian Tracked Route-Clearing Vehicle BAT-M



SYSTEM

Alternative Designations: Dozer
Date of Introduction: 1967
Proliferation: Widespread

Description:
Crew: 2
Chassis: AT-T heavy tracked artillery tractor
Weight (mt): 26
Length Overall (m): 10
Height Travel (m): 3.5
Width Overall (m): 4.7
Clearance (mm): 425
Gradient (°): 30
Trench Crossing (m): 1.57
Fording Depth (m): .7
Vertical Step (m): 1
Time from Travel to Operating Position (min): 5 to 7

AUTOMOTIVE

Engine: V12, 415 hp, diesel
Cruising Range (km): 500
Speed (km/h): 35
Navigation Equipment: No
NBC Protection: Yes
Radio: INA

BLADE

Width (m): 4.8
Blade Rate (m^3/hr): 250
Operating Speed (km/h): 10

ROTARY CRANE

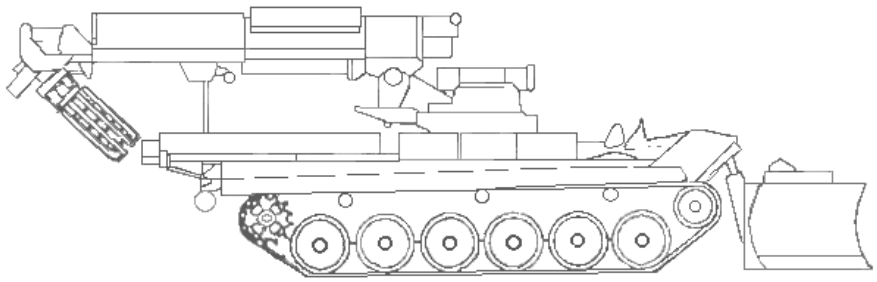
Capacity (mt): 2

VARIANTS

BAT
BAT-2: Based on MT-T artillery tractor

NOTES
The BAT tractor dozer is an AT-T heavy tractor with a large dozer blade mounted at the front of the hull. It is designed for general engineer use, road and trail clearing and construction. The BAT-M is an improved model (over the BAT) and is electro-hydraulic, whereas the BAT is electro-pneumatic. The BAT-M also has a hydraulic crane, and the dozer blade can be swung to the rear improving the vehicle's load distribution when in traveling mode.

Russian Obstacle Clearing Vehicle IMR-2M



SYSTEM

Alternative Designations: N/A
Date of Introduction: 1982
Proliferation: FSU and former Warsaw Pact armies

Description:
Crew: 2
Chassis: T-72A
Weight (mt): 44.3
Length (traveling) (m): 9.55
Height (traveling) (m): 3.68
Width (traveling) (m): 3.73
Gradient (°): 25
Fording Depth (m): 1.2
System Components: Multipurpose dozer equipment, boom, treadway mine exploder

AUTOMOTIVE

Engine: 12 cyl, 840 hp, diesel
Cruising Range (km): 500
Speed (km/h): 60
Night Driving Equipment: Yes
Radio: R-173 radio, R-174 intercom
NBC Protection System: Yes
Smoke Screening System: INA

BLADE

Can be used as a dozer, grader and V-blade, vertical plane skew ability.
Operating Speed (bulldozer) (km/h): 8-12
Earth Displacement (m^3/hr): 300
Lane Clearing Rate (km): .35

ALL-PURPOSE TOOL

Trench Digging (1.1 to 1.3m deep)(m^3/hr**):** 8-10
Pit Digging (up to 2.5m deep) (m^3/hr)**:** 12-16

BOOM

Capacity (mt): 2
Reach (m): 8.4

MINE SWEEPING SPEED (km):

AT pressure mines: 6-15
Tilt Rod mines: 7

VARIANTS

IMR: The IMR is a NBC-protected, combat engineer vehicle based on the T-54/55 tank chassis. It is fitted with an articulating dozer blade and a telescoping crane that fits a number of attachments.
IMR-2: Equipped with mine sweepers and mine-clearing extended charges. Line drawing is of IMR-2.

NOTES
The IMR-2M differs from the IMR-2 in that the IMR-2M has no line-launched mineclearing charge. The IMR-2M has more armor, hydraulic equipment and a scraper-ripper.

Russian Engineer Reconnaissance Vehicle IRM

Weapons & Ammunition Types	Typical Combat Load
7.62-mm PKT MG Lt Ball, Ball-T API, API-T	**2,000**

SYSTEM
Alternative Designations: *Zhuk* (Beetle)
Date of Introduction: 1976
Proliferation: Former Soviet Union

Description:
Crew: 6 (commander, driver, 4x dismountable engineers),
Chassis: Based on the BMP-1 chassis (7 road wheels instead of 6 on BMP-1)
Weight (mt): 17
Length (m): 8.2 (detector arms in travel mode)
Height (m): 2.4
Width (m): 3.1
Ground Pressure (kg/cm^2): 0.69
Gradient (°): 36
Side Slope (°): 17
Fording Depth (m): Amphibious
Trench Crossing (m): 2.3
Vertical Step (m): .65

AUTOMOTIVE
Engine Type: Diesel
Engine Horse Power: 300
Cruising Range (km): 500
Speed (km/h):
On Road: 52
Swim: 12
Swim Capability (sea state): 3
Reserve Buoyancy (%): 14
Night Driving Equipment: Yes
Navigation Equipment: Yes (see Recon and Nav)
Radio: Onboard and 2 x R-147 (dismount)
NBC Protection System: Yes, collective protection system
Smoke Screening System: Vehicle engine exhaust smoke system (VEESS)

ARMAMENT
Caliber, Type, Name: 7.62-mm (7.62x 54R) Machinegun PKT
Mount Type: Turret
Max Aimed Range (m): 1,300
Max Effective Range (m):
Day: 1,000 / 400-500 on the move
Night: 800
Fire on Move: Yes
Rate of Fire: 250 rpm (practical, in 2-10 round bursts)

MINE DETECTING CAPABILITY
Two extendable arms for mine detecting. The mine detector arms are hydraulically articulated to their operating position in three minutes. The detector will bring the vehicle to a halt upon encountering an obstacle or detecting a metallic object.
Handheld mine detectors (2)
AT Mine Detection Zone (m)
Width: 3.6
Depth: .3
River-type wide-span mine detector: RShM-2 (detects mines planted depth of .3m with current velocity of 3-5 km/h).

RECONNAISSANCE AND NAVIGATION
Rate of Recon (km/h):
Route Recon: 8-10
Mines: 5
Water Obstacle (100m) (min): 5
A PIR-451 periscope is mounted on the right front of the vehicle at the commander's station. It can extend to 1.5 meters and can move vertically up to 750 mm.
Equipment:
Mechanical penetrometer (to analyze soil for trafficability)
Sonar (echo sounder with an auto recorder and three hydro-acoustic transducers) .5 to 20 m (for water bottom profiles, mine and obstacle detection)
Gyrocompass and gyro-stabilized artificial horizon: AGI-1s
Surveillance and night observation equipment: TNPO-160, TNP-370, TVN-2BM
Navigation: Inertial with constant coordinate and direction readout: TNA-3
IR searchlight is mounted to the right of the PKT MG.
Equipment for dismounted engineers:
Digital Camera
Portable Periscope: PIR-T. The 15x periscope is used primarily for detailed studies of enemy structures and obstacles.
Soil Penetrometer, portable
Ice Drill
Laser Rangefinder
Thermal Viewer, handheld
GPS Receiver, handheld
Mine detectors, portable: RVM-2M and IMP-2
Radios, Handheld: R-147 (x2)

VARIANTS
IPR: Very similar to the IRM except it has a folding snorkel on the rear deck. Thus it may be able to operate on the bottom of rivers and lakes.

NOTES
The IRM engineer reconnaissance vehicle conducts reconnaissance of routes, fords, water barriers (velocity, depth, underwater obstacles, and bottom profile and density), ice, mapping, and overall terrain trafficability. Its chassis employs components of the BMP-1 IFV. It has two propellers on the rear of the hull for propulsion in the water. A wave deflector covers the front of the hull. The IRM has an emergency extraction/self-recovery system available which allows the vehicle to quickly extract itself when stuck in mud, etc without having the crew exit the vehicle. The system consists of two racks of 12 rockets each mounted on the rear deck between the propellers. This rocket propulsion system is especially valuable if the vehicle is stuck when under enemy fire.

Czechoslovak Armored Vehicle-Launched Bridge MT-55A

SYSTEM

Alternative Designations: None
Date of Introduction: 1970
Proliferation: At least 20 countries.
Description:
Crew: 2
Chassis: T-55A Tank (modified)
Weight (mt): 36
Length with Bridge (m): 9.90
Height with Bridge (m): 3.35
Width with Bridge (m): 3.30
Ground Clearance (mm): 425
Gradient (°): 30
Fording Depth (m): 1.4
Vertical Step (m): .7
Trench (m): 2.7

VARIANTS
None

AUTOMOTIVE

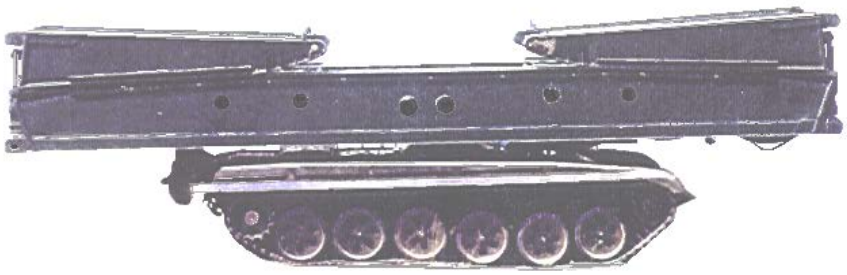
Engine: V-12 Diesel, 580 hp
Cruising Range (km): 690
Speed (km/h):
Max Road: 32-35
Average Cross-Country: 16-20
Radio: R-123
Self-Entrenching Blade: No
NBC Protection System: Yes
Smoke Equipment: Vehicle engine exhaust smoke system.

BRIDGE

Type: Scissors
Capacity (mt): 50
Width of Obstacle (m): 17
Width (m): 3.3
Length Opened (m): 18
Weight (kg): 6.5
Emplacement Time (min): 2
Displacement Time (min): 5-6

NOTES
The MT-55A has a gap measuring device and infrared equipment for bridge-laying at night. It can also launch the MT-72 bridge.

Russian Armored Vehicle-Launched Bridge MTU-72



SYSTEM

Alternative Designations: None
Date of Introduction: 1974
Proliferation: At least one country.
Description:
Crew: 2, Commander and driver
Chassis: T-72S
Weight (mt): 40
Length with bridge (m): 11.64
Height with bridge (m): 3.38
Width with bridge (m): 3.46
Ground Clearance (mm): 49
Gradient (°): 31
Side Slope (°): 22
Fording Depth (m): 1.2
Fording Width (m): 1000
Vertical Step (m): .85
Trench (m): 2.8

VARIANTS
None

AUTOMOTIVE

Engine: 840 hp Diesel
Cruising Range (km): 500
Speed (km/h):
Max Road: 60
Max Off-Road: 45
Average Cross-Country: 35
Radio: R-173 and R-134
Self-Entrenching Blade: Yes
NBC Protection System: Yes
Smoke Equipment: Vehicle engine exhaust smoke system.

BRIDGE

Type: Cantilever
Capacity (mt): 50
Width of Obstacle (m): 18
Width (m): 3.55
Length Opened (m): 20
Weight (kg): 6,400
Emplacement Time (min): 3
Displacement Time (min): 8

NOTES
The crew is armed with a light machine gun, a submachine gun, and hand grenades for protection.

Russian Self-Propelled Amphibious Ferry PMM-2

SYSTEM

Alternative Designations: None
Date of Introduction: 1983
Proliferation: At least four countries.
Description:
Crew: 3
Chassis: Based on amphibious version of the Kharkov T-64 (same as MT-T transporter, PTS-2 tracked amphibian)
Load (mt) (water): 42.5
Weight (mt): 36
Length with bridge (m): 13.5
Width with bridge folded/open (m): 3.5/10.5
Height with bridge folded (m): 3.85
Ground Clearance (m): .4
Approach Angle (°): 25
Departure Angle (°): 25
Minimum Operating Depth (m): 1.3
Airdrop/Air Transportable: No

AUTOMOTIVE

Engine: V-64-4 V-12 710 hp Diesel
Cruising Range (km): 500 (est)
Speed (km/h):
Max Road: 55
Water: 10 (Two propellers)
NBC Protection System: Probable

BRIDGE

Type: SP Ferry
Capacity (mt): 42.5
Obstacle Gap (m): 20
Deck Length Opened One (m): 10
Loading Ramps (2) width ea (m): 5
Deck Width Opened (m): 4.2
Emplacement Time Approx (min): 5

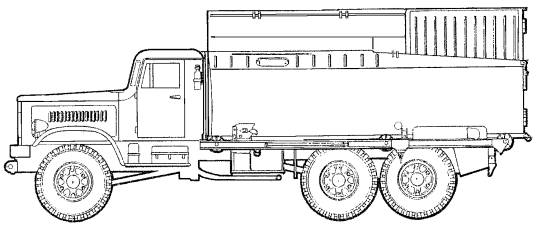
VARIANTS
Amphibious Bridging System-Wheeled (ABS-W)

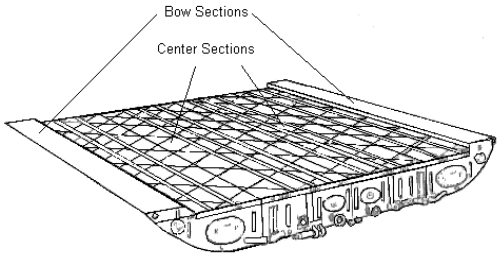
Remarks: When unfolded the PMM-2 creates a raft that can carry a main battle tank without further assistance or construction. While two systems can be combined to form an 85-ton capable ferry, the PMM-2 does not form float bridges.

On top of the hull, the system has two large box pontoons carried one atop the other. They are hinged to hydraulically unfold to either side of the hull for water operations. Small tread way ramps are folded on the pontoons. The unfolded pontoons have wave deflectors, as well as ramps to expedite the loading and unloading of vehicles.

NOTES
The PMM-2 replaces the GSP and has one main advantage as a ferry over the GSP: whereas two GSP half-ferries must be joined together to produce one ferry with a capacity of 50 metric tons, one PMM-2 can handle approximately the same capacity–eight PMM-2 vehicles can form eight separate ferries or four large ferries (85-ton capacity). The PMM-2 bears great similarity to the PTS-2 tracked amphibian, with its cab and boat-like bow. The chassis is similar to that of the MT-T artillery prime mover, with seven road wheels and four return rollers.

Russian Heavy Folding Pontoon Bridge PMP





SYSTEM

Alternative Designations: Ribbon bridge
Date of Introduction: 1961
Proliferation: Over 20 countries.
Description:
Crew: See Assembly Data
Chassis: KraZ-255B

BRIDGE

Type: Pontoon
Total Length of Bridge (m): 227
Capacity/Load Class (mt): 60
Roadway Width (m): 6.5
Working Party: Varies - approx. 65 for full bridge set. See RAFT ASSEMBLY DATA
Material: SKhL-4 steel
Pontoons in Set: See NOTES
Bridge/center: 32
Ramp/shore: 4
Bridge Pontoons:
Weight (kg): 6,790
Length (m):
- Unfolded: 6.75
- Folded: 6.75

Width (m):
- Unfolded: 8
- Folded: 5

Depth Unfolded (m):
- Bow Section: .9
- Center Section: .7
- Folded: 2

Ramp Pontoons
Weight (kg): 7,252
Length (m):
- Unfolded: 5.6
- Folded: 5.6

Width Unfolded (m):
- River End: 7.3
- Shore End: 7
- Folded: 3.1

RAFT ASSEMBLY DATA

40-Ton Raft-Bridge
Pontoons: 2
- Overall Deck Length (m): 13.5
- Assembly Time (min): 8
- Working Party (est.): 6

60-Ton Raft-Bridge
Pontoons: 3
- Overall Deck Length (m): 20.3
- Assembly Time (min): 10
- Working Party (est.): 9

80-Ton Raft-Bridge
Pontoons: 4
- Overall Deck Length (m): 27
- Assembly Time (min): 12
- Working Party (est): 12

NOTES
Although the complete PMP ribbon bridge set consists of 32 center pontoons and 4 ramp pontoons, the normal bridge unit consists of a half-set (one complete bridge) made up of 16 center and 2 ramp pontoons. Each 4-section is launched from the KrAZ-255B. It automatically unfolds upon entering the water. The sections then lock in place to form a bridge unit 6.75 meters long and 8 meters wide. Normally, all the units are launched simultaneously. They join together parallel to the near shore to form a continuous roadway. The roadway then swings across the water obstacle; powerboats (6 per half-set) hold it in place on the designated centerline.

Engineers can use the full 36-pontoon set to construct 227 meters of bridge. They may also configure it as 40- to 170-ton rafts. A half-set gives the capability to construct 119 meters of 60-ton bridge, 191 meters of 20-ton bridge, or rafts. Under ideal conditions assembly speeds of 7 meters of bridge per minute can result. This bridge can be built in streams with a velocity of up to 2 meters a second (approx. 7 km/h).

Russian Heavy Folding Pontoon Bridge PMP continued _____

RAFT ASSEMBLY DATA continued

110-Ton Raft-Bridge
Ramp Pontoon: 1
Bridge Pontoons: 5
Overall Deck Length (m): 39.3
Assembly Time (min): 15
Working Party (est.): 18

170-Ton Raft-Bridge
Ramp Pontoon: 1
Bridge Pontoons: 8
Overall Deck Length (m): 59.6
Assembly Time (min): 15
Working Party (est.): INA

AUXILIARY EQUIPMENT
Powerboats or tracked amphibians: 12

LAUNCH SEQUENCE

1. The travel locks are disengaged, the pontoon carrier backs to the edge of the water, brakes sharply, and then the pontoon slides over the carrier roller system into the water where it unfolds almost immediately.

2. The pontoon is then stiffened by activating six locking devices.

3. Once the pontoons have been launched and stiffened they are interconnected parallel to the near shore to form a continuous strip of roadway.

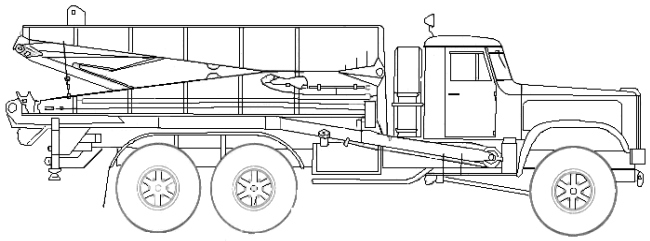
4. This roadway is then swung across the water obstacle and held in place by powerboats.

Whenever possible the launching operations are done along a continuous shoreline permitting all pontoons to be launched at the same time. If necessary, the bridge can be built on a small frontage using the successive raft system. This slows construction time.

RETRIEVAL

For retrieval the launch operation is reversed. The pontoon carrier backs to the water's edge, an integral jib is unfolded from the truck bed, and two cables are strung from the winch (located behind the driver's cab) through the jib pulleys, around the pontoon retrieving guides, and secured to the pontoon retrieval studs. The winch simultaneously folds and lifts the pontoon to the truck bed. The jib is then folded back into the truck bed, and the pontoon is winched over the roller system and secured. The whole procedure takes but a very few minutes.

Russian Truck-Mounted Scissors Bridge TMM



SYSTEM

Alternative Designations: Mechanized Bridge, Scissors Bridge
Date of Introduction: 1964
Proliferation: At least 20 countries
Description:
Crew: See working party
Chassis: Modified KrAZ-214 (6 × 6), 7,000 kg, or KrAZ-255B (6 × 6), 7,500 kg, and KrAZ-260 trucks.
Weight (mt): 19
Length with bridge (m): 9.3
Height with bridge (m): 3.15
Width with bridge (m): 3.2
Ground Clearance (mm): 360
Gradient (°): 0
Fording Depth (m): 1

BRIDGE

Type: Truck-mounted scissors
Capacity/Load Class (mt): 60
Material: Low alloy steel
Width (m):
Unfolded: 3.8
Folded: 3.2
Weight (kg): 4.24
Pier: (TMM on KrAZ-255)
Height (m):
Min: 1.7
Max: 3.21
Ground Area (m^2/pier): 2.4
Weight (m): 1.15
Lowering Method: Cable release
Raising Method: Hand winch
Locking Method: Manual

ASSEMBLY DATA

Spans in Set: 4
Length of 1 Span (m):
Unfolded: 10.5
Folded: 5.2
Total Length of Bridge (m): 42
Obstacle Span (m):
Span: 9.4
Depth: 3
Roadway Width (m):
Closed: 3.2
Extended: 5.2
Assembly Time (min): 20-40
1 Span: 8-15
4 Spans: 30-60
Recovery Time (min): Same as assembly
Working Party: 3 per span/12 total

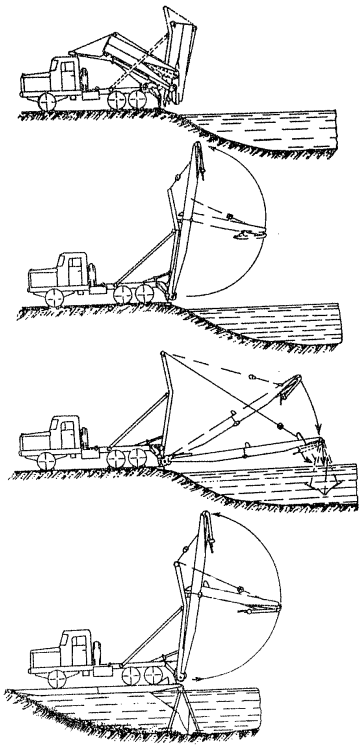
VARIANTS

TMM-3: KrAZ-255B 6 x 6 improved bridgelaying mechanism.
TMM-6: MAZ-543 8 × 8 truck with 17 m bridge spans (unfolded).

NOTES
The TMM is a multiple-span, trestle-supported, scissors-type, treadway bridge. One bridge set comprises four 10.5 meter, spans carried on, and launched from specially modified trucks. Spans fold in half for transport. Three of the spans have integral-mounted adjusted (1.7 to 3.2 meters) trestle legs, while the fourth (far-shore) span has none.

During travel, the trestles can fold beneath the scissors plan. A launching girder mounted on the truck bed launches the TMM hydraulically over the tailgate. Assisted by winch cables and pulleys, the girder raises, unfolds, and emplaces the span with the folding trestle legs. If necessary the TMM can be laid underwater. This requires about 50% more emplacement time.

Russian Truck-Mounted Scissors Bridge TMM continued



LAUNCH SEQUENCE

1. Truck backs into position.

2. A hydraulic launching girder raises the folded span to the vertical position.

3. The span is straightened by a cable/winch system, and then is lowered with the integral trestle legs swinging into position.

4. Once the lowering operation is completed, the cables are disconnected, the launching girder is brought to travel position, and the truck moves off.

Chapter 9
Command and Control Systems

This chapter provides basic characteristics of selected tactical command and control (C^2) systems either in use or readily available to the OPFOR. Critical C^2 equipment includes communications systems, as displayed in the Table 1 on page 9-2.

Many foreign militaries are leveraging advances in automated technologies in order to use increasing amounts of data across all warfighting capabilities. Increases in processing power and broadband technologies through commercial research and development make real time situational awareness and communications on the move a tangible objective for many foreign forces. The emergence of rudimentary Integrated Battlefield Management Systems (IBMS) in tier three forces represents this global trend. Net Centric operations are viewed worldwide as a key element of modern military operations, an IBMS is a system that integrates multiple command and control formats as well as sensor data into one display that improves situational awareness through multiple sources.

There are a variety of technologies available to achieve improved situational awareness through network enabled battlefield systems. Foreign forces will incorporate various modern systems into the C^2 structure and will rely on manual operators to fuse them to legacy systems.

Incorporating commercial telecommunications and internet service to meet strategic, operational and tactical objectives represents one of the most important aspects of the foreign forces information warfare (INFOWAR) campaign. In tier one and tier two forces, the level of automated interoperability can be integrated across many levels of command through domestically produced systems designed for military use. These systems are equivalent to friendly system capabilities. This selection of systems is not intended to be complete; rather, it is representative of the types and capabilities that are currently fielded or available.

Command systems in the WEG are initially limited to command vehicles, such as the listed BMP-1KSh. For additional information on vehicles, see Vehicle Upgrade Table, Ch. 15.

While the focus of the communications equipment for this chapter is primarily tactical communications systems and the more recently fielded IBMS systems, this chapter does include limited information on satellite communication systems (SATCOMs), navigation (NAV) systems, and weather systems. Satellites have added a new dimension to the battle space in the past few decades especially in terms of SATCOM and NAV capabilities.

There are currently over a thousand operating satellites orbiting the earth, with more than half having a primary mission of supporting communication and navigation efforts both commercially and militarily world-wide. See the Tables 2-4 for specific information on examples of these satellites, their owners/operators, and users.

Questions and comments on data listed in this chapter should be addressed to:

Ms. Jennifer Dunn
DSN: 552-7962 Commercial (913) 684-7962
e-mail address: jennifer.v.dunn.civ@mail.mil

Table 1: Tactical Communications Systems

System	Country of	Description	Frequency Range	Digita	FH?	Range (km)	Power Output
Panther-V	UK	Vehicle/Manpack VHF/UHF	30-108	Yes	Yes	50	50W
Jaguar-V	UK	Vehicle/Manpack VHF	30-88	Yes	Yes	50	50W
R163-50U	Russia	Vehicle VHF	30-80	Yes	No	40	30W
R173M	Russia	Vehicle VHF	30-80	No	No	30	20W
M3TR	GE	Vehicle/Manpack HF/VHF/UHF	1.5-512	Yes	Yes	50	50W
RF5000	US	Vehicle HF	1.6-30	Yes	Yes	75	400W
XK2000	GE	Vehicle HF	1.5-30	Yes	No	75	150W
R123M	Russia	Vehicle HF/VHF	20-52	No	No	30	22W
Panther-P	UK	Hand-held Squad/Platoon Radio	30-88	Yes	Yes	10	5W
TRC5102	France	Hand-held Squad/Platoon Radio	30-88	Yes	No	7	2W
ACH42	S. Afr.	Hand-held Squad/Platoon Radio	45-68	No	No	7	2W
R31K	Bulgaria	Hand-held Squad/Platoon Radio	44-54	No	No	5	1W
RL402	Swe/Nor	MMW Radio Relay	225-1850	Yes	Yes	Network	N/A
R423-1	Russia	Troposcatter Relay System	4400-4700	No	N/A	Network	N/A
KSR8	Hungary	Microwave Relay System	8000	Yes	N/A	Network	N/A
R161-5	Russia	HF Radio Station	1.5-30	No	No	3000	5kW
Scimitar-H	UK	HF SPF Radio	1.6-30	Yes	Yes	500	20W
PRC138	US	HF SPF Radio	1.6-80	Yes	Yes	500	20W
PVS5300	UK	HF SPF Radio	2-30	Yes	No	500	20W
PRC104	US	HF SPF Radio	2-30	No	No	500	20W

Table 2: Communication Satellites

Name of Satellite System	Country of Operator/Owner	Users	Class of Orbit	Comments
Amos	Israel	Military/ Commercial	GEO	C-band, Ku-band, and Ka-band transponders.
Apstar	China	Commercial	GEO	C-band and Ku-band transponders.
AsiaSat	China	Commercial	GEO	C-band and Ku-band transponders.
Chuangxin	China	Government	LEO	Prototype of advanced telecommunications satellite for LEO.
Express	Russia	Commercial	GEO	C-band, Ku-band, and L-band transponders.
Gonets	Russia	Commercial/Government	LEO	UHF.
Meridian	Russia	Military	Elliptical	C-band transponders.
Raduga	Russia	Military	GEO	C-band transponders.
Rodnik	Russia	Military	LEO	UHF.
Thuraya	United Arab Emirates	Commercial	GEO	C-band and L-band transponders.
Yahsat (Y1A)	United Arab Emirates	Military/ Commercial	GEO	C-band, Ku-band, and Ka-band transponders.
Zhongxing	China (PR)	Military/Government	GEO	Ku-band transponders.

Table 3: Navigation Satellites

Name of Satellite System	Country of Operator/Owner	Users	Comments	Class of Orbit
Beidou	China	Military	Navigation/Global Positioning	GEO
Compass	China	Military	Navigation/Global Positioning	GEO
Glonass	Russia	Military/Commercial	Navigation/Global Positioning	MEO
Parus	Russia	Military	Navigation	LEO

Table 4: Weather Satellites

Name of Satellite System	Country of Operator/Owner	Users	Comments	Class of Orbit
Electro	Russia	Government	Meteorology	GEO
Haiyang	China	Government	Meteorology	LEO
Meteor	Russia	Government	Meteorology	LEO

Note: Additional information exists for all these satellites to include perigee, apogee, eccentricity, inclination, period, mass, power, launch site, and launch vehicle and is available on request.

Norwegian Tactical Communications System Eritac

SYSTEM
Alternative Designations: Eritac

Date of Introduction: 1999

Proliferation: Oman, Kuwait, Egypt, Saudi Arabia, Croatia, Romania

SYSTEM
Description:
KONGSBERG's tactical communications system EriTac is a high-capacity, autonomous, distributed switching system. Voice and data capability integrated from the strategic to the tactical level.

Topology and Network Characteristics. Compatible with bus, star, ring and mesh topologies. Requires minimal network information to configure due to saturation routing principles for switched connections. Plug and play configuration reduces setup time.

Performance:

Data Rates:

HF: Combat Net radio 2 kbps

VHF: Combat Net Radio 16 - 64 kbps

UHF: Broadband IP radio 2 Mbps

UHF Broadband and fiber optic ethernet backbone for transport to higher echelons: 100 Mbps

Supported by both wireless and wired gateways

Security:
Encrypted, Frequency Hopping Spread Spectrum Transmission capable, Electro Magnetic Pulse (EMP) hardened.

Components Backbone:
IPX600: Connects Eritac Network to IP and TDM Network

RL532: Radio transmitter link for Eritac network

Components Tactical Local Area Network:
TR600: Tactical Gateway and Router between local and remote Combat net Radios

WM600: IP Based Radios
Frequency Range: 225 to 400 MHz

Communications: Automatic selection of link for every Data Rate and service (HF-UHF-VHF-Sat), based on required Quality of Service

Frequency band Types:
HF/VHF/UHF/SHF

Communications Transmission Platforms:
CNR/HCLOS/WLAN/SATCOM/ Fiber Optics

Pakistani Integrated Battlefield Management System (IBMS)

SYSTEM
Alternative Designations: Horus

Date of Introduction: 1990's

Proliferation: Possibly 2 countries

SYSTEM
Description:
The Integrated Battlefield Management System (IBMS) provides the Pakistani military a BMS that capable of providing near real time battlefield situational awareness (SA) data through an integrated network of both mobile and fixed nodes.

Wireless SMS Messaging:
Exchange SMS target information via general packet radio service (GPRS)

VHF/UHF : Digital signal multiband interoperability

High speed UHF and fiber optic backbone for transport to higher echelons

Multi Tiered Command and Control Across Multiple Communications Infrastructures

Supported by both wireless and wired gateways

Provides authenticated access control at various echelons depending on the operational necessity

Situational Awareness Features:
It uses GNSS based updates and displays all vehicles registered in the network. Includes real time status and decision point warnings.
It relies on a modern GNSS (GPS/GLONASS/ COMPASS) for positioning data. Terrestrial navigation systems can use time difference between the receipt of radio signals to increase the accuracy of the location data when the GNSS signal is degraded

Vehicle Management : Records routes of registered vehicles

Command and Control Console:
Adds and deletes vehicles for specific tasks
Associates vehicle echelon with assigned domains
Provides situational alerts

Geographical Information System:
Multi layered electronic overlays
Map manipulation features
Zoom in pan out rotate maps and graphics
Navigation, speed and distance calculation

Security: Encrypted

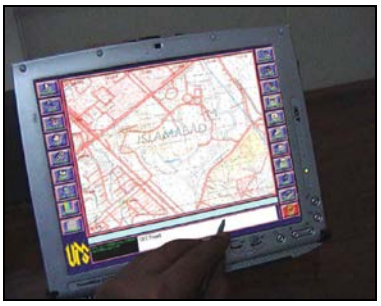
Components:
Central command center contains access points to the wide area subsystem, compatible with all modes of communication including fiber links

Static and mobile management centers include routers and radio access points (RAP) to backbone

Tracking devices are installed in weapons platforms (including Al Khalid and Al Zarrar MBTs).

COMMUNICATIONS
Frequency band Types: HF/VHF/UHF/SHF

Communications Transmission Platforms: CNR/HCLOS/ WLAN/SATCOM/ Fiber Optics



NOTES
INA

Russian Command and Staff Vehicle BMP-1KShM

Weapons & Ammunition Types	Typical Combat Load
Stowed 7.62-mm MG	**2,000**

SYSTEM
Alternative Designations: "Potok"- 2
Date of Introduction: 1976
Proliferation: Bulgaria, China, Czech Republic, Poland, and Sweden
Description:
Crew: 1 plus vehicle/staff commander (included below)
Troop Capacity: Staff 4-6 (total vehicle capacity 5-7)
Chassis: BMP-1
Combat Weight (mt): 13.3
Length Overall (m): 6.74
Height Overall (m): 2.15
Width Overall (m): 2.94
Ground Pressure (kg/cm^2): 0.57

Automotive Performance:
Engine Type: Diesel
Cruising Range (km): 600
Speed (km/h):
- Max Road: 65
- Max Off-Road: 40-45
- Average Cross-Country: INA
- Max Swim: 7

Fording Depths (m): Amphibious

Command: Normal configuration for **r**ear compartment has 2 officer workstations and two radio operator consoles.

Communications:
Radios, frequency, and range:
- R-168-5KVE 1.5-30 MHz (HF), voice/digital, 10-300 km
- R-168-25UE 30-108 MHz (VHF),voice/digital, 20-40 km
- R-168-100UE 30-80 MHz (VHF), voice/digital, 30-60 km
- 2 x R-168-5UN(1)E 30-108 MHz (VHF), man pack, 10-25 km
- R-168-5KNE 1.5-30 MHz (HF), voice/digital, 10, 40, 300 km
- R-438 satellite comms system, data exchange up to 5,000 km

Command level: Division, Regiment, Brigade and Battalion
Intercoms: 2
Communications links: 1-12
Encryption: R-168MVE Masking devises, E-9U Secure transmission equipment.
Digital navigation monitor: Yes, GLONASS,1G11N gyrocompass
Graphic display: Yes
Automated networks: Yes
Emplace Time (min): 2-3
Vehicle can communicate on the move: Yes
CP can operate autonomously/in network: Yes/Yes

Communications (cont):
4 x AT-3031Telephones
Onboard generator: 5kW hull (rear) mounted
Whip antennae for mobile comms: 1 HF whip, 3 VHF Whips
Other antennae: VHF discones masted, HF dipoles and 11-m mast

Options:
spall liners, air conditioning, and a more powerful engine

ARMAMENT
Main Armament: (Caliber, Type, Name: 7.62-mm (7.62x 54R) MG, PKM, stowed Rate of Fire (rd/min): 250 practical / 650 cyclic, 2-10 round bursts
Loader Type: Belt-feed (100-rd belts)
Ready/Stowed Rounds: INA
Elevation (°): INA
Fire on Move: No

ATGM Launcher: N/A

Firing Ports: None

SIGHTS
Type: INA
Sighting range (m): 1,500
Magnification: INA
Night Sights Available: Yes

ARMAMENT AMMUNITION
Caliber, Type, Name:
7.62-mm API, API-T
- Maximum Aimed Range (m): 1,500
- Max Effective Range (m):
  - Day: 1,000/400-500 on the move
  - Night: INA
  - Tactical AA Range: INA
- Armor Penetration (mm): 8 (RHA) at 500 m

Other Ammunition Types: Light Ball/Ball-T, Heavy Ball

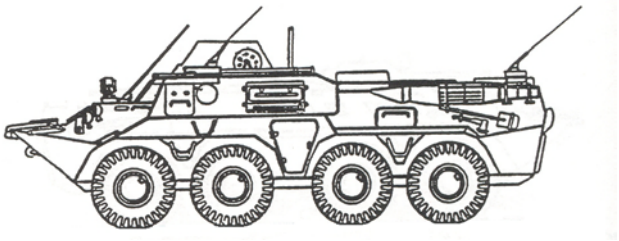
VARIANTS

BMP-1KSh: Legacy system regiment or division command and staff vehicle, with turret mounted erectable 10-meter radio mast. Radios include R-130 HF, R-107, R-111 VHF, R-123/173 VHF**.**

MP-31 and **1V31** use different radio configurations for fire control.

NOTES
For stationary long-range transmissions, HAWK EYE 10-meter folding discones masted antenna is removed from carrying case on right side of vehicle and inserted into antenna base, which extends forward from the turret.

Russian Command and Staff Vehicle Kushetka-B



Weapons & Ammunition Types	Typical Combat Load
Stowed 7.62-mm MG	**2,000**

SYSTEM
Alternative Designations: R-149BMR
Date of Introduction: 1990s
Proliferation: At least 1country
Description:
Crew: 1 plus vehicle/staff commander (included below)
Troop Capacity: Staff 4-6 (total vehicle capacity 5-7)
Chassis: K1Sh1 version UnSh wheeled 8 X 8 derived from BTR-80
Combat Weight (mt): 13 est
Chassis Length Overall (m): 7.65
Height Overall (m): 2.63
Width Overall (m): 2.90

Automotive Performance:
Engine Type: 260-hp Diesel
Cruising Range (km): 600
Speed (km/h):
- Max Road: 80
- Max Off-Road: 50
- Average Cross-Country: 30
- Max Swim: 9

Fording Depth (m): Amphibious

Command: Normal configuration for **r**ear compartment has 2 officer workstations and two radio operator consoles.

Communications:
Radios, frequency, and range:
- R-173M 30-80 MHz (VHF), standard vehicle type, 20 km
- R-171M 30-76 MHz (VHF), duplex, voice/digital, 35-80 km
- R-163-50, R-163 UP 30-80 MHz (HF), voice/digital, 20-60 km
- R-163-10V 2-30 MHz (HF'/VHF), voice/telegraph, 10-30 km
- 2 x R-163-1V HF/ VHF portable short-range units
- R-438 satellite comms system, data exchange up to 5,000 km

Command level: Division, brigade, and battalion
Intercoms: 2
Communications links: 1-12
Encryption: Yes, E-24D
Digital navigation monitor: Yes, GPS
Graphic display: Yes
Automated networks: Yes
Emplace Time (min): 2-3
Vehicle can communicate on the move: Yes
CP can operate autonomously/in network: Yes/Yes
Onboard generator: Yes
Whip antennae for mobile comms: 2 HF whips, 3 VHF
Other antennae: VHF discones masted, HF dipoles and 11-m mast

Protection:
Armor, Turret Front (mm): Against 12.7-mm rounds
Applique Armor (mm): N/A
Explosive Reactive Armor (mm): N/A
Active Protective System: N/A
Mineclearing Equipment: N/A
Self-Entrenching Blade: N/A
NBC Protection System: Collective
Smoke Equipment: VEESS, 6 x 81-mm smoke grenade launchers

ARMAMENT
Main Armament: (turret mount)
Caliber, Type, Name: 7.62-mm (7.62x 54R) MG, PKM
Rate of Fire (rd/min): 250 practical / 650 cyclic, 2-10 round bursts
Loader Type: Belt-feed (100-rd belts)
Ready/Stowed Rounds: INA
Elevation (°): INA
Fire on Move: Yes
Firing Ports: Yes

SIGHTS
Type: INA
Sighting range (m): 1,500
Magnification: INA
Night Sights Available: Yes

VARIANTS
The vehicle shares the same configuration as BMM medical vehicles and the 1V152/Kapustnik-B ACRV. Other less similar users of the UnSh/1KSh1chassis include the BREM-K recovery vehicle and several radio and IW vehicles.

MAIN ARMAMENT AMMUNITION
Caliber, Type, Name:
7.62-mm API, API-T
- Maximum Aimed Range (m): 1,500
- Max Effective Range (m):
  - Day: 1,000/400-500 on the move
  - Night: INA
  - Tactical AA Range: INA
- Armor Penetration (mm): 8 (RHA) at 500 m

Other Ammunition Types: Ball-T, Heavy Ball

Russian R-142 NSA, Command and Control Vehicle

Photo by: Vitaly Kuzmin

SYSTEM

Alternative Designations: INA
Date of Introduction: 1980
Proliferation: Russia,

Communications:
Radios, frequency, and range:
R-173M 30-80 MHz (VHF), standard vehicle type, 20 km
R-171M 30-76 MHz (VHF), duplex, voice/digital, 35-80 km
R-163-50, R-163 UP 30-80 MHz (HF), voice/digital, 20-60km
R-163-10V 2-30 MHz (HF'/VHF), voice/telegraph, 10-30 km
2 x R-163-1V HF/ VHF portable short-range units
R-438 satellite comms system, data exchange up to 5,000 km
Command level: Division, brigade, and battalion
Intercoms: 2
Communications links: 1-12
Encryption: Yes, E-24D
Digital navigation monitor: Yes, GPS
Graphic display: Yes
Automated networks: Yes
Emplace Time (min): 2-3
Vehicle can communicate on the move: Yes
CP can operate autonomously/in network: Yes/Yes
Onboard generator: Yes
Whip antennae for mobile comms: 2 HF whips, 3 VHF
Other antennae: VHF discones masted, HF dipoles and 11-m mast

Description:
Troop Capacity: 3 in cab, 18 in rear
Weight (mt):
Gross Vehicle Weight: 7
Curb: 3.6
Length Overall (m): 7.73
Height Overall (m): 3.375
Width Overall (m): 3.34
Payload on/off Highway (kg): 6,000
Number of Axles: 3
Ground Clearance (mm): 550
Turning Radius (m): 10
Wheels:
Size (mm): 533 X 610
Central Tire Pressure Regulation System: Yes

AUTOMOTIVE

Engine: V8, 165 hp, diesel turbocharged
Cooling: Water
Cruising Range (road) (km): 1000
Speed (km/h): 85
Fuel Capacity (liters):
Left Tank: 120
Right Tank: 120
Towing Capability (kg):
Off Highway: 2,000
On Highway: 7,000
Gradient (loaded) (°): 31
Fording Depths (m): .5

CARGO SPACE

Height (mm): 890
Width (mm): 2,470
Length (mm): 4,890
Cargo Bed Area (m^2): ~ 12

VARIANTS

KamAZ-43101: More powerful 220hp engine
Numerous other variants for various duties.

NOTES
Besides functioning as a command and control vehicle, the R-142 can perform various EW functions.

Chapter 10
Information Warfare Systems

INFOWAR is defined as specifically planned and integrated actions taken to achieve an information advantage at critical points and times. The goal is to influence an enemy's decision-making through his collected and available information, information systems, and information-based processes, while retaining the ability to employ friendly information, information-based processes, and systems to control the use of the electromagnetic spectrum at critical locations and times in the battle space or to attack the enemy.

All INFOWAR elements are mutually supporting. FOREIGN FORCES INFOWAR occurs through the combinations of seven elements:

- Electronic warfare (EW).
- Deception.
- Physical destruction.
- Protection and security measures.
- Perception management.
- Information attack (IA).
- Computer warfare.

EW capabilities allow foreign forces to exploit, deceive, degrade, disrupt, damage, or destroy sensors, processors, communications, and command and control (C^2) nodes. Information supremacy, delay, and denial, or distortions of the adversary's use of the electromagnetic spectrum and information infrastructure are the objectives. Electronic warfare (EW) is a perfect example of the integrated nature of foreign forces INFOWAR elements. The EW section in this chapter provides basic characteristics of selected systems either in use or readily available to the foreign forces.

Computer warfare includes capabilities that allow the foreign forces to conduct network warfare (NETWAR) to attack and exploit information systems by attacking key information technology systems within cyberspace, and to conduct network operations (NETOPS) to establish and protect C4ISR networks and information. In NETWAR the foreign forces obtains access through social engineering processes such as phishing schemes but can also employ complex technologies to intercept communications through man in the middle (MITM) attacks and hack into a system remotely. Once access is obtained, foreign forces will attempt to degrade the system or to exploit the system to collect intelligence. Some forms of attack can be launched unexpectedly through a data driven attack known as a "drive-by- download" that is embedded into a website or uploaded to a commonly used system, the victim in these cases releases malware by attempting to access what is believed to be a legitimate site or program. There are various methods used to accomplish this for the purpose of releasing viruses and other malware designed to give the attacker control over the victim's computer. The methods used to gain access involve highly developed social engineering techniques and or network attacks such as a spoofed email account or a false website.

Because these types of attacks are launched by the end user they are a concern since the attack is able to legitimately pass through various electronic defense systems such as firewalls. If access is obtained an electronic beachhead is established on the infected computer exposing the rest of the network to further attacks such as distributed denial of service attacks that overwhelm internet servers. Attacks can include vandalizing or sabotaging a website, downloading sensitive information or degrading a key war fighting function through the release of malware.

Cyber espionage describes those INFOWAR actions that involve collecting sensitive and proprietary information such as plans, capabilities or personal data. The threat will exploit poor information technology security that exposes sensitive data to risk of exploitation or manipulation.

Information attack is a type of action that focuses on the intentional disruption or distortion of information in a manner that supports accomplishment of the mission. Unlike computer warfare attacks that target the information systems, information attacks target the information itself. Attacks on the commercial Internet by civilian hackers have demonstrated the vulnerability of cyber and information systems to innovative and flexible penetration, disruption, or distortion techniques.

Computer warfare consists of attacks that focus specifically on the computer systems, networks, and/or nodes. This includes a wide variety of activities, ranging from unauthorized access (hacking) of information systems for intelligence-collection purposes, to the insertion of malicious software (viruses, worms, logic bombs, or Trojan horses). Such attacks concentrate on the denial, disruption, or manipulation of the infrastructure's integrity. Terrorist organizations use a variety of encryption techniques such as embedding communications into innocuous computer applications in order to transmit data in a surreptitious manner. Other methods are the use of code words to conceal the meaning of topics and swapping Subscriber Identity Module (SIM) cards or cell phones to prevent electronic surveillance systems from identifying the user of a particular phone.

Evolving mobile technology has increased the portability of battlefield automated systems improving the integration and capabilities of many military functions. The proliferation of these capabilities increases the military's dependence on mobile devices and the networks that support them. Referred to as the "edge of the network," mobile systems provide improved situational awareness. However, the complexity associated with these enhancements in functionality, has introduced additional vulnerabilities. Vulnerabilities associated with wireless networking, and the need to support an expanding list of military applications, make mobile technology an important, feasible and valuable target for INFOWAR operations. Mobile devices share many of the vulnerabilities of personal computers. However, the attributes that make mobile phones easy to carry, use, and modify as well as comparatively low security standards open them to a range of attacks.

This selection of systems is not intended to be complete; rather, it is representative of the types and capabilities that are currently fielded or available. Later WEG updates will include equipment for other elements of INFOWAR operations. For more information on the INFOWAR tactics techniques and procedures see chapter 7 of TC 7-100.2 OPFOR Tactics.

Questions and comments on INFOWAR data in this chapter should be addressed to:

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Tactical Electronic Warfare Systems

System	Country of Origin	Description	Frequency Range (MHz)	Vs. GPS?	Vs. FH?	Range (km)	Power Output
MEERKAT-S	France	ESM/ELINT	2-40,000	No	Yes	500km	Passive
WEASEL 2000	UK	ESM/ELINT	.5-40,000	-	Yes	500km	Passive
EULe	Germany	ESM/ELINT	.9-3,000	-	Yes	450km	Passive
MCS90 TAMARA	Czech Rep	ELINT	820-3,000	-	No	450km	Passive
R-703 /709	Russia	ESM	1.5-2,000	Yes	n/a	Unk	Unk
CICADA-C	Germany	Mounted ESM/ECM HF/VHF/UHF	.525-3,000	Yes	Yes	100km	10kw
TRC274	France	Mounted ESM/ECM HF/VHF/UHF	20-3,000	Yes	Yes	150km	4kW 1.2kW on the move
GSY1800	S. Africa	Mounted ESM/ECM HF/VHF/UHF	1-3000	Yes	Yes	100km	(ECM: 1kW)
PELENA-6	Russia	Mounted ECM HF/VHF/UHF	20-1,000	No	No	60 km	60W
R-330 ZH	Russia	Mounted ECM HF/VHF	100-2000	Yes	No	60km	1kW
CICADA-R	Germany	Mounted ESM/ECM HF/VHF/UHF	6,000-18,000	No	Yes	100km	1kW
LIMAN P2	Ukraine	Mounted ECM VHF/UHF	225-1,215*	Yes	Yes	100km	Unk
R-934B	Russia	Mounted ECM VHF/UHF	100-400	No	No	50km	500W
BOQ-X300	Sweden	Mounted ECM S/C/X/Ku/K	2-40,000	Yes	n/a	Unk	Unk
CBJ-40 BOME	France	Mounted ECM S/C/X/Ku	2-20,000	Yes	n/a	Unk	Unk
PELENA-1	Russia	Mounted ECM S/C	1,000-4,000	Yes	n/a	250 km	Unk
SPN-2/4	Russia	Mounted ECM X/K	6,000-17,500	No	No	130km	(ECM: 1kW)
SGS2000	Germany	Mounted ESM/ECM HF/VHF/UHF	1.5-1000	No**	Yes	100km	(ECM: 1kW)
JN-1102	China	Mounted ECM VHF (UAV Mounted)	20-500	No	Unk	Unk	Unk
BARRAGE	France	Mounted ECM VHF (UAV Mounted)	1-3000	Yes	No	Unk	Unk
AJ-045A	Bulgaria	Mounted ECM VHF (UAV Mounted)	20-100	No	No	10km	Unk
HUMMEL	Germany	Mounted ESM/ECM VHF	20-80	No	Yes	100km	(ECM: 1kW)
STORM-H	France	Manpack ECM HF/VHF/UHF/ SHF	20-470	No	No	5km	1kW (est.)
EL/K 7029/A/B	Israel	Mounted ESM /VHF /UHF/ESM	116-400	-	Yes	100km	Passive
ORION	Russia	ELINT	200-18,000	-	No	400km	Passive
AVTOBAZA-M	Russia	ELINT	200-18,000	-	No	400km	Passive

*Liman does not DF in the 960 to 1,215 MHz range
**SGS 2000 frequency range can be extended up to 3000MHz

Russian, SPN-2/3/4, Ground Based EA, High-Power Radar Jammer

SYSTEM
Alternative Designations: Heart Ache
Date of Introduction: 197
Proliferation: At least 2 countries
Description:
Crew: 5
Number of vehicles: 3 (Antenna, Control, and Power Plant)
Troop Capacity: NA
Gross Vehicle Weight (mt): >13.2
Curb: 8.4
Length Overall (m): 7.36
Height Overall (m): 2.68
Width Overall (m): 2.67
Number of Axles: 3
Ground Clearance (mm): 410
Turning Radius (m): 10.8
Side Slope (°): 32
Vertical Step (mm): 800
Gradient (loaded) (°)**:** 65
Fording Depths (m): 1.49
Trench Crossing Width (mm): 875
Wheels:
Size (in): 14x20
Central Tire Pressure Regulation System: Yes
Run Flat: INA

Automotive Performance:
Engine: V8, 180 hp, gasoline
Cooling: Liquid
Cruising Range (road) (km): 650
Speed (km/h): 75
Fuel Capacity (liters):
Main Tank: 300
Aux Tank: 60
Towing Capability (kg):
Off Highway: 5,000
On Highway: 10,000
Radio:
Communications radios sets located in the control vehicle
Protection: INA

PERFORMANCE
Frequency Range: 13.3 GHz to 17.5 GHz
Output Power: 1,100W
Jammer receiver sensitivity: 90dB/W
Radar detection range of air launched weapons at direct radio contact of 40km: 140km
Radar identification range: 75km
Angular limits:
Azimuth: 360 degrees
Elevation:
Narrow radiation pattern: -2.5 deg to +45 deg
Wide radiation pattern: -7.5 deg to +78 deg
Accuracy of angular coordinates follow up:
Azimuth: 3.75 deg
Elevation: 1.40 deg
Endurance: 24 hours
Main Antenna: Receiving multiple beam antenna, sidelobe compensation antenna, transmitter multiple beam antenna; direction finder; frequency determination and reproduction system; analysis and control system; preliminary and multichannel output power amplifiers; and a computer

CONTROL VEHICLE
Control Panel; data transmitter; communications radio sets; automatic monitoring and registration system; signal simulator

POWER VEHICLE
80-hp (60kW) diesel generator and an industrial power mains converter

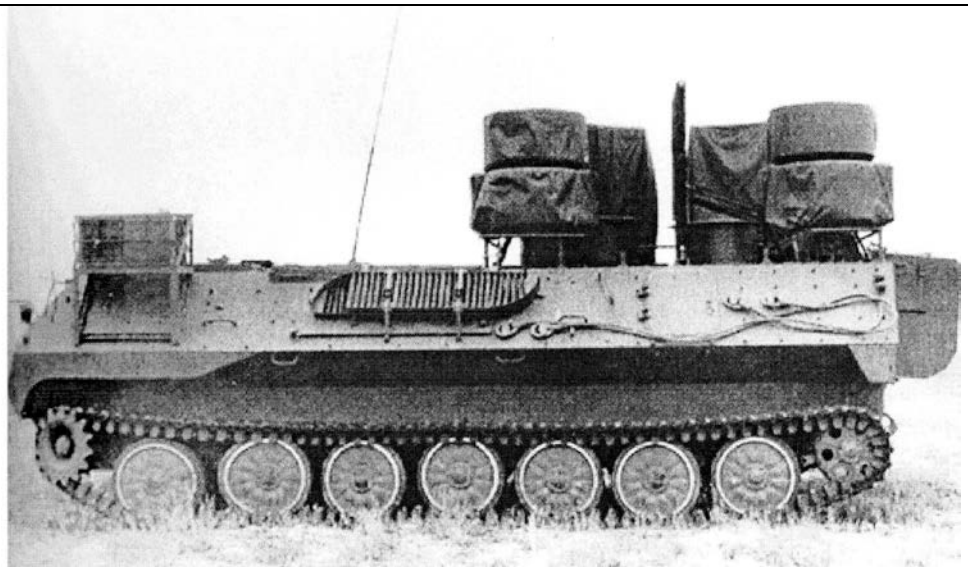
VARIANTS
SPN-3: Variant of theSPN-2 designed to operate in the 3-cm band. Band coverage is said to be 8.5 GHz to 10 GHz.

SPN-4: Variant of the SPN-2 designed to operate in the 4 cm band. Band coverage is said to 6.0 GHz to 8.5 GHz.

http://www.militaryperiscope.com/weapons/sensors/esm-ew/w0007953.html

NOTES
The 1l245 is mainly used to defeat airborne radar systems and JSTARS however it has the capability to and jam ground systems as well.

Russian, 1L245, Airborne EA, Radar Jammer



SYSTEM
Alternative Designations: Vstrecha, Ground-Based Weapons Control Radar Suppression System
Date of Introduction: 197
Proliferation: At least 2 countries
Description:
Crew: 3
Platform (chassis): MT-LBu
Combat Weight (mt): 15.7
Chassis Length Overall (m): 7.26
Height Overall (m): 2.72
Width Overall (m): 2.85

Automotive Performance:
Engine Type: YaMZ-238, 240hp diesel
Cruising Range (km): 500 km
Speed (km/h):
Max Road: 60
Max Off-Road: 26
Cross-Country: INA
Max Swim: 4.5
Fording Depths (m): Amphibious

Radio:
Communications Radios Sets
Protection: Against 5.56 ball 5.56, all-around

PERFORMANCE
Frequency Range: 8 GHz to 18 GHz
Output Power: 1,000W
Simple pulse signals received and analyzed:
duration, 1-5μs repetition rate, 0.25-10 kHz

Pulse linear-frequency modulated signals:
Duration, microsecond 1-25
Spectral width, MHz 1-20
Repetition rate, kHz 0.5-3.0

Polarization of signals received: vertical and horizontal

Sector, deg:
Combat operation (azimuth x elevation) 120 x 15 ECM with respect to the main radar 2 x 2 directional lobe of the reconnaissance strike system

Radar detection and suppression range:
Reconnaissance strike system 80km-200km
Tactical aircraft 30km-100km

Polarization of signals transmitted: chaotic

Types of jamming: noise, frequency-aimed and spectrum-conjugated, quasi-continuous or time-responsive

NOTES
The 1l245 is mainly used to defeat airborne radar systems and JSTARS. However, it has the capability to and jam ground systems as well

Russian, Infauna, Airborne EA Jammer

SYSTEM:
Alternative Designations: None
Date of Introduction: 2012
Proliferation: Russian Airborne Forces (VDV)
Description: Modified BTR 80 chassis identified as the K1Sh1.

SPECIFICATIONS:
Height: 2.21 m hull
Weight: 12,000 kg
Length: 7.65 m
Crew: 2
Troop Capacity: 8
Combat Weight (mt): 13.6
Chassis Length Overall (m): 7.55
Height Overall (m): 2.41
Width Overall (m): 2.95
Ground Pressure (kg/cm^2): INA
Drive Formula: 8 x 8

AUTOMOTIVE PERFORMANCE:
Engine Type: 6V or 15 V DC
Cruising Range (km): 600
Speed (km/h): Max Road: 85
Max Off-Road: 60
Average Cross-Country: 40
Max Swim: 10
Fording Depths (m): Amphibious

EW/JAMMING SYSTEM:
Frequency Jamming Range: 5 bands – 20-2020MHz
Output Power: 60W
Voltage Supply: V-12.6 V
Weight (Separated from vehicle): 14 kg

PEFORMANCE:
Fielded To: EW Battalions in Airborne Forces of the Russian Army
Deployment: The main task of the Infauna is to protect combat vehicles and troops against radio controlled mines and explosives (IEDs).

- Deployed as part of a convoy or in overwatch position, depending on mission requirements.
- Provides command and control, jamming against radio communication systems, and "fiber optic reconnaissance and jamming" at battalion level.
- Can also produce aerosol interference which is used for protection against high-precision weapons with laser and video-management systems.
- As part of the Airborne Forces, this system will be used to accompany initial entry troops and assist with securing key terrain to enable follow-on forces (Motorized, Mechanized, and Armor) to deploy into combat areas.

INFAUNA WITH ANTENNA DEPLOYED

Russia, Tigr-M REI PP LEER-2, Mobile EW System

SYSTEM:

Alternative Designations: N/A

Date of Introduction: 2012

Proliferation: Russia.

Description: Threat multi-range jammer.

Frequency Jamming Range: 20-1000MHz

VEHICLE SPECIFICATIONS:

Range: 400 KM

Power Supply: YMZ-5347-10 multi-fuel diesel engine w/215 HP

Speed: 125km/max

Crew: 6

Protection: Protection against small arms 7.62 and shrapnel. The engine bonnet is armored to protect it from small arms fire. The vehicle also has good off-road capability. The vehicle has axles fitted with forced-locking bevel gear differentials which allow it to operate well on soft ground.

FIELDING AND DEPLOYMENT: The Tigr-M MKTK REI PP mobile technical control, electronic emulation and electronic countermeasures system is designed for developing radio emitters, jamming and suppressing radio-electronic means including cellular phone systems.

- System can also imitate various radio electronic systems.
- Can operate in a static position and on the move
- Operates close to the FLOT in support of Motorized, Mechanized or Armor forces moving at high rates of speed.

LEER WITH ANTENNA DEPLOYED

Russian, Avtobaza, Ground Based ES, ELINT System

SYSTEM:
Alternative Designations: 1L222
Date of Introduction: 1980-1999
Proliferation: at least 4 Countries*
Crew: 4
Description: Passive ELINT signals intercept system designed to intercept and locate pulsed airborne radars including fire control radars, terrain following radars and ground mapping radars as well as weapon (missile) data links.

SPECIFICATIONS:
Power Supply: 6V or 15 V DC
Weight: 13.3 t.
Frequency Range: 8 GHz to 17.5 GHz
Power (kW): 12 consumption

RECEIVER:
Range: 250 km
Sensitivity of receiver: -88dB
Receive modes: side-looking airborne radars (SLAR) used in combat aircraft, targeting radars of air-to-surface weapons, and radars used to guide aircraft flying at extremely low altitudes, early warning and control radars and jammers
Operational Frequency Range: X and Ku –Band
Target Data: **T**arget quantity according to frequency, assignment of jamming systems, type of emitting radars and their angular coordinates
Frequency identification accuracy: ± 30MHz
Accuracy of DF, degrees:
Azimuth: 0.3-0.5
Elevation: 3
Target throughput: Up to 60 targets
Reaction Time: 50 μs

ANTENNA:
Description: Rotating parabolic antenna
Azimuth: 360º
Elevation:
18 º– 8.5 to 10.2 GHz
30º– 13.4 to 17.5 GHz
Rotation: 6 -12 orbits per minute

OPERATION:

- Frequency Range: 8,000 MHz-17,455 MHz
- Adjustable prioritization of target sets
- Up to 100 meters distance from automated command post (ACP)
- Monitors 15 targets per second up to 60 targets
- Less than 25 min set up time
- Real time self reporting status updates
- Provides location data, and target processing for Ground-Based Aircraft Radar Jamming System

Environmental conditions:
Operation:
Ambient temperature, ° C from -45 to +40
Humidity 98% at temp ≥25 ° C

VARIANTS:
Avtobaza-M Target detection range of up to 400 km (est.)

Frequency range: .2 to 18 GHz

NOTES: It was reported by at least one source to have been modified to receive and locate emissions associated with satellite telephones. It was reportedly proliferated to Iran and Syria in 2011 -2012.

United Kingdom, Weasel 2000, Ground Based ES, ELINT System _____

SYSTEM
Alternative Designations: None
Date of Introduction: 2005
Proliferation: At least 2 countries
Description:
Crew: 2 at the Network Control Center NCC. Sensors operate automatically after setup.
Platform: Mercedes Ax or 4 ton
Combat Weight (Tons): 12.6 tons

Antenna and Receiver:
Mount: Motor-driven for azimuth adjustment with remote control.
Antenna Type: Spinning omni directional and dish receiver antenna, with 360º azimuth coverage
Direction Finding assembly: Dual 8 port switched amplitude comparison system
Frequency Range: 0.4 to 10GHz C-D (up to 40 GHz Corvus option)
Bearing Accuracy (DF) : 1 deg RMS from 3-40 GHz
Polarization Range: 2-18 GHz
Receiver sensitivity: -62dBmi
Range: 60 dB

Operation:
Coverage sector for motor drive is 0-180° azimuth.
Travel mode: Systems operates in a fixed position only.
Remote operation: Wired remote options are available for up to 85 meters. Can operate with one or more remote sensors for triangulation of targets. Search receiver automatically tunes to correct frequency once the emission is identified.
Display: Two receivers one to locates the radar source, and the other will check the source against a database for identification purposes. Readout is a tabulated display of threat significance.
Other links: Analysis and threat data can be transmitted to remote users. The data can also be fused with other sensor systems for target location by azimuth intersection.
Weasel Systems can be used in conjunction with the Scorpion Jamming System.

PERFORMANCE
Surveillance range (km): Passive system

VARIANTS
TAC Weasel is a smaller version. Weasel III has an open architecture that interfaces with a variety of search and analysis subsystems. The Weasel II has been an active program since 2008.

Russian, Aviaconversia, GNSS Jamming Transmitter _____

SYSTEM
Alternative Designations: GPS / GLONASS Jammer
Date of Introduction: 1990s
Proliferation: Iran, Iraq, North Korea
Description:
Aviaconversia portable GPS and GLONASS jammer jams civilian and military frequencies for GLONASS and GPS.

SPECIFICATIONS
Range: 150-200 KM
Power Supply: 6V or 15 V DC
Weight: 8 – 12 kg depending on configuration
Frequency range: 1,577 MHz (civilian channel) and 1,230 MHz (military channel).

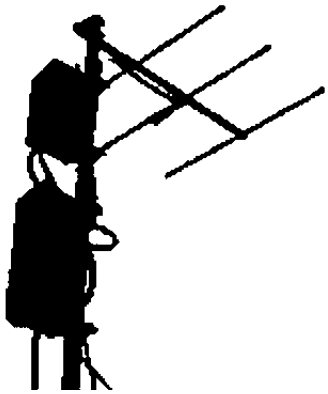
Antenna and Transmitter:
Mount: fixed site, man portable, vehicle and airborne platforms available.
Antenna Type: Omni directional or directional yagi
Transmitter: Continuous-wave with cable link to antenna
Signal: Coherent pulse Doppler, J-band
Power (kw): 25 consumption, 4emitted
Width of radiation pattern lobe (°): 360

Operation:
Jammers can reach full range only in ideal conditions and in ideal terrain. Designed to affect C2, maneuver and fire support activities. Forces the use of traditional navigation techniques and slows mobility progress. May affect high precision munitions.

PERFORMANCE
Continuously jams GPS signals.
6 MHz frequency deviation from main frequency to counter EP measures.
Adjustable modulation from 44 to 270 Hz to counter various GNSS systems.

NOTES
GNSS stands for ***global navigation satellite system (***which includes GPS, GLONASS, and others).

Belarusian, Optima-3, GNSS Jamming Complex



SYSTEM
Alternative Designations: GPS / GLONASS Jammer
Date of Introduction: 2003
Proliferation: Fielded in one country and marketed for sale in at least 2 others
Description:
Optima-3 GNSS jamming complex is a network of jamming transmitters that can be controlled by a central command station by either GSM cell phone or ultra short wave radio. The system is referred to as a distributed jamming complex, because it employs nine transmitters in the base configuration to achieve maximum degradation or deniability of satellite based navigation systems in a specified area. It is remotely operated by a separate automatic control system.

SPECIFICATIONS

Range: 100 KM
Power Supply: 220 VAC or 24 V DC
Weight: Approx 10kg for transmitter
Frequency range: 1,575.42 MHz (civilian channel) and 1,227.6 MHz (military channel).

Antenna and Transmitter:
Mount: Fixed site vehicle compatible with 24 VDC converter
Antenna Type: Omni directional
Transmitter: Continuous-wave with cable link to antenna
Signal: complex frequency and interval waveform degrade the GNSS code.
Power (W): 20
Width of radiation pattern lobe (°): 60 deg +/-10 deg in the horizontal and 40 deg +/-10 deg in the vertical

Operation:
Jammers can reach full range only in ideal conditions and in ideal terrain. Designed to affect C2, maneuver and fire support activities. Forces the use of traditional navigation techniques and slows mobility. May affect high precision munitions.

PERFORMANCE
Remote controlled net enabled jamming complex. The baseline system has nine transmitters, and an ASU-PP (Avtomatizirovannaya sistema upravleniya peredatchikami pomekh) automated control system. Number of system components depends on customers intended use and factors such as area covered topography.

The ASU-PP runs of 200VAC and is used for remote activation of the distributed jammers. System status and situational awareness is monitored by the operator at the remote workstation. Metrics include jammer positions and jamming areas as well as transmitter status and serviceability. The main components are the operator's automated workstation and a control unit for each command link. The workstation includes a PC with its application software, an LCD monitor, keyboard, mouse, printer and uninterruptible power supply.

Remote Operation:
The command link includes VHF radio and mobile telephone C2 interface equipment, a GSM antenna, and a power supply unit.

GSM-900/1800 Standard- limited by the network coverage area
Radio link: 30-50 km
Response time: Five seconds via the radio channel no more than 60 seconds via the GSM channel

Chinese, ASN-207, Unmanned Aerial Vehicle EW, ECM

UAV uses a reusable solid rocket booster prior to jettison after takeoff*

SYSTEM
Alternative Designations: D-4
Date of Introduction: 2002
Proliferation: At least 1 country

Description:
Engines: 1x –51 hp HS-700 four-cylinder, two-stroke gasoline air-cooled piston
Propulsion: 2-blade wooden push propeller
Weight (kg):
- Takeoff: 222
- Fuel and Payload (combined): 50

Speed (km/h):
- Maximum (level): 210
- Cruise: 150

Ceiling (m):
- Maximum: 5,000-6,000
- Minimum: 100

Fuel (liters): INA
Endurance (hr): 8-16
Range (km):
- RPV Mode: 600
- Pre-programmed Mode: 600

Dimensions (m):
- Wing Span: 6
- Length (fuselage): 3.8
- Height: 1.4 (excluding skids)

Launch Method: Solid rocket booster on a zero length launcher.
Recovery Method: Parachute (nonsteerable)
Landing Method: 2 spring loaded skids
Maximum Flights Per Aircraft: INA

Survivability/Countermeasures: INA
Pre-programmable waypoints for self correcting

EW/ECM
Payload Type:
JN-1102 EW/ECM suite which can scan, intercept, analyze, monitor, and jam enemy ground to air communications at 20~500MHz. The system consists of a UAV-mounted intercept subsystem a UAV-mounted jamming subsystem and a ground based intercept and control subsystem.

VARIANTS:
ASN-206: An older version of the ASN-207 UAV with less control range, smaller payload capacity, and shorter endurance.

NOTES
*The UAV is launched from a zero-length launcher using a solid rocket booster that is jettisoned after take-off.

Germany, Cicada-C and R, ES, EA Jamming Transmitter

SYSTEM:
Alternative Designations: N/A
Date of Introduction: 1990s
Proliferation: 10 Countries Including German, Dutch, Spanish and Australian Armies.
Description: Threat multi-range jammer.

SPECIFICATIONS:
Range: 150-200 KM (est.)
Power Supply: 6V or 15 V DC
Weight: 8 – 12 Mt. depending on configuration
Frequency Range: 0.525 MHz to 3,000 MHz

JAMMING TRANSMITTER:
Transmit modulation: (deception and burn through) FM Voice, FM Telegraph / Teletype ,FM Facsimile, AM Telegraph, AM Voice
Jamming operation modes: PRESET FREQ. JAM, BROAD JAM, ATTACK JAM, MANUAL JAM, DECEPTION
Broadjam bandwidth: up to 240 MHz, in 0.1 MHz steps, simultaneous generation of up to 16 separate broadband segments
Jamming efficiency: up to 16 simultaneously active radio nets

ANTENNA AND TRANSMITTER:
Mount: fixed site, vehicle and airborne platforms available.
Antenna Type: Omni directional or directional yagi

RECEIVER:
Receive modes: FM Voice, FM Telegraph / Teletype, FM Facsimile, FM Morse Code AM Telegraph, AM Voice, AM Morse Code, AM Facsimile.
Fast scan speed: 250 MHz/s, 1000 MHz/s (upgrade)
Passive Antennas:
- dipole or monopole antennas
- vertical or horizontal polarized omnidirectional antennas
- antennas for operation on the move

AMPLIFIER:
Amplifier types: broadband, solid-state, liquid cooled
- output power up to 10 kW into 50 Ω
- frequency change time at the power output < 100 µs

Transmitter: Continuous-wave with cable link to antenna
Amplifier Power Consumption (kW): 25, 4emitted
Width of radiation pattern lobe (°): 360

OPERATION:
- Frequency Range: 1.5 MHz-3000 MHz
- Automatic computer controlled jamming sequences
- High power Amplifier 10kW
- Time Division Multiplexer (TDM) jams multiple targets
- "Look Through" Capability ensures jammer is only active when target signal is on the air
- Deception jamming
- Broadband TDM (barrage) jamming against simultaneous spread spectrum transmitters
- Programming of protected frequencies not to be jammed
- Local or remote control

Environmental conditions:
Operation:
-25°C to + 55°C
Storage:
- 40 °C to +70°C

VARIANTS:
Cicada-R
Frequency range: 6 to 18 GHz

Germany, Light Electronic Support System (EULe), Ground Based ES, SIGINT

Source German Bundeswehr

Source: Panzerbaer

SYSTEM:
Alternative Designations: Owl (English), (TMS) 210
Date of Introduction: 2000's
Proliferation: Germany.
Description: Transportable Monitoring System

VEHICLE SPECIFICATIONS:
Vehicle Range: 150-200 km (est.)
Engine: Mercedes Benz 306 hp
Drive: 4x4
Length: 6.6 m
Width: 2.39 m
Crew: 2
Weight: 14 t
Max Speed: 80 km/h

RECEIVERS:
Designation: ESMB
Power Supply: 11V or 32 V DC
Weight: 36.8 kg
Operational Frequency Ranges: 9 kHz to 3GHz
DF and Intercept: 20MHz to 1300 MHz (Intercept only above 1300MHz)
Range: LOS from target, dependent on remote station
Receive modes: FM Voice, FM Telegraph / Teletype, FM Facsimile, FM Morse Code AM Telegraph, AM Voice, AM Morse Code, AM Facsimile, GSM Telephone.
Fast scan speed: 1.3GHz/s
Scan Mode: frequency, memory and radio frequency panorama
Target Data: Identifies and locates**,** LPI, LPD emissions Frequency Hop, and Spread Spectrum
Frequency identification accuracy: ± 30MHz
Accuracy of DF, degrees: 2
Target throughput: INA
Reaction Time: 10 µs

ANTENNAS AND TRANSMITTER:
Passive Antennas:
- ADD195: 20 MHz to 1300 MHz
- ADD170 UHF DF antenna for GSM: 800MHz to 2 GHz
- HE 500 20 MHz to 3 GHz
- antennas for operation on the move

STORAGE and C2 INTERFACE:
Storage: 1 Tbyte
Remote:
LAN 500 m, 128kbps (copper pair)
Serial 300m, 20kbps
GSM Link, 10kbps

OPERATION:
- Software Defined (RAMON) Receiver
- Frequency Range: 9 kHz-3000 MHz
- Uses two or more station for DF
- Local or remote control
- Up to 12 hours continuous operation

Environmental conditions:
Operation:
- 40 °C to +65 °C

Storage:
- 40 °C to +70 °C

VARIANTS:
Receiver: ESMD
Frequency range: 9kHz to 26.5 GHz

Swedish, Saab BOQ X-300 Airborne, ECM/EW Pod, (on JAS39/Gripen)_____

Weapon & Ammunition Types	Combat Load
27-mm Mauser BK 27	**120**
Other Loading Options	
7 Hardpoints plus sensor hardpoint under intake	
AIM-9 Sidewinder on the wingtips	**2**
AIM-120 AMRAAM	**4**
AGM-65A/B Maverick	**4**
Saab RBS15F anti-shipping missile	**2**
Dasa DWS39 munitions dispenser or KEPD 150 pods	**2**
Bofors rocket pods	**4**
Conventional or retarded bombs	
Reconnaissance and electronic warfare pods	

SYSTEM (AIRCRAFT)
Alternative Designations: None
Date of Introduction: 1997
Proliferation: Sweden (Hungary and South Africa – planned)
Description:
Crew: 1 (pilot) (JAS 39A/C), 2 pilots (JAS 39B/D)
Appearance:
Wings: Multi-sparred delta.
Engines: Turbofan with intake boxes on both sides of fuselage.
Tail: Leading edge swept fin with upright inset rudder.
Engines: 1 x 12,140 lbs thrust Volvo Aero RM12, 18,200 lbs thrust with afterburner
Weight (kg):
Takeoff: 12,500 (A/C), 14,000 (B/D)
Empty: 6.500 (A/C), 7,100 (B/D)
Speed (km/h):
Maximum (at altitude): 2,150, Mach 1.8+
Max "G" Force (g): +9/-3 g
Ceiling (m): 16,000
Fuel (liters):
Intern Range (km):
Combat Radius: 800
Ferry: 3,000
Takeoff Run/Landing Roll (m): 800/800al: 3,008 (A/C), 2,852 (B/D)
External: 3,300.
Dimensions (m):
Length: 14.1 (A/C), 14.8 (B/D)
Wingspan: 8.4 over tip rails
Height: 4.5

Standard Payload (kg):
External: 3,600
Hardpoints: 7 (4 wing, 1 centerline, 2 wingtip rails)
Survivability/Countermeasures:
Martin-Baker zero/zero ejection seat.
IFF and an integrated EW system that provides radar warning, electronic support measures, chaff, flare, and decoy dispensers.
ARMAMENT
27-mm Mauser BK 27
AVIONICS/SENSOR/OPTICS
The long-range multi-purpose pulse Doppler radar has air-to-air operating modes covering long-range search, multi-target track-while-scan, multiple priority target tracking, air combat quick search modes, and raid assessment and beyond visual range missile mid-course updates. Also equipped with INS, radar altimeter, and electronic display (incorporating wide-angle HUD), and FLIR
Night/Weather Capabilities:
All-weather, all-altitude, day/night interceptor, attack, and reconnaissance aircraft.
BOQ-X300 ECM/EW POD.
Alternative Designations: None
DATE OF INTRODUCTION: 2012
PROLIFERATION: Sweden
COUNTRY OF ORIGIN: Sweden
FREQ. BANDS: S/C/X/Ku/K
FREQ. RANGE: 2-40,000 MHz Jams GPS Does Not Jam FH
RANGE: INA

POWER OUTPUT: INA
TYPE: Airborne Electronic Countermeasures (ECM), radar jamming system.
BOQ-X300 ECM/EW POD.

BOQ-X300 ECM/EW POD.

Description: The BOQ-X300 high-performance jamming pod is the latest pod being developed by Saab for the Gripen fighter. The pod is a modular system that integrates a sophisticated jammer, supported by a RWR and ESM system. As an option, the pod can be configured with a dual fiber optic towed decoy to provide effective countermeasures against monopulse threat. The BOQ-X300 provides self-protection for high value assets such as fighter, attack and reconnaissance aircraft. The pod is designed to suppress legacy threats, surface based as well as airborne. A secondary role for the BOQ-X300 is to provide jamming for training of radar operators in airborne as well as ground- or sea-based environments.
As a training jammer, the BOQ-X300 is a part of the Saab REWTS (Responsive Electronic Warfare Training System) concept.

NOTES
The JAS 39 Gripen is a fourth generation, multi-role combat aircraft. The Gripen is the first Swedish aircraft that can be used for interception, ground-attack, and reconnaissance (hence the Swedish abbreviation JAS – Fighter (J), Attack (A), and Reconnaissance (R)) and it is now successively replacing the Draken and the Viggen. The JAS 39 is part of a system that fights the "information war" in which aircraft receive and convey information through an air-to-air tactical information data link system (TIDLS).

Finland, Elektrobit, ES Wideband COMINT Sensor

SYSTEM:
Alternative Designations: N/A
Date of Introduction: 2010s
Proliferation: Finland.
Description: Wideband COMINT Sensor.

SPECIFICATIONS:
Range: 5-10 KM (est.)
Power Supply: 6V or 15 V DC
Weight: 2 kg. depending on configuration
Frequency Range: 30 MHz to 40 GHz

RECEIVER:
Receive modes: VHF/UHF/SHF
Fast scan speed: 250 MHz/s, 1000 MHz/s (upgrade)
Passive Antennas:
- dipole or monopole antennas
- vertical or horizontal polarized omnidirectional antennas
- antennas for operation on the move

AMPLIFIER:
Amplifier types: broadband, solid-state, liquid cooled
- output power up to 10 kW into 50 Ω
- frequency change time at the power output < 100 μs

Transmitter: Continuous-wave with cable link to antenna
Amplifier Power Consumption (kW): 25, 4emitted
Width of radiation pattern lobe (°): 360

OPERATION:
- High capacity raw data recording of predetermined area
- Reconfigurable waveforms broadband wireless signals
- High power Amplifier 10kW
- Enables finding and analyzing low probability of intercept (LPI) signals operational and maintenance cost
- Remote operation and sensor management

Environmental conditions:
Operation:
INA
Storage:
INA

VARIANTS:
INA
Frequency range: INA

Chapter 11

Chemical, Biological, Radiological, and Nuclear (CBRN) Weapons

The use of CBRN weapons can have an enormous impact on the battlefield and in peacetime and wartime operational environments. These weapons are a subset of weapons of mass destruction (WMD). WMD are weapons or devices intended for or capable of causing a high order of physical destruction or mass casualties (death or serious bodily injury to a significant number of people). The casualty-producing elements of WMD can continue inflicting casualties on the enemy and exert powerful psychological effects on the enemy's morale for some time after delivery. Conventional weapons e.g., precision weapons or volumetric explosives) can also take on the properties of WMD.

Countries with chemical weapons programs are adding agents and more sophisticated delivery systems. The sophistication of chemical and biological weapons (CBW) capabilities is increasing. Proliferation of weapons technology, precision navigation technology, and technology in developing nations continue. At least 25 countries now possess—or are in the process of acquiring and developing—capabilities to inflict mass casualties and destruction chemical weapons or the means to deliver them. Various nations could export a wide array of CBW products, including items to numerous countries of proliferation concern. The controlled items include specific chemical agent precursors, pathogens with biological warfare (BW) applications, and dual-use equipment that can be used in both chemical and programs. In the next several years, the threat from the proliferation of CBW may increase. This could result from the development of agents that are more difficult to detect and from the adoption of more capable delivery systems. States with existing programs may master the production processes for complete weapons development and will be less dependent on outside suppliers.

In response to foreign developments, the OPFOR maintains a capability to conduct chemical, nuclear, and possibly biological warfare. It might use CBRN weapons either to deter aggression or as a response to an enemy attack. However, it would prefer to avoid the use of these weapons by either side. This is especially true of nuclear and biological weapons, which have lethal effects over much larger areas than do chemical weapons. The effects of biological weapons can be difficult to localize and to employ in combat without affecting friendly forces. Their effects on the enemy can be difficult to predict. Unlike nuclear or biological weapons, chemical agents can be used to affect limited areas of the battlefield. The consequences of chemical weapons use are more predictable and thus more readily integrated into battle plans at the tactical level. In the event that either side resorts to CBRN weapons, the OPFOR is prepared to employ CBRN protection measures.

Force modernization has introduced a degree of flexibility previously unavailable to combined arms commanders. It creates multiple options for the employment of forces at strategic, operational, and tactical levels with or without the use of CBRN weapons. Many of the same delivery means available for CBRN weapons can also be used to deliver precision weapons that can often achieve desired effects without the stigma associated with CBRN weapons.

The threat of using these systems to deliver CBRN weapons is also an intimidating factor. Should any opponent use its own CBRN capability against the OPFOR, the OPFOR is prepared to retaliate in kind. It is also possible that the OPFOR could use CBRN against a neighbor as a warning to any potential enemy that it is willing to use such weapons. The fact that the weapons may also place noncombatants at risk is also a positive factor from the OPFOR's perspective. Thus, it may use or threaten to use CBRN weapons as a way of applying political, economic, or psychological pressure by allowing the enemy no sanctuary. The threat associated with these threats can be used for strategic political intimidation in peace or wartime.

The OPFOR might use CBRN weapons either to deter aggression or as a response to an enemy attack. It has surface-to-surface missiles (SSMs) capable of carrying nuclear, chemical, or biological warheads. Most OPFOR artillery is capable of delivering chemical munitions, and most systems 152-mm and larger are capable of firing nuclear rounds. Additionally, the OPFOR could use aircraft systems and cruise missiles to deliver a CBRN attack. The OPFOR has also trained special-purpose forces (SPF) as alternate means of delivering CBRN munitions packages.

OPFOR planning and preparation for combat always assumes the possibility of enemy use of CBRN weapons. However, use of these weapons can force both aggressor and opponent closer to the brink of an escalating conflict with consequences beyond those anticipated by either side. Recent developments in munition technologies have yielded a class of conventional munitions known as advanced conventional munitions (ACM). These munitions on WMD delivery systems (such as aircraft, artillery, large rockets, and ballistic or cruise missiles) can generate lethal and destructive results equal to or greater than CBRN. These weapons are more likely to be used from the onset of hostilities, to avoid the military and political consequences of using CBRN. Some of these munitions are known as "advanced munitions" or "special munitions" (pg 7-64 to 66), "artillery-delivered high precision munitions" (ADHPM, pg 7-66), "volumetric" or "fuel-air-explosive" munitions (or FAE at pg 13-9 to 10), or "cluster munitions" (in Vol 2, pg 5-4). With inclusion of these ACM within WMD, some writers have categorized WMD as "CBRNe" (adding "explosive"). ACM are addressed in their respective chapters.

On the modern battlefield, precision weapons possess destructive power approaching that of low-yield nuclear weapons. Other munitions (e.g., cluster munitions and FAE) greatly expand the effects area of conventional munitions. Another category of ACM is weapons for "grid attack". These are usually a part of the effort known as INFOWAR (Chapter 8); however, delivery systems can include the same systems (theater missiles, artillery rockets, and others) which WMD munitions. These include "graphite bombs" to short out power transformers, and directed energy (DE) weapons. Technological advances are making it possible to develop WMD based on qualitatively new principles, such as infrasonic (acoustic) or particle-beam weapons. The most effective current DE weapons are electromagnetic pulse (EMP) weapons to kill electronic components in modern electronics (including communications systems, computers, radars, vehicles, aircraft, precision munitions, etc.). A number of forces have research programs for non-nuclear EMP (NNEMP) weapons, and claim to be close to weapon development. However, the only sure weapons to achieve these effects are nuclear munitions. A high-altitude detonation can generate massive EMP damage over a wide area (1,000+ km), and render a modern force impotent. It would also cripple most of the area infrastructure (power grid, communication systems, dams, hospitals, monetary institutions, traffic control, airfields, satellite links, etc.).

The use of CBRN weapons can have an enormous impact on all combat actions. Because chemical employment is more likely than the other three types; the chapter begins by focusing on OPFOR chemical capabilities. The OPFOR may also have some biological, nuclear, and radiological capabilities, despite the lower probability of their employment. Detection and destruction of enemy WMD and delivery systems is a top priority. In response to these threats, many forces increasingly emphasize mobility and dispersing their forces to decrease the effects of those weapons. A prepared force must also execute aggressive planning and training, and must field specialized equipment for CBRN protection. These are discussed last in the chapter.

This chapter will provide basic characteristics of selected weapons and equipment. Questions and comments on data listed in this chapter should be addressed to:

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CHEMICAL WARFARE

The OPFOR is equipped, structured, and trained to conduct both offensive and defensive chemical warfare. It is continually striving to improve its chemical warfare capabilities. It believes that an army using chemical weapons must be prepared to fight in the environment it creates. Therefore, it views chemical defense as part of a viable offensive chemical warfare capability. It maintains a large inventory of individual and collective chemical protection and decontamination equipment. (See the CBRN Protection portion of this chapter.)

Chemical Agents and Effects

One way of classifying chemical agents is by the effects they have on humans, and on other animals. Persistence and delivery method are other selection criteria for a specific mission.

There are two major lethality categories among agents, each with subcategories. ***Lethal*** agents, categorized by how they attack and kill personnel, include nerve, blood, blister, and choking agents. ***Nonlethal*** agents include incapacitants and irritants. The table on page 11-6 lists characteristic effects of example chemical agents on personnel.

Nerve agents are fast-acting. Practically odorless and colorless, they attack the body's nervous system, causing convulsions and eventually death. Nerve agents are further classified as either G- or V-agents. At low concentrations, the GB series incapacitates; it kills if inhaled or absorbed through the skin. The rate of action is very rapid if inhaled, but slower if absorbed through the skin. V-agents produce similar effects, but are quicker-acting and more persistent than G-agents. Persistence varies among these agents, based on formulation.

Blood agents block the body’s oxygen transferal mechanisms, leading to death by suffocation. A common blood agent is hydrogen cyanide (AC). It kills quickly and dissipates rapidly. This is a persistent agent.

Blister agents, such as mustard (H) or lewisite (L), and combinations of these two compounds can disable or kill after contact with the skin, being inhaled into the lungs, or being ingested. Contact with the skin can cause painful blisters, and eye contact can cause blindness. These agents are especially lethal when inhaled. These are persistent agents.

Choking agents, such as phosgene (CG) and diphosgene (DP) block respiration by damaging the breathing mechanism, which can be fatal. As with blood agents, this type is nonpersistent; and poisoning comes through inhalation. Signs and symptoms of toxicity may be delayed up to 24 hours.

Incapacitants include psychochemical agents and paralyzants. These agents can disrupt a victim's mental and physical capabilities. The victim may not lose consciousness, and the effects usually wear off without leaving permanent physical injuries.

Irritants, also known as riot-control agents, cause a strong burning sensation in the eyes, mouth, skin, and respiratory tract. Effects of these agents, the best known being tear gas (CS), are also temporary. Victims usually recover completely without having any serious aftereffects.

Representative Chemical Agents and Their Effects

Type Agent	Symbol/Name	Symptoms	Effects	Rate of Action
Nerve	G Series GB/Sarin GD/Soman (VR 55)	Difficult breathing, sweating, drooling, nausea, vomiting convulsions, and dim or blurred vision.	At low concentrations, incapacitates; kills if inhaled or absorbed through the skin.	Very rapid by inhalation; slower through skin (5-10 minutes).
	V Agent	Same as above.	Incapacitates; kills if contaminated skin is not decontaminated rapidly.	Delayed through skin; more rapid through eyes.
Blood	AC/Hydrogen cyanide	Rapid breathing, convulsions, coma, and death.	Incapacitates; kills if high concentration is inhaled.	Rapid.
Blister	HD/Mustard HN/Nitrogen Mustard L/Lewisite HL/Mustard and Lewisite CX/Phosgene Oxime	Mustard; nitrogen mustard—no early symptoms. Lewisite and mustard-searing of eyes and stinging of skin. Phosgene oxime—powerful irritation of eyes, nose, and skin.	Blisters skin and respiratory tract; can cause temporary blindness. Some agents sting and form welts on skin.	Blister delayed hours to days; eye effects more rapid.
Choking	CG/Phosgene DP/Diphosgene	Eye and throat irritation, fatigue, tears, coughing, chest tightness, nausea, vomiting.	Damages the lungs.	Delayed, variable.
Incapacitant	BZ/3-Quinuclidinyl-benzilate	Slowing of mental and physical activity; disorientation and sleep.	Temporarily incapacitates.	30-60 minutes.
Irritant	DA/Diphenylchloroarsine DM/Adamsite CN/Chloroacetophenone CS/O-Chlorobenzylidene-malononitrile PS/Chloropicrin	Causes tears, irritates skin and respiratory tract.	Incapacitates, non-lethal.	Very rapid.

Chemical Agent Persistency

Chemical agents are also classified according to their persistency. Persistency is the length of time an agent remains effective in the target area after dissemination. The two basic classifications are as persistent or non-persistent. Generally, the OPFOR would use persistent agents in areas it does not plan to enter and nonpersistent agents where it does.

Persistent nerve agents can retain their disabling or lethal characteristics from days to weeks, depending on environmental conditions. Persistent agents produce either immediate or delayed casualties. Immediate casualties occur when the soldier inhales a chemical vapor. Delayed casualties occur when the chemical agent is absorbed through the skin or is ingested.

Persistent agents may be used to—

- Contaminate rear area supply depots or materiel.
- Block avenues of approach.
- Neutralize personnel defending a strongpoint.
- Protect flanks.
- Degrade an enemy unit's efficiency.

Aside from producing mass casualties initially, persistent agents can affect enemy morale and performance. Rounds fired sporadically may compel enemy troops to wear protective masks and clothing for prolonged periods, reducing morale and degrade performance as a result of fatigue, heat, stress, discomfort, and decreased perception. Many weapons, especially precision weapons, cannot be effectively used by operators wearing protective gear.

Nonpersistent agents generally last a shorter period of time than persistent agents, depending on the weather conditions. For example, the nerve agent sarin (GB) forms clouds that dissipate within minutes after dissemination. However, some liquid GB could remain in chemical shell or bomb craters for periods of time varying from hours to days, depending on weather conditions and type of munition. Because of this continuing but not readily discernible threat from exposure to low concentrations of the vapor, GB can also be highly effective in harassing roles. The use of a nonpersistent agent at a critical moment in battle can produce casualties or force enemy troops into a higher level of individual protective measures. With proper timing and distance, the OPFOR can employ nonpersistent agents and then have its maneuver units advance into or occupy an enemy position without having to decontaminate the area or don protective gear.

Times generally provided for the agents reflect general climate and temperate weather. In hot weather, persistent agents may have a much shorter persistence, more characteristic of non-persistent agents. In windy conditions, nonpersistent aerosol agents may dissipate rapidly; and the affected area may shift downwind.

Toxic Industrial Chemicals

In addition to traditional chemical warfare agents, the OPFOR may find creative and adaptive ways to cause chemical hazards using chemicals commonly present in industry or in everyday households. In the right combination, or in and of themselves, the large-scale release of such chemicals can present a health risk, whether caused by military operations, intentional use, or accidental release. Collateral effects include disruption of civilian activities, traffic movement, and social disruption which can disrupt military activities and movement in the affected area.

Toxic industrial chemicals (TICs) are chemical substances with acute toxicity that are produced in large quantities for industrial purposes. Exposure to some industrial chemicals can have a lethal or debilitating effect on humans. The near-universal availability of large quantities of highly toxic stored materials, their proximity to urban areas, their low cost, and the low security associated with storage facilities, make them a potentially attractive option for use as weapons of opportunity or weapons of mass destruction.

Employing a TIC against an opponent by means of a weapon delivery system, whether conventional or unconventional, is considered a chemical warfare attack, with the TIC used as a chemical agent. The target may be the enemy's military forces or his civilian population.

In addition to the threat from intentional use as weapons, catastrophic accidental releases of stored industrial chemicals may result from collateral damage associated with military operations, electrical power interruption, or improper facility maintenance or shutdown procedures. These events are common in armed conflict and post-conflict urban environments.

The most important factors to consider when assessing the potential for adverse human health impacts from a chemical release are acute toxicity, physical properties (volatility, reactivity, flammability), and the likelihood that large quantities will be accidentally released or available for exploitation. Foremost among these factors is acute toxicity.

The following are examples of high- and moderate-risk TICs, based on acute toxicity by inhalation, worldwide availability (number of producers and number of countries where the substance is available), and physical state (gas, liquid, or solid) at standard temperature and pressure:

- High-Risk. Ammonia, chlorine, fluorine, formaldehyde, hydrogen chloride, phosgene, sulfuric acid.

- Moderate-Risk. Carbon monoxide, methyl bromide, nitrogen dioxide, phosphine. This list does not include all chemicals with high toxicity and availability. Specifically, chemicals with low volatility are not included. Low-vapor pressure chemicals include some of the most highly toxic chemicals widely available, including most pesticides.

Some of the high-risk TICs are frequently present in an operational environment. Chlorine (water treatment and cleaning materials), phosgene (insecticides and fertilizers), and hydrogen cyanide are traditional chemical warfare agents that are also considered TICs. Cyanide salts may be used to contaminate food or water supplies. Hydrogen chloride is used in the production of hydrochloric acid. Formaldehyde is a disinfectant and preservative. Fluorine is a base element that is used to produce fluorocarbons. Fluorocarbons are any of various chemically inert compounds that contain both carbon and fluorine. Fluorocarbons are present in common products are refrigerants, lubricants, and nonstick coatings, and are used in the production of resins and plastics.

The current definition of TICs does not include all chemicals with high toxicity and availability. Specifically, chemicals with low volatility are not included. These low-vapor-pressure chemicals include some of the most highly toxic chemicals which are widely available, including most pesticides. Selected missions may require isolation of wide areas through chemical contamination, debilitation of personnel or animal stocks through contamination of food and water supplies, and other missions which require the use of low-volatility TICs. These may be mixed with oil or other chemical bases to extend their persistence and facilitate dispersal. Thus, there is a wide range of other TICs which could be employed for this use.

Sodium is commonly used in the commercial manufacture of cyanide, azide, and peroxide, and in photoelectric cells and sodium lamps. It has a very great latent heat capacity and is used in molten form as a coolant in nuclear breeder reactors. The mixture of sodium and water produces sodium hydroxide, which can cause severe burns upon skin contact.

The table below lists high- and moderate-risk TICs based on acute toxicity by inhalation, worldwide availability (number of producers and number of continents on which the substance is available), and physical state (gas, liquid, or solid) at standard temperature and pressure.

High- and Moderate-Risk Toxic Industrial Chemicals

High Risk	*Moderate Risk*	
Ammonia	Acetone cyanohydrins	Methyl chloroformate
Arsine	Acrolein	Methyl chlorosilane
Boron trichloride	Acrylonitarile	Methyl hydrazine
Boron trifluoride	Allyl alcohol	Methyl isocyanate
Carbon disulfide	Allyl amine	Methyl mercaptan
Chlorine	Allyl chlorocarbonate	n-Butyl isocyanate
Diborane	Boron tribromide	Nitrogen dioxide
Ethylene oxide	Carbon monoxide	Phosphine
Fluorine	Carbonyl sulfide	Phosphorus oxychloride
Formaldehyde	Chloroacetone	Phosphorus pentafluoride
Hydrogen bromide	Chloroacetonitrile	Selenium hexafluoride
Hydrogen chloride	Chlorosulfonic acid	Silicon tetrafluoride
Hydrogen cyanide	Crotonaldehyde	Stibine
Hydrogen fluoride	Diketene	Sulfur trioxide
Hydrogen sulfide	1,2-Dimethyl hydrazine	Sulfuryl chloride
Nitric acid, fuming	Dimethyl sulfate	Tellurium hexafluoride
Phosgene	Ethylene dibromide	Tert-Octyl mercaptan
Phosphorus trichloride	Hydrogen selenide	Titanium tetrachloride
Sulfur dioxide	Iron pentacarbonyl	Trichloroacetyl chloride
Sulfuric acid	Methanesulfonyl chloride	Trifluoroacetyl chloride
Tungsten hexafluoride	Methyl bromide	

Household Chemicals. It is commonly recognized that some everyday household chemicals have incompatible properties which can produce a hazardous chemical reaction when mixed with other chemicals. This includes substances that will react to cause an imminent threat to health and safety, such as explosion, fire, and/or the formation of toxic materials. For example, chlorine bleach, when mixed with ammonia, will generate the toxic gases chloramine and hydrazine that can cause serious injury or death. Another example of such incompatibilities is the reaction of alkali metals, such as sodium or potassium, with water.

Chemical Weapons

Delivery means include multiple rocket launchers (MRLs), artillery, mines, rockets, and theater missiles. Aircraft delivery means include aerial bombs or spray systems (such as for crop dusters or insecticide craft. Recent additions are cruise missiles and unmanned aerial vehicles (UAVs). Other possible delivery means include SPF, affiliated insurgent or guerrilla organizations, or unaware infected human or animal vectors.

Either fixed- or rotary-wing aircraft can deliver chemicals by air. They use low-level and contour flight profiles during these missions. Unarmed helicopters can perform these missions, possibly escorted by armed helicopters or attack aircraft. For example, a medium transport helicopter configured for chemical missions can include a 750- to 1,000-liter dispensing system. Planning for helicopter chemical missions must include a minimum of 3 hours for disarming the aircraft and then installing the chemical dispenser. Commercial crop-duster aircraft can be easily converted for use in chemical agent delivery.

Chemical Agents and Delivery Systems

Delivery System	Agent Type			
	Blood	Blister	Nonpersistent Nerve	Persistent Nerve
122-mm Howitzer		X	X	
130-mm Gun			X	X
152-mm Howitzer		X	X	
155-mm Howitzer		X	X	
122-mm Rocket	X		X	X
140-mm Rocket			X	
220-mm Rocket			X	X
300-mm Rocket			X	X
SRBM				X
Aerial Bomb 100 kg		X		
Aerial Bomb 250 kg			X	X
Aerial Spray		X		

Chemical munitions are fitted with long or short bursters, according to the agent properties and the intended effect. A munition with the nerve agent sarin (GB) and a long burster releases the agent as a vapor or fine aerosol. This creates an immediate inhalation hazard with some of the fragmentation effect of a conventional munition. A 152-mm howitzer battalion firing GB rounds for one minute could affect an area 650 x 450 m. When firing a chemical mission, the OPFOR generally employs at least a battalion of cannon artillery or a battery of MRLs.

A blister or persistent nerve agent-filled munition with a short burster is used to contaminate terrain or equipment. The short burster disperses the agent in droplets or as a coarse aerosol, creating a skin hazard. The agent evaporates more slowly; and its effects remain on target longer.

Weapons for delivery by ground forces include hand-delivered satchel charges for timed or remote detonation, chemical mines, and vehicle-borne or water-borne charges.

BIOLOGICAL WARFARE

Biological weapons can facilitate military advantages for success prior to or during wartime, and can provide a great equalizer in the face of a numerically and/or technologically superior adversary. However, research, development, and employment of these weapons are fraught with many strategic political and military concerns for consideration prior to use. Also, effects and their limits can be difficult to predict; any user OPFOR must be concerned with the possibility that the effects could spread to friendly forces, peoples, and home territories.

Biological Agents

Biological weapons consist of pathogenic microbes, microorganism toxins, and bio-regulating compounds. Biological weapons are extremely potent and provide wide-area coverage. The type of target to be attacked is the first factor in determining the choice of agent and dissemination system. Other factors include deliverability, desired level of effects, desired rates of incubation and transmission, persistence of maximum effect, etc. Depending on the specific type, these weapons can incapacitate or kill people or animals and destroy plants, food supplies, or materiel. Some agents are extremely virulent and persistent, retaining their capabilities to infect for days, weeks, or longer.

Biological agents include three basic categories: pathogens, toxins, and bio-regulators.

Examples of Biological Warfare Agents

Pathogens	Toxins	Bio-regulators
Anthrax Cholera Plague Smallpox Tularemia Influenza Fevers	Mycotoxins Venoms Shell fish Botulinum Ricin	Neurotransmitters Hormones Enzymes

Pathogens cause diseases such as anthrax, cholera, plague, smallpox, tularemia, or various types of fever. These weapons would be used against targets such as food supplies, port facilities, and population centers to create panic and disrupt mobilization plans.

Toxins are produced by pathogens and also by snakes, spiders, sea creatures, and plants. Toxins are faster acting and more stable than live pathogens. Most toxins are easily produced through genetic engineering. Toxins produce casualties rapidly and can be used against tactical and operational targets.

Bio-regulators are chemical compounds that are essential for the normal psychological and physiological functions. A wide variety of bioregulators are normally present in the human body in extremely minute concentrations. These low-molecular-weight compounds, usually peptides (made up of amino acids), include neurotransmitters, hormones, and enzymes. Examples of bioregulators are insulin (a pancreatic protein hormone that is essential for the metabolism of carbohydrates) and enkephalin (either of two pentapeptides

with opiate and analgesic activity that occur naturally in the brain and have a marked affinity for opiate receptors).

These compounds can produce a wide range of harmful effects if introduced into the body at higher than normal concentrations or if they have been altered. Psychological effects could include exaggerated fear and pain. In addition, bioregulators can cause severe physiological effects such as rapid unconsciousness and, depending on such factors as dose and route of administration, can also be lethal. Unlike pathogens, which take hours or days to act, bioregulators could act in only minutes. The small peptides, having fewer than 12 amino-acid groups, are most amenable to military application.

Biological Agent Effects

Another way to categorize biological warfare agents is by their effects. Effects of types of agents on various types of targets are noted above by agent type.

Effects of Biological Agents	
Agent Type	Agent Effects
Anti-personnel	Microorganisms or toxins that cause disease or death
Anti-plant	Living microorganisms that cause disease or death
Anti-animal	Agents that can be used to incapacitate or destroy domestic animals through disease, or used to limit wool, hide, or fur production.
Anti-materiel	Agents used to deteriorate critical materiel needed for the war effort such as leather, canvas, high-grade rocket fuels, or electronics.

Biological Agent Delivery Means

It is possible to disseminate biological agents in a number of ways. Generally, the objective of biological weapons is to expose enemy forces to an agent in the form of a suspended cloud of very fine biological agent particles. Those between 1 and 10 micrometers (μm) in diameter are the most effective because, once inhaled, particles of this size tend to lodge deep in the lungs close to vulnerable body tissues and the bloodstream. Dissemination through aerosols, either as droplets from liquid suspensions or by small particles from dry powders, is by far the most efficient method.

There are two basic types of biological munitions: point-source bomblets delivered directly on targets, and line-source tanks that release the agent upwind from the target. Within each category there can be multiple shapes and configurations. Military systems as well as unconventional means can deliver agents.

Point-source dissemination involves on-target attacks using forms of fuzed munitions that explosively disseminate or spray the biological agent at or near the ground. The delivery means include ballistic and cruise missile warheads, fixed- and rotary-wing aircraft, and cannon and rocket artillery.

Line-source dissemination involves off-target (upwind) attacks using agent disseminators moved along paths perpendicular to the wind direction. Means of delivery include fixed- and rotary-wing aircraft, unmanned aerial vehicles, cruise missiles, boats, submersibles, and ground

vehicles. Attack means also include multiple detonation or spray munitions emplaced at or near ground level upwind from the target and triggered remotely or by timing devices.

Military systems, as well as unconventional means, can deliver biological agents. Potential delivery means include rockets, artillery shells, aircraft sprayers, saboteurs, and infected rodents. The OPFOR might use SPF, affiliated irregular forces, and/or civilian sympathizers to deliver biological agents within the region, outside the immediate region (to divert enemy attention and resources), or even in the enemy's homeland. Unconventional dissemination means include commercially available or specially designed sprayers or other forms of aerosol generators mounted in automobiles, trucks, or boats. Backpack and "suitcase" devices also can be used to effectively disseminate biological agent aerosols. Devices resembling insecticide spray cans may be used to introduce an agent into heating, ventilating, and air conditioning systems. Drinking water can be contaminated by means of high-pressure agent injectors attached to plumbing system components. Another way to disseminate infectious agents is by the use of insects, rodents, or other arthropod vectors.

RADIOLOGICAL WARFARE

It is possible that the OPFOR may develop and employ radiological weapons whose effects are achieved by using toxic radioactive materials against desired targets. The purpose of employing radiological materials could be to achieve leverage or intimidation against regional neighbors. However, such weapons could also be used to deter intervention by extra regional forces or disrupt such forces once deployed in the region. While they can be used as area denial, intimidation, and political weapons, radiological weapons are also considered weapons of terror.

Radiological Weapons

A radiological weapon is any device, including weapon or equipment other than a nuclear explosive device, specifically designed to disseminate radioactive material to cause destruction, damage, or injury by means of radiation produced by the decay of such material. Radiological weapons differ from chemical and biological weapons in that radiation cannot be "neutralized" or "sterilized" and many radiological materials have half-lives in years. Two general types of radiological weapons are radiological dispersal devices and radiological exposure devices.

Radiological Dispersal Devices

A radiological dispersal device (RDD) is an improvised assembly or process, other than a nuclear explosive device, designed to disseminate radioactive material in order to cause destruction, damage, or injury. Unlike nuclear weapons, RDDs do not produce a nuclear explosion. However, RDDs spread radioactive material contaminating personnel, equipment, facilities, and terrain. They kill or injure by exposing people to radioactive material. Victims are irradiated when they get close to or touch the material, inhale it, or ingest it. The actual dose rate depends on the type and quantity of radioactive material spread over the area, and contributing factors such as weather and terrain.

The OPFOR could disperse radioactive material using low-level radiation sources in a number of ways, such as—

- Arming a conventional missile warhead with active material from a nuclear reactor.
- Releasing low-level radioactive material intended for use in industry or medicine.
- Disseminating material from a research or power-generating nuclear reactor.
- Depositing a radioactive source in a water supply.

Dispersal of radioactive materials is inexpensive and requires limited resources and technical knowledge. The primary source for radioactive material used in the construction of RDDs is from nuclear power plants and radioactive materials used in hospitals. Thus, a likely source for the weapon for such an event could be materials obtained in or near the target area.

One design of RDD, popularly called a "dirty bomb," uses conventional explosives to disperse radioactive contamination. Any conventional or improvised explosive device can be used by placing it in close proximity to radioactive material. The explosion causes the dissemination of the radioactive material. A dirty bomb typically generates its immediate casualties from the direct effects of the conventional explosion (blast injuries and trauma).

However, one of the primary purposes of a dirty bomb is to frighten people by contaminating their environment with radioactive materials and threatening large numbers of people with exposure. As an area denial weapon, an RDD can generate significant public fear and economic impact. In some cases, an area may not be habitable for nonmilitary personnel, but military operations could continue, with appropriate protective measures.

Radiological Exposure Devices

A radiological exposure device (RED) is a radioactive source placed to cause injury or death. Thus contamination and harmful health effects result from exposure to discrete sources, such as a radioactive source concealed in a high traffic area. The placement of an RED may be covert in order to repeat exposures and increase potential doses if the source is not detected.

NUCLEAR WARFARE

The OPFOR plans to conduct the initial nuclear attack suddenly and in coordination with nonnuclear fires. An OPFOR force may employ nuclear weapons for various reasons. But the force is less likely to employ them against a superior enemy that also has superior inventories of nuclear weapons and delivery systems. A terrorist or insurgent force may use nuclear weapons, especially if it believes that it can avoid exposure and consequences for the actions.

Initial nuclear attack objectives include destruction of the enemy's main combat formations, C2 systems, and nuclear and precision weapons, thereby isolating the battlefield. Other key targets include means of early entry, such as canals, ports, airfields, and railroad facilities. Urban areas can be targeted to pressure the enemy into a negotiated end to conflict, or political concessions.

Another significant objective, and perhaps the most effective use of a nuclear weapon, would be to deliver a high-altitude electro-magnetic pulse (EMP) burst above a target area, to destroy much of the high technology communications systems and degrade infrastructure operations within the area. Studies show that such a blast, depending on weapon size and target type, could destroy integrated circuitry for hundreds of kilometers, and halt information networks for thousands of kilometers. These include intelligence and command nets, GPS systems, electrical grids, air and surface and water traffic, etc. Internet-based nets control medical systems, dam controls, monetary systems, and other infrastructure systems. During critical phases of a national crisis or military operation, such a loss could be render forces impotent.

Nuclear Delivery Means

If the OPFOR decides to use nuclear weapons, delivery systems include aircraft, and ballistic and cruise missiles. Many artillery 152-mm or larger systems are capable of firing nuclear rounds, if available. Other possible delivery means could include personnel such as SPF with satchel or vehicle-based weapons. The OPFOR may also choose to use affiliated forces for nuclear delivery. A force without nuclear-capable missiles or aircraft could obtain missile warheads or aircraft-delivery bombs and modify them for ground use with timers or remote detonators.

CBRN PROTECTION

Due to the proliferation of CBRN weapons, the OPFOR must anticipate their use, particularly the employment of chemical weapons. OPFOR planners readily admit that casualties would be considerable in any future war involving the use of CBRN weapons. However, they believe that the timely use of active and passive measures can significantly reduce a combat unit's vulnerability. These measures include but are not limited to protective equipment, correct employment of reconnaissance assets, and expeditious decontamination procedures.

All OPFOR units and branches have a responsibility for assuring CBRN protection, activities, and training. However, it is the specialized chemical troops who have primary responsibility for ensuring that combat units function as capably as possible in a CBRN or CBRN-potential environment. Specialized CBRN equipment and selected equipment in engineer and logistical units will be used to assure protection. CBRN reconnaissance equipment include monitor devices, warning nets, and specialized vehicles, aircraft, and unmanned aerial vehicles. They also include individual and collective protection and decontamination equipment.

CBRN protection functions are not limited to maneuver units. Artillery and air defense brigades have their own chemical defense units. Medical and SSM units have decontamination equipment. Engineer troops also are important, performing functions such as decontaminating roads, building bypasses, and purifying water supplies. Of course, all arms have a responsibility for CBRN reconnaissance and at least partial decontamination without specialist support. However, they can continue combat actions for only a limited time without complete decontamination by chemical troops.

CBRN Reconnaissance

Equipment for CBRN reconnaissance includes CBRN reconnaissance patrol vehicles, CBRN rotary-wing and fixed-wing aircraft, and CBRN monitoring and alert systems. Some forces have UAVs equipped for CBRN patrols. When operating in reconnaissance patrols, personnel travel in reconnaissance vehicles and aircraft specially equipped with CBRN detection and warning devices. CBRN observation posts will also be set up to monitor conditions throughout the battlefield area. The observers immediately activate CBRN detection devices after an enemy overflight, missile burst, or artillery shelling.

The OPFOR transmits CBRN warning information over communications channels in a parallel form using both the command net and the air defense and CBRN warning communications net. Depending of what type of unit initially detected the contamination, detection reports leading to such warnings may go either through chemical defense and force protection channels or through the maneuver unit or ground reconnaissance reporting chain. The CBRN net is integrated with a battle management system, which uses a digital map overlay and displays attack imminent data, and denotes CBRN attack areas. Many OPFOR forces use an "attack alert net" with audible warnings to signal various types of attack. Thus different signals describe the attack as: air, ground, or CBRN. Units are notified with a preformatted warning which can be passed in near-real-time to affected battalions and relayed to lower units.

CBRN Protective Equipment

Basic personal protective measures begin with CBRN protective equipment. When used correctly, this equipment for ***Individual Protection*** enables troops to continue combat actions on contaminated terrain. Items of equipment for individual or collective protection are adequate to protect soldiers from contamination for hours, days, or longer, depending on the nature and concentration of the contaminant. Troops put on their protective masks and suits as soon as a CBRN attack occurs, or when the alarm is given. Troop units receive alerts of such attacks by siren, radio, wire, verbal warning, signal flares, or signal rockets. Agent detector kits and automatic alarms are available, and are capable of detecting BW agents. Radiation detection systems can include monitors and Geiger counters.

The OPFOR also uses ***collective protection*** systems, such as shelters and combat vehicles equipped with filter and ventilation systems. When riding in CBRN-protected combat vehicles, personnel do not need to wear individual protective gear. One drawback of collective protection systems is that personnel exiting a shelter or vehicle cannot return until they completely decontaminate or remove their protective clothing.

Once personnel are exposed to CBRN, units will seek to minimize harm. Antidotes can palliate the effects of chemical agents. Some vaccines and treatments can be used to treat personnel exposed to BW agents on-site. Radiation badges can help monitor levels of exposure.

Decontamination Systems

The OPFOR distinguishes between two types of decontamination of personnel and equipment: partial and complete. It tries to perform one or both as soon after exposure as possible. Specialized decontamination vehicles like those on following pages speed the effort.

A combat unit should conduct a partial decontamination with organic equipment no later than one hour after exposure to contamination. This entails a halt while troops decontaminate themselves and their clothing, individual weapons, crew-served weapons, and vehicles.

Complete decontamination involves the decontamination of the entire surface of a contaminated piece of equipment. This usually requires special decontamination stations established by decontamination units. Before deploying his equipment, the commander of a decontamination unit dispatches a reconnaissance element to select a favorable site, mark areas for setting up the equipment, and mark entry and exit routes.

Under some circumstances, it may be accomplished by troops using individual decontamination kits. However, more efficient and rapid decontamination can be executed with specialized decontamination systems, such as specialized vehicles.

The OPFOR decontaminates terrain by covering contaminated soil or spraying it with solvent or disinfectant from specially designed decontamination vehicles. For radiological decontamination, engineer earth-moving equipment can remove the contaminated top layer. An alternative is to cover it with uncontaminated materials (soil, wood, or other surfacing materials).

Russian Decontamination/Smoke Generator Vehicle TMS-65M

Weapons & Ammunition Types	Typical Combat Load
N/A	N/A

SYSTEM
Alternative Designations: None
Date of Introduction: INA
Proliferation: At least 1 country
Description:
Crew: 2
Automotive Performance:
Chassis Type: Ural 4320, 6x6
Weight of System (mt)
Empty: INA
Filled: INA
Chassis Length Overall (m): 7.3
Height Overall (m): 2.5
Width Overall (m): 2.8
Engine Type: YaMZ-238M2, 240 hp, V-8 liquid cooled diesel
Cruising Range (km): 1040
Speed (km/h):
Max Road: 82
Max Off-Road: INA
Cross-Country: INA
Ground Clearance (m): .4
Fording Depths (m): .1.5
Emplacement Time: 10-12 minutes
Displacement Time: 10-12 minutes

SMOKE GENERATOR
Physical Characteristics:
Name: INA
Length (m): INA
Height (m): INA
Width (m): INA
Number of Nozzles: 6
Location of Nozzle: INA
Nozzle Orifice Size (m): INA

Nozzle Movement:
Traverse (°): 90
Elevation (°): 12
Depression (°): 23
Operating RPM's of Turbine Engine: INA
Idle Speed (rpm): INA
Max Effective Speed (rpm): INA
Ability to Generate on the Move: Yes

Performance Characteristics:
Engine Name: VK-1A modified gas turbine
Fuel Type: INA
Fuel Capacity (l): 1500
Operating Temperature (°C): INA
Operating Time (min): 60
Time to Initiate Smokescreen (min): 10
Pump Type: INA
Pump Capacity (l/min): INA
Generator Efficiency (%): 96

Smoke Agent
Agent Type: GOST 305-73
Nomenclature: GOST-305-82 Petroleum Obscurants: Manmade Agents
Cloud Color: White
Capacity of Smoke Agent (l): 1500
Smoke Agent Consumption Rate (l/hr): 1500
Odor: Faint sulfur
Protection Required: None

VARIANTS
None

NOTES
The TMS-65M is primarily used for the decontamination of vehicles and equipment whether stationary or on the move. Additionally, the system can be used to decontaminate ground and hard surface roads as well as produce protective smokescreens. The VK-1 turbine engine (a modified MIG-17 engine) along with a sealed control cab is mounted on an Ural 4320, 6x6 truck chassis. The turbine engine can be moved vertically or horizontally by controls located in the operator's control cab. The operator's control cab is fixed to the left side of the turbine engine and is equipped with floodlights for limited visibility operations. Two 1500-liter tanks are mounted across the front of the truck bed between the driver's cab and the turbine engine. One tank is used for obscurant, decontaminants, or water and the other tank is used for the fuel to power the turbine engine. The obscurant, decontaminant, or water is fed through pipes into the turbine engine exhaust stream. Depending upon the size and level of contamination the TMS-65M is capable decontaminating equipment at a rate of 30 seconds to 3 minutes per item.

Slovakian Decontamination/Smoke Generator Vehicle TZ-74

Weapons & Ammunition Types	Typical Combat Load
N/A	N/A

SYSTEM
Alternative Designations: None
Date of Introduction: INA
Proliferation: At least 3 countries
Description:
Crew: 2
Automotive Performance:
Chassis Type: Tatra 148 PPR 15, 6x6
Weight of System (mt)
Empty: 14.4
Filled: 21.9
Chassis Length Overall (m): 8.49
Chassis Height Overall (m): 2.5
Chassis Width Overall (m): 3.2
Engine Type: Tatra 2-298-1, 1,200 hp V-8 air cooled diesel
Cruising Range (km): 400
Speed (km/h):
Max Road: 71
Max Off-Road: INA
Cross-Country: INA
Ground Clearance (m): INA
Fording Depths (m): .1.0
Emplacement Time: approximately 10-12 minutes
Displacement Time: approximately 10-12 minutes

SMOKE GENERATOR
Physical Characteristics:
Name: INA
Length (m): 9.5
Height (m): 2.95
Width (m): 2.5
Number of Nozzles: 1
Location of Nozzle: Center of turbine engine exhaust diffuser
Nozzle Orifice Size (m): 1.27

Nozzle Movement:
Traverse (°): 120
Elevation (°): 30
Depression (°): 20
Operating RPM's of Turbine Engine: 13,000 rpm (equals 84%)
Idle Speed (rpm): 5400
Max Effective Speed (rpm): 1400
Ability to Generate on the Move: No

Performance Characteristics:
Engine Name: Type M701 C-500
Fuel Type: Diesel
Fuel Capacity (l): 2,000
Operating Temperature (°C): INA
Operating Time (min): 22.0
Time to Initiate Smokescreen (min): 1
Pump Type: 24-V
Pump Capacity (l/min): 900
Generator Efficiency (%): 98

Smoke Agent
Agent Type: TZ-74 Fog Oil
Nomenclature: TZ-74 Fog Oil-Petroleum Obscurants: Manmade Agents
Cloud Color: White
Capacity of Smoke Agent (l): 208
Smoke Agent Consumption Rate (l/hr): 120.0
Odor: Diesel fuel
Protection Required: Protective mask

VARIANTS
None

NOTES
The TZ-74 is primarily used for the decontamination of vehicles and equipment whether stationary or on the move. Additionally, the system can be used to decontaminate ground and hard surface roads as well as produce protective smokescreens. The TZ-74 is based on the chassis of the Tatra 148 PPR 15, 6x6 trucks. The system uses a gas turbine engine to generate a smoke screen over a large area. The gas turbine is mounted on the rear of the vehicle with the operator's cabin on the left-hand side, and an obscurant tank on the right-hand side. The remainder of the rear of the vehicle consists of storage tanks for liquids and fuel for the turbine engine. A smokescreen is created as a result of the introduction of oil, diesel fuel, or a combination of both into the exhaust nozzle of the turbine engine. The introduction of the mixture into the turbine engines exhaust causes an immediate dispersion and evaporation of the mixture that condenses in the cooler part of the stream after expulsion from the motor.

The TZ-74 can produce smoke in about a minute after the turbine engine is turned on. Although the jet engine has enough fuel to operate for 3 hours, its mission time is severely limited by the capacity of the internal liquid sources available. However, if external sources are used, the mission times are dramatically increased. The main decontaminant tank has a 5,000-liter capacity. The fog oil tank has a 200-liter capacity. The fuel tank for the gas turbine has a 2,000-liter capacity.

Chapter 12
Logistics

This chapter provides the basic characteristics of selected ***logistics vehicle and trailers.***. This chapter provides the basic characteristics of selected trucks, maintenance vehicles, and other logistic equipment readily available to the OPFOR. It includes a representative vehicle from the light, utility, medium, and heavy truck categories. Later updates of this guide will include data on a wider selection of trucks, trailers, vans and other logistical equipment.

Questions and comments on data listed in this chapter should be addressed to:

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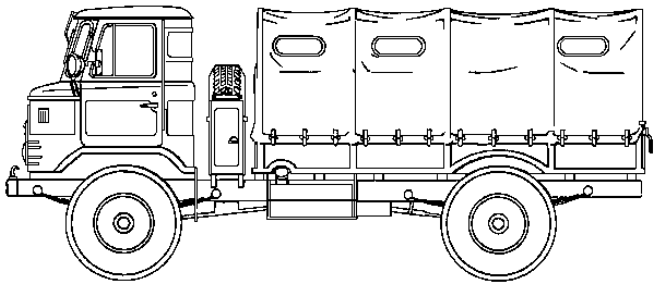
Russian 2 mt 4 x 4 Cargo Truck GAZ-66



SYSTEM

Alternative Designations: INA
Date of Introduction: 1964
Proliferation: Widespread

Description:
Troop Capacity: 3 in cab, 18 in rear
Weight (mt):
Gross Vehicle Weight: 5.8
Curb: 3.6
Length Overall (m): 5.65
Height Overall (m): 2.44
Width Overall (m): 2.32
Payload on/off Highway (kg): 2,000
Number of Axles: 2
Ground Clearance (mm): 315
Turning Radius (m): 10
Wheels:
Size (in): 12x18
Central Tire Pressure Regulation System: Yes

AUTOMOTIVE

Engine: V8, 115 hp, gasoline
Cooling: Water
Cruising Range (road) (km): 875
Speed (km/h): 95
Fuel Capacity (liters):
Left Tank: 105
Right Tank: 105
Towing Capability (kg):
Off Highway: 2,000
On Highway: 2,000
Gradient (loaded) (°): 39
Fording Depths (m): .8

CARGO SPACE

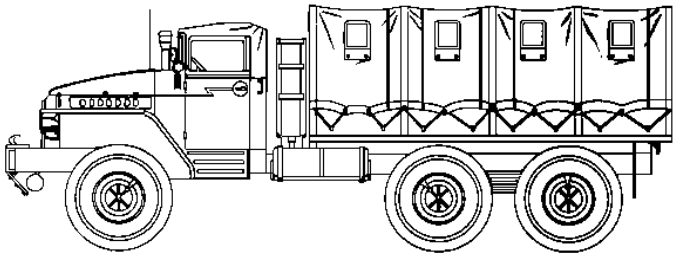
Height (mm): 890
Width (mm): 2,050
Length (mm): 3,330
Cargo Bed Area (m^2): 6.8

VARIANTS

GAZ-66B: Canvas-top cab for air transport or airdrop
GAZ-66A: Steel cab
Numerous other variants for various duties.

NOTES
Besides functioning as a general cargo carrier, the GAZ-66 is used as a prime mover for 120-mm mortar. The DDA-66 variant is an NBC decontamination truck.

Russian 4.5 mt 6 x 6 Cargo Truck Ural-375D



SYSTEM
Alternative Designations: INA
Date of Introduction: 1965
Proliferation: Widespread

Description:
Troop Capacity: 3 in cab, 24 in rear
Weight (mt):
Gross Vehicle Weight: 13.2
Curb: 8.4
Length Overall (m): 7.36
Height Overall (m): 2.68
Width Overall (m): 2.67
Payload on/off Highway (kg): 4,500
Number of Axles: 3
Ground Clearance (mm): 410
Turning Radius (m): 10.8
Side Slope (°): 32
Vertical Step (mm): 800
Gradient (loaded) (°)**:** 65
Fording Depths (m): 1.49
Trench Crossing Width (mm): 875
Wheels:
Size (in): 14x20
Central Tire Pressure Regulation System: Yes
Run Flat: INA

AUTOMOTIVE

Engine: V8, 180 hp, gasoline
Cooling: Liquid
Cruising Range (road) (km): 650
Speed (km/h): 75
Fuel Capacity (liters):
Main Tank: 300
Aux Tank: 60
Towing Capability (kg):
Off Highway: 5,000
On Highway: 10,000

CARGO SPACE

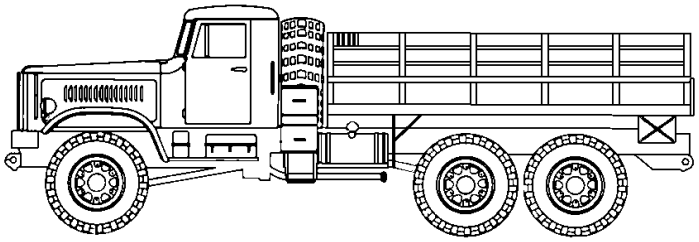
Height (mm): 872
Width (m): 2.43
Length (m): 3.9
Cargo Bed Area (m^2): 9.5

VARIANTS

URAL-375: Observation hatch and unimproved power train
URAL-375E: Decontamination vehicle
URAL-375N: 2,000 kg additional payload
URAL-375S: Truck-tractor
URAL-375T: Equipped with winch

NOTES
Besides functioning as a general cargo carrier, the Ural-375D is used as a prime mover for light and medium artillery. The Ural-375 chassis also serves as a base for the BM-21 MRL, POL tankers, vans, and cranes. The Ural-4320 began to replace the Ural-375D around 1978.

Russian 7.5 mt 6 x 6 Cargo Truck KrAZ-255B



SYSTEM

Alternative Designations: INA
Date of Introduction: 1967
Proliferation: Widespread

Description:
Troop Capacity: 3 in cab, 16 in rear
Weight (mt):
Gross Vehicle Weight: 19.7
Curb: 12
Length Overall (m): 8.64
Height Overall (m): 2.94
Width Overall (m): 2.75
Payload (kg): 7,500
Number of Axles: 3
Ground Clearance (mm): 360
Turning Radius (m): 14
Wheels:
Size (in): 20x21
Central Tire Pressure Regulation System: Yes
Run Flat: INA

AUTOMOTIVE

Engine: V8, 265 hp, diesel
Cooling: Water
Cruising Range (road) (km): 850
Speed (km/h): 70
Fuel Capacity (liters):
Right Tank: 165
Left Tank: 165
Towing Capability (kg):
Off Highway: 10,000
On Highway: 50,000
Gradient (loaded) (°): 30
Fording Depths (m): 1

CARGO SPACE

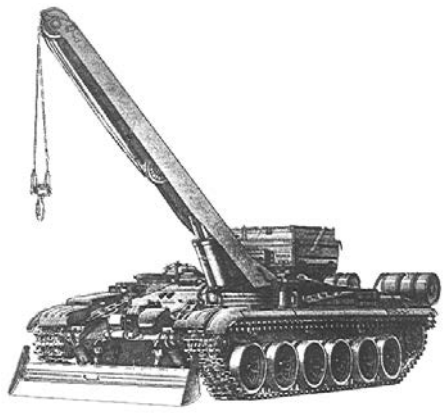
Length (m): 4.56
Width (m): 2.5
Height (m): .92
Cargo Bed Area (m^2): INA

VARIANTS

KrAZ-258: Tractor-truck
Numerous other variants for various duties.

NOTES
Primarily designed as a cargo truck, the KrAZ-255B is also used as a prime mover for various equipment including a tank-transporter trailer and PMP pontoon bridge.

Russian Armored Recovery Vehicle BREM-1



Weapons & Ammunition Types	Typical Combat Load
12.7-mm AD MG	840

SYSTEM

Alternative Designations: None
Date of Introduction: 1984
Proliferation: At least 5 countries.
Description:
Crew: 3 (see NOTES)
Chassis: T-72 tank
Weight (mt): 41
Length Overall (m): 7.98
Height Travel (m): 2.45
Width Overall (m): 3.46
Clearance (mm): 457
Gradient (°): 30
Trench Crossing (m): 2.8
Fording Depth (m): 1.2
Vertical Step (m): .85

AUTOMOTIVE

Engine: V-12 Multi-fuel Diesel, 840 hp
Cruising Range w/external tanks (km):
Dirt Road w/o Towed Vehicle: 650
Dirt Road Towing Vehicle: 220-430
Highway w/o Towed Vehicle: 700
Speed (km/h):
Max Highway: 60
Dirt Road: 45
Towing Tank on Dirt Road: 12
Smoke Equipment: Vehicle engine exhaust smoke system (VEESS)
Four smoke grenade launchers may be fitted.
NBC Protection: Yes
Radio: R-123

BLADE

Width (m): 3.1

CRANE

Capacity (mt):
2 m Extension: 19
4.4 m (max) Extension: 3
Boom Length (max) (m): 4.4

WINCH

Capacity (mt):
Line Pull: 25
With Blocks: 100
Cable Length (m): 200
Auxiliary Wench:
Capacity (line pull) (kg): 530
Cable Length (m): 400

TOWING

Capacity (mt): 50
Towing Rods:
Two 1.68 m
Two 5.5 m
Hydraulic Jack Capacity (mt): 30

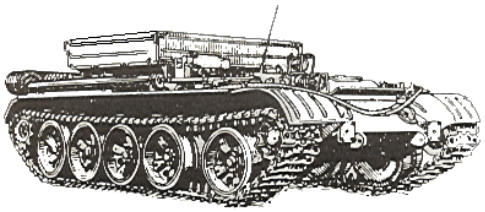
ARMAMENT

Caliber, Type, Name: 12.7-mm, AD MG NSV-T
Mount Type: Cupola
Max Effective Range (m):
AA: 1,500
Ground: 2,000
Fire on Move: Yes

VARIANTS
None

NOTES
The BREM-1 is designed to tow damaged tanks from the battlefield to damaged vehicle collection points. It has a crew of three—commander, driver, and mechanic. Instead of a turret it has a rectangular platform on top of the hull for work and loading.

Russian Armored Recovery Vehicle T-54-T



SYSTEM

Alternative Designations: BTS-2 (Medium Tank Towing Vehicle-2)
Date of Introduction: 1965
Proliferation: At least 50 countries
Description:
Crew: 3 to 5
Chassis: T-54
Weight (mt): 36
Length (m): 7.5
Height (m): 1.9
Width (m): 3.27
Clearance (mm) 264
Gradient (°): 31
Trench Crossing (m): 2.7
Fording Depth (m):
Unprepared: 1.4
With Snorkel: 5.5
Vertical Step (m): .8

AUTOMOTIVE

Engine: V-12 Diesel, 520 hp
Cruising Range (km): 400
Speed (km/h): 48

Smoke Equipment: Vehicle engine exhaust smoke system.
NBC Protection: No. (see VARIANTS)
Radio: INA

CRANE CAPACITY (mt): 1

TOWING CAPACITY (mt): At least 40

ARMAMENT
None

VARIANTS
There are numerous variants based on T-54 and T-55 chassis each with differing equipment modifications.
T-54 (A): Former East German manufacture. Push/pull bar at front, 1 mt crane, NBC equipment, no winches or spades.
T-54 (B): Former East German manufacture. Similar to T-54 (A). Tow cable brackets at hull rear, hull front protective plate, snorkel. No winch or spade.
T-54 (C): Former East German manufacture. Heavy-duty crane, snorkel.

NOTES
The T-54-T armored recovery vehicles are based on modified chassis of the T-54 medium tank. The recovery vehicle variants have a crane able to lift up to 3 mt, a loading platform, and a spade on the rear of the vehicle. They can mount a snorkel for deep fording. Performance figures are the same for the T-54 (and T-55) tanks. They replaced older tank recovery vehicles based on the T-34 chassis.

Russian 6 mt 6 x 6 General Utility Truck KamAZ 4310

Photo by: Vitaly Kuzmin

SYSTEM

Alternative Designations: INA
Date of Introduction: 1980
Proliferation: Russia, Bulgaria, Lithuania, Serbia, Poland, Hungary, Romania, Latvia, Cuba, Venezuela, Panama, Vietnam, Afghanistan, Turkey, Algeria, Kuwait, Sudan, Senegal, Burkina Faso, Botswana, Guinea, Iran, India, Pakistan

Description:
Troop Capacity: 3 in cab, 18 in rear
Weight (mt):
Gross Vehicle Weight: 7
Curb: 3.6
Length Overall (m): 7.73
Height Overall (m): 3.375
Width Overall (m): 3.34
Payload on/off Highway (kg): 6,000
Number of Axles: 3
Ground Clearance (mm): 550
Turning Radius (m): 10
Wheels:
Size (mm): 533 X 610
Central Tire Pressure Regulation System: Yes

AUTOMOTIVE

Engine: V8, 165 hp, diesel turbocharged
Cooling: Water
Cruising Range (road) (km): 1000
Speed (km/h): 85
Fuel Capacity (liters):
Left Tank: 120
Right Tank: 120
Towing Capability (kg):
Off Highway: 2,000
On Highway: 7,000
Gradient (loaded) (°): 31
Fording Depths (m): .5

CARGO SPACE

Height (mm): 890
Width (mm): 2,470
Length (mm): 4,890
Cargo Bed Area (m^2): ~ 12

VARIANTS

KamAZ-43101: More powerful 220 hp engine
Numerous other variants for various duties.

NOTES
Besides functioning as a general cargo carrier, the KamAZ-4310 is used as a Command and Control Vehicle.

SOFRAME RP 2.5 Trailer

SYSTEM
Date of Introduction: 2012
Proliferation: Widespread
Primary Country: FRANCE

DESCRIPTION
Nominal Payload 2.5 tonnes
Trailer type Full
Tanker Height 1500 mm
Cargo Height 2300 mm
Generator Height 2070 mm
Length 3880 mm
Width 2050 mm
Ground Clearance 320 mm

PAYLOAD WEIGHT DATA
Tanker Payload on-road 1500 liters
Cargo Payload on-road 1540 kg
Generator Payload on-road 1640 kg
Tanker Curb Weight 800 kg
Cargo Curb Weight 760 kg
Generator Curb Weight 660 kg
Gross Vehicle Weight on-road 2300 kg

Number of Axels 1
Suspension, rear Torsion bars
Number of tires 2 and two landing gear or dolly wheels
Break system (rear) Drum, full air

UTILITY
Transport: Water, fuel, tents, generators, barb wire, refrigerated containers, space heaters, ammunition and field supplies.

MOBILITY
Air Lift (including helicopter)
Crane Lift
Fork Lift

VARIANTS
Tanker designed to carry fuel or water
Cargo designed to carry field equipment
Generator designed to carry generators.

NOTES
Multipurpose cross-country trailer can carry a series of modular bodies including standard cargo bodies, fuel, water and generators. Designed to be transportable by aircraft or helicopter.

NK P-126 MPT 2-wheel Trailer

SYSTEM
Date of Introduction: 2009
Proliferation: Europe and Africa
Primary Country: GREECE

DESCRIPTION
Nominal Payload 2.0 tonnes
Trailer type Full
Towing Vehicle MAN-Steyr or Mercedes-Benz Unimog trucks
Length 4000 mm
Width 2400 mm
Height 2780 mm
Track center-to-center rear 2000 mm

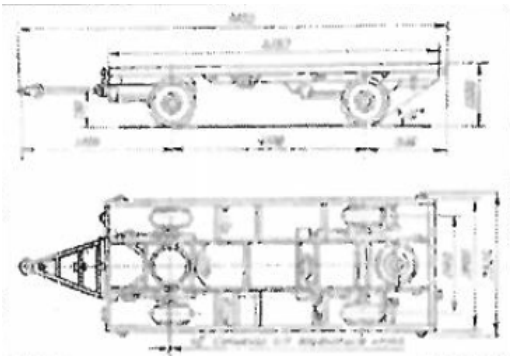
PAYLOAD WEIGHT DATA
Payload on-road 2000 kg
Curb Weight 1800 kg
Gross Vehicle Weight (on-road) 3800kg

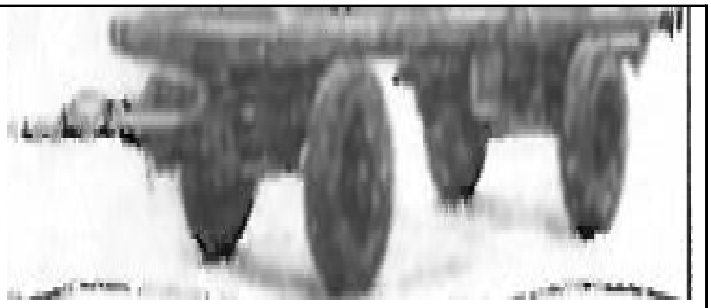
Number of Axels 1
Suspension, rear Longitudinal leaf
Number of tires 2 plus spare
Break system (rear) Full dual air line

UTILITY
Transport: tents, generators, barb wire, refrigerated containers, space heaters, ammunition and field supplies.

SPECIFICATIONS
Multipurpose trailer suited for twin mounted generator sets. Welded steel cargo body with steel sheet roof. Hinged rear tailgate and side covers provide easy access for servicing and cooling air circulation for two air or liquid cooled gensets. Trailer is equipped with NATO towing eye, jockey wheel at the front and retractable leg at the rear.

MAZ-8950 Trailer





SYSTEM
Date of Introduction: 1996
Proliferation: East Europe
Primary Country: RUSSIA

DESCRIPTION
Nominal Payload 10.0 tonnes
Trailer type Full
Towing Vehicle Kraz-255B
Length 8920 mm
Width 2820 mm
Height 1200 mm
Wheelbase 4100 mm
Track – center-to-center, rear 2160 mm
Cargo Bed Length 6780 mm
Cargo Bed Width 2800 mm
Cargo Bed Height side 1200 mm
Loading Height 1200 mm
Towing lunette height 730 mm

PAYLOAD WEIGHT DATA
Payload off-road 10500 kg
Payload on-road 10500 kg
Curb Weight 4500 kg
Gross Vehicle Weight off-road 15000 kg
Gross Vehicle Weight on-road 15000 kg

Number of Axels 2
Suspension, front Independent torsion bar
Suspension, rear Independent torsion bar
Number of tires 4
Break system (rear) Mechanical and rear wheels
Break system (front) Pneumatic, all-wheel

UTILITY
Haul various types of equipment weighing up to 10 tonnes.

SPECIFICATIONS
Double axle low-frame chassis has specifically constructed frame intended for mounting various types of equipment. Trailer has four stabilizing jacks which can be switched to traveling position when the vehicle is in motion.

Chapter 13
Obscurants and Flame

This chapter provides basic information on obscurant and flame systems in use or readily available to the OPFOR that provide support combat missions for protection, as well as for destruction of the enemy during various phases of combat.

Obscurants, such as smoke, can be employed to make it difficult for the enemy to conduct observation, determine the true disposition of troops, and fire at targets with precision. The smoke agents used may be either neutral or toxic. The threat of toxic smoke options, such as tear gas, may cause an adversary to use chemical protection systems even if only neutral smoke is being used. See section “Obscurant Capabilities” of this chapter for more information.

Flame systems, or fire producing weapons, have been used throughout the history of war for obscuration effects, and for destruction of personnel, weapons, and materiel. Incendiary mixes used in war included ancient "Greek Fire". Weapons included English "fire ships" against the Spanish Armada and Indian use of flaming arrows against western settlements. See section “OPFOR Flame Weapon Capabilities” of this chapter for more information.

Weapons and munitions can be used on the modern battlefield to produce fires for destruction of materiel and personnel, for generating obscuration, for psychological operations, and for a variety of other uses. They may be initiated by pyrotechnic incendiary devices, munitions and materials. Many bombs, gun rounds, rockets, artillery rounds and explosive devices have incendiary effects. Incendiary hand grenades are still available, e.g., IHG and thermite grenades. Incendiary rounds such as 7.62-mm armor-piercing-incendiary (API) machinegun rounds are considered much more hazardous to aircraft than mere AP rounds. Some incendiary materials, such as white phosphorus, offer explosive, incendiary and disruptive area effects which equal or exceed high-explosive munitions against personnel and materiel.

In recent years newer technologies and applications have expanded the variety and use of flame weapons on the battlefield. Because flame applications apply to weapons used in the functional areas, see those areas (infantry, antitank, artillery, engineers, etc.) for more information on specialized applications. The OPFOR will use modern flame technologies, improvised flame weapons such as "Molotov cocktails", fuel-air improvised explosive devices, and tested tactics (initiating forest fires, oil derrick fires, industrial fires, etc.) to achieve military goals in the Contemporary Operational Environment.

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Obscurant Capabilities

Agents. The OPFOR employs a mix of smoke agents and their delivery systems, as well as improvised obscurants to generate obscuration effects. The more common obscurants include—

- Petroleum smokes (fog oil and diesel fuel).
- Hexachloroethane (HC) or hexachlorobenzene (HCB) smoke
- Aluminum-magnesium alloy smoke (Type III IR for bispectral effects—visual/IR bands)
- Phosphorus: white phosphurus (WP), red phosphorus (RP), WP/butyl mix (PWP)
- Metallic (including graphite or brass) smokes for MMW band and multi-spectral effects
- Improvised obscurants: Colored signal smokes, dust, burning tires, oil wells, etc.

The table below shows regions of the electromagnetic (EM) spectrum that different types of obscurants can block and the types of EO systems that operate in those spectral regions.

ELECTRO-OPTICAL AND OTHER SYSTEMS DEFEATED BY OBSCURANTS

Spectral Region	Optical/Electro-Optical System	Type of Obscurant
Ultraviolet 1nm-0.4μm	Developmental Sensors and Weapon Systems	Developmental Obscurants
Visible 0.4μm-0.8μm	Viewers: -Naked Eye -Day Sights, Optics -Camera Lens -EO Systems, including Charged Coupled Device (CCD) cameras -Battlefield TV and CCD TV - ATGMs with Daylight Beacons	All NOTE: Obscurants can counter or degrade night-time use of Visual Band illumination - including Spotlights, Flares, Flashlights, Vehicle lights.
Near-IR 0.8μm-1.3μm	Viewers: -SACLOS ATGM Trackers -Night Vision (Image Intensifiers,IR) - CCD, aka Low-light-level (LLL) TV Sensors: -Laser Designators, ND-Yag laser -Laser Rangefinders, ND-Yag laser	All NOTE: Obscurants can counter or degrade night-time use of IR Band illumination - including Spotlights, Flares, and night vision systems.
Short-Wave IR 1.3μm-2.5μm	Sensors: -Laser Rangefinders, other lasers -Laser Designators, other lasers	WP, PWP, RP, Dust, Type III IR Obscurant
Mid-IR 2.50μm-7μm	Viewers and Sensors (3-5μm): -Thermal Imagers -Terminal Homing Missiles	WP, PWP, RP, Dust, Type III IR Obscurant
Far-IR 7μm-15μm	Viewers and Sensors (8-12μm): -Thermal Imagers -Terminal Homing Missiles	WP and PWP (Instantaneous Interruption Only), Dust, Type III IR Obscurant
Millimeter Wave-Lower Frequency 300GHz-30GHz	Radars Communication Systems	MMW Band and Multispectral Obscurants

As shown above, smokes may operate in more than one band of the spectrum. The OPFOR is capable of employing obscurants effective in the visible through far-IR wavebands as well as portions of the millimeter waveband. These obscurants are commonly referred to as

multi-spectral smoke. The OPFOR uses a number of different smoke agents together for multi-spectral effects. Thus, obscurants such as fog oil blocks portions of the electromagnetic spectrum more fully when seeded with chaff. The vast quantities of white phosphorus (WP) on the battlefield also suggest that random mixtures of this agent with other obscurants (both manmade and natural) could occur, by chance or design. Neutral smoke agents are liquid agents, pyrotechnic mixtures, or phosphorus agents with no toxic characteristics.

The OPFOR may mix incapacitating or toxic smokes with obscurants. Toxic smokes (commonly referred to as combination smoke) may include tear gas or other agents. They degrade EO devices in the visual and near-IR wavebands. They can also debilitate an unmasked soldier by inducing watering of the eyes, vomiting, or itching. Some of these smokes contain toxic compounds and known or suspected carcinogens. A prolonged exposure to obscurants in heavy concentrations can have toxic effects. The toxic effect of exposure to fog oil particles is uncertain and, as is true of all smokes, depends heavily upon dose, time, and frequency of exposure.

Delivery Systems. Ample OPFOR smoke dispensing munitions and equipment includes:

- Smoke grenades.
- Vehicle engine exhaust smoke systems (VEESS).
- Smoke barrels, drums, and pots.
- Mortar, artillery, and rocket smoke rounds.
- Large-area smoke generators (ground and air).
- Spray tanks (ground and air).

Grenades. Smoke grenades can provide small-area smokescreens and fill gaps in the smokescreens produced by large-area smoke-generating devices. They can also provide signaling smoke and simulate burning vehicles in decoy smokescreens. The OPFOR has equipped many of its combat vehicles with smoke grenade launchers (dispensers) for the purpose of screening the vehicles from direct observation. Red phosphorus (RP) and a variety of other synthetic compounds are used as fillers in smoke grenades.

Armored Fighting Vehicles. Many armored fighting vehicles can generate smoke with their exhaust systems. A platoon using VEESS can produce a screen that covers a battalion frontage for 4 to 6 minutes.

Some armored fighting vehicles have forward-firing smoke grenade dispensers. These dispensers can produce a multi-spectral screen out to more than 300 m ahead of vehicles. This involves more than a simple self-protection capability. Launching grenades to that distance gives vehicles room to maneuver behind smoke that can screen their advance, lateral movements, or movements between defensive positions. With favorable conditions vehicles could advance distances of 300 m or more behind a line of smoke before emerging to engage enemy positions.

Barrels, Drums, and Pots. Smoke barrels drums and pots are a primary source of smoke to support combat. When smoke units are unavailable, engineers set them out. They can create small- and large-area obscuring clouds on or in front of friendly positions or screen semi-fixed and fixed installations. Smoke barrels, drums, and pots contain a solid obscuring agent that can be ignited by electric ignition systems, percussion igniters, or friction fuzes.

SMOKE POTS AND BARRELS

COUNTRY	NAME	TYPE	PHYSICAL CHARACTERISTICS				MATERIEL	SHAPE	FUZE TYPE/DELAY TIME (s)	BURN TIME (min)	PROLIF-ERATION
			Length (mm)	Height (mm)	Diameter (mm)	Weight (kg)					
Bosnia-Herezegovina	KODS M3F	Training Smoke Pot	INA	130	80	INA	Metal	Cylindrical	Friction / INA	8.0	2
Bosnia-Herezegovina	KODS M3E	Irritant Smoke Pot	INA	130	80	INA	Metal	Cylindrical	Electronic / INA	8.0	2
Bulgaria	DM-11	Smoke Pot	115	160	160	7.0	Sheet Metal	Cylindrical	Friction / 2.0	7.0	1
Bulgaria	GDSH-5	Large Smoke Pot	INA	INA	INA	40.0	Metal	Cylindrical	Electronic / INA	7.0	1
Egypt	Small White Smoke Barrel	Smoke Pot	INA	100	150	2.5	Tin (Tin with plastic steel)	INA	Friction / 30.0	6.0	1 (IOC 1994)
Egypt	Medium White Smoke Barrel	Smoke Pot	INA	270	150	8.0	Tin (Tin with steel)	INA	Friction / 30.0	16.0	1 (IOC 1994)
Germany	F-35 Smoke Pot	Smoke Pot	91	122	91	7.0	Sheet Metal	Cylindrical	Friction (Ensign-Bickford-Type)/ 4.5	7.0	1 (IOC 1959)
Germany	HC-81	Smoke Pot	INA	265	182	10.2	Metal	INA	Friction (Pull friction and electronic ignition) / 4.5	12.0	1 (IOC 1994)
India	Mark 3	Smoke Pot	INA	INA	INA	INA	Metal	INA	INA	6.0	1 (IOC 1994)
Jordan	PFG HC Smoke Pot	Smoke Pot	INA	215	182	10.0	Metal	INA	Friction / 4.5	12.0	1
Russia	BDSh-5 Smoke Barrel, Large	Large Smoke Pot	490	412	412	40.1	Sheet Metal	Barrel-like	Friction / 30.0 Percussion / Up to 30.0 Electrical / 10.0	10.0	10 (IOC 1944)

SMOKE POTS AND BARRELS (CONTINUED)

COUNTRY	NAME	TYPE	PHYSICAL CHARACTERISTICS				MATERIEL	SHAPE	FUZE TYPE/ DELAY TIME (s)	BURN TIME (min)	PROLIFER -ATION
			Length (mm)	Height (mm)	Diameter (mm)	Weight (kg)					
Russia	DB-11 Smoke Barrel	Large Smoke Pot	INA	INA	INA	INA	Sheet Metal	Cylindrical	Friction / Percussion	INA	2
Russia	DSH-100 Smoke Drum	Smoke Barrel	1000	400	4000	130	Sheet Metal	Cylindrical	Percussion / 1.3	10.0	2 (IOC 1945)
Russia	UDSh Smoke Pot	Smoke Pot	INA	INA	INA	13.5	Metal	Cylindrical	Mechanical Time / 30.0 Electronic / 10.0	10.0	1 (IOC 1996)
Russia	ShD-MM Small Smoke Pot	Smoke Pot	INA	INA	INA	3.0	Metal	Cylindrical	Mechanical Time / 7.0	4.5	1 (IOC 1996)
Sweden	451 B Smoke Pot	Smoke Pot	INA	INA	INA	1.5	Metal	INA	INA	2.5	1 (IOC 1993)
Yugoslavia	KDP-25 Smoke Pot, Floating Type	Smoke Pot	INA	365	300	21.0	Metal	Cylindrical	Friction / 20.0	20.0	1

NOTES:

1. Smokepots and barrels contain a smoke agent and can be placed on the battlefield and ignited. Generally they produce a longer-lasting smokescreen.

2. The following are examples of the lengths of the concealing area of a smokescreen:

BDSh-5 Large Smoke Pot: up to 200 meters
UDSh Multipurpose Smoke Pot: from 100 to 150 meters
ShD-MM Modified Small Smoke Pot: from 70 to 100 meters

Artillery. Artillery (including mortars) can deliver various types of smoke rounds. Seven to 10 percent of all artillery fire may be smoke rounds. These are mostly WP and plasticized white phosphorus (PWP), which have a moderate degrading effect on thermal imagers and a major one on lasers. The table below shows ammunition expenditures required for various types of artillery to produce a 1-km smokescreen for 15 minutes.

Munition expenditure norms for producing a 1-km smokescreen for 15 minutes

Weapon	Wind Direction					
	Head or Tail		Oblique (45%)		Flank	
	Number of Tubes	Number of Rounds	Number of Tubes	Number of Rounds	Number of Tubes	Number of Rounds
82-mm Mortar	12	900	8-12	750	8	600
120-mm Mortar	8	450	8	350	4	250
122-mm Howitzer	8	300	8	220	4	150
152-mm Howitzer	13-14	200	10	150	6-7	100

Notes:
1. Assuming the wind speed is 3-5 m/s.
2. If the wind speed is 6-7 m/s, multiply the ammunition consumption by 1.5.
3. An artillery battery of 6-8 pieces, regardless of caliber, can produce a smokescreen of—
   - Over a 500- to 700-m frontage with a crosswind.
   - Over a 150- to 200-m frontage with head or tail wind.

   If a frontage exceeds these dimensions, divide it among the batteries.
4. When there is a layer of snow over 20 cm deep, multiply the ammunition consumption by a factor of 1.5 to 2.

On a smaller scale, the below table shows the number of mortar smoke rounds required to maintain a 100-m smokescreen for 1 minute.

Mortar smoke round norms for producing a smokescreen

Wind Direction	Mortar Caliber	
	82-mm	120-mm
Head or Tail	6	3
Flanking	4	2

Aircraft. The OPFOR employs smoke bombs or pots dropped by either fixed- or rotary-wing aircraft. Some aircraft have spray attachments. Light utility helicopters can deliver blinding or camouflage smoke for a maneuver unit. During smoke missions, the pilot operates both the aircraft and the smoke-generating equipment. Weight limitations do not allow for additional personnel or armament.

Large-Area Smoke Generators. The OPFOR can deliver smoke from either ground or aerial platforms. Chemical units may use two types of smoke generators: spray and oil.

Spray smoke generators (in various sizes and models) consist of a steel container with one or more orifices. The necessary operating pressure either is supplied from accompanying compressed-air bottles or is chemically produced. Proper operation of such equipment requires

constant pressure in the compressed-air bottles and thorough maintenance of the equipment after use. Depending on the size of the orifice and the amount of obscuring agent consumed per minute, a typical spray smoke generator can produce a smoke cloud for 5 to 30 minutes. The main feature of spray smoke generators is their ability to generate a large smoke cloud in a few minutes.

Another type of smoke generator is an oil smoke generator. This type, sometimes called "thermo-mechanical," is mounted on smoke-generator trucks. The burner's fuel oil and the obscurant-producing oil are introduced into the generator through appropriate piping and metering valves. A blower provides air for fuel-oil combustion. The obscurant oil immediately evaporates, producing an obscuring cloud that, together with the products of combustion of the burner fuel oil, provides the smokescreen. The obscuring cloud can be seeded with various types of particles (including metallic) to attenuate the far-IR and radar regions of the EM spectrum.

An example of a smoke generator truck is the Roman AF-79, shown below. Although not designed for this purpose, some decontamination vehicles with chemical defense units can also generate smoke. These can be found in the CBRN Chapter, at pages 11-17 and 11-18.

Romanian Smoke Generator Vehicle AF-79

Weapons & Ammunition Types	Typical Combat Load
N/A	N/A

SYSTEM
Alternative Designations: None
Date of Introduction: INA
Proliferation: At least 2 countries
Description:
Crew: 2
Automotive Performance:
Chassis Type: Ural 4320, 6x6
Weight of System (mt)
Empty: INA
Filled: INA
Chassis Length Overall (m): 7.3
Height Overall (m): 2.5
Width Overall (m): 2.8
Engine Type: YaMZ-238M2, 240 hp, V-8 liquid cooled diesel
Cruising Range (km): 1040
Speed (km/h):
Max Road: 82
Max Off-Road: INA
Cross-Country: INA
Ground Clearance (m): .4
Fording Depths (m): .1.5
Emplacement Time: INA
Displacement Time: INA

SMOKE GENERATOR
Physical Characteristics:
Name: INA
Length (m): 9.5
Height (m): 2.9
Width (m): 2.5
Number of Nozzles: 6
Location of Nozzle: Directly above the back doors
Nozzle Orifice Size (m): 1.34

Nozzle Movement:
Traverse (°): N/A
Elevation (°): N/A
Depression (°): N/A
Operating RPM's of Turbine Engine: N/A
Idle Speed (rpm): N/A
Max Effective Speed (rpm): N/A
Ability to Generate on the Move: No

Performance Characteristics:
Engine Name: INA
Fuel Type: Diesel
Fuel Capacity (l): INA
Operating Temperature (°C): -20 to 80
Operating Time (min): 67.0
Time to Initiate Smokescreen (min): 15
Pump Type: EX 820 hydraulic pump
Pump Capacity (l/min): INA
Generator Efficiency (%): 90

Smoke Agent
Agent Type: GOST 305.82 and water
Nomenclature: AF-79 Fog Oil-Petroleum Obscurants: Manmade Agents
Cloud Color: White
Capacity of Smoke Agent (l): 1663
Smoke Agent Consumption Rate (l/hr): INA
Odor: INA
Protection Required: INA

VARIANTS
None

NOTES
The AF-79 smoke generator is mounted on a Ural 4320, 6x6 truck chassis and is primarily used for the production of protective smokescreens. The smoke generator is housed in a chambered roof, box bodied van measuring 4.3 meters long and 2.5 meters wide. There are two doors with windows that are located at the rear of the van. Six smoke discharge nozzles are located directly above these rear access doors. The two rear doors provide access to the 1,680-liter storage tank. The heating elements are located on both the right and left side of the storage tank. The left and right side rectangular-shaped doors located near the rear of the body and directly above the dual axle assembly is used to gain access to the AF-79 burners. These burners produce the smoke by vaporizing oil and water. A second door located on the right side toward the front of the body, behind the generators fuel tank is used to gain access to the internal equipment within the van portion of the vehicle. The van's interior is arranged with color-coded instrumentation for the hydraulic and switchboard control panels.

The height and location of the nozzles does not appear to be a severe hindrance in the movement of smoke toward the ground. As the smoke comes out of the nozzles, it begins to move upward before it begins a downward slide towards the ground. The wind conditions and the temperature of the cloud and its surrounding atmosphere govern the smoke movement.

The AF-79 cannot produce smoke on the move because the truck that carries the smoke generator can supply shaft power either to the wheels of the truck or to the hydraulic pump of the smoke generator, but not both. The hydraulic pump produces the pressure used by the pumps for pumping water, fuel, and fog oil for the generation of smoke. If the truck is moving, no hydraulic pressure is available to run the smoke pumps. Thus, the AF-79 cannot produce smoke while moving.

OPFOR Flame Weapon Capabilities

Flame weapons do not simply burn, rather produce massive flame effects in a burst or stream. Technologies for these weapons include flammable liquid fills, fills with sticky gels known as napalm, fuel-air-explosives, and thermobaric explosives. Delivery systems include ballistic and cruise missile aerial bombs, improvised aerial bombs, aerial and ground rockets, flamethrowers, grenade launchers, stationary or vehicle-based explosive devices, and hand thrown devices.

The OPFOR uses two basic types of flamethrowers. One type fires pressurized liquid fuel, while the other fires a rocket-propelled, encapsulated warhead. Either type of flamethrower delivery system can be very effective in reducing strongpoints and in built-up areas. The first type is found only in specialized flamethrower units belonging to the chemical troops. It utilizes tanks of fuel, igniter mechanism, and a sprayer wand to deliver a stream of flame. In previous decades, flame vehicles were employed, such as a U. S. flame variant of the M-4 tank, and the Russian OT-55 which fired flame rounds. However, the limitations of those vehicles resulted in their decline in use. Today this type of flame thrower includes man-portable models (such as the Russian LPO-50), as well as heavy models that are usually cart-mounted (such as TPO-50).

Although sometimes called "flamethrowers", the second class of weapon is actually a mix of shoulder-launch grenade launchers with encapsulated flame warheads. They are found not only in such flamethrower units, but also in maneuver units. An earlier "rocket flame weapon" was the RPO, a shoulder launcher with a napalm fill in reloadable rounds. In tactical units (except for special missions), it has been supplanted by the RPO-A series (-A/Z/D) of disposable launchers, with napalm, smoke, or thermobaric explosive (TBX, described below).

The most common version, RPO-A, has a thermobaric warhead—a revolutionary application of flame technology. A thermobaric warhead is "volumetric" an explosive which produces slightly less blast (air pressure) than a high-explosive. But it delivers searing high heat, and pushes air outward in a massive long-duration blast wave. The "vacuum bomb" can char and melt materiel surfaces (aircraft skin, radars, etc) and push them away; then the collapsing air crushes those surfaces in a compression wave. Both heat and blast can kill and injure personnel. The munition has even more effect where people hide (vehicles, bunkers, caves, buildings, foxholes, etc). Their surfaces reflect blast waves into ripping, shearing, and tearing "complex blast waves" that collapse buildings, collapse lungs, and kill. The blast can collapse light vehicle armor, penetrate hatch seals and openings in vehicles, bypass flapper valves in vehicle filtration systems, and enable the heat wave to incinerate personnel and materiel inside. Even if the vehicle seals and personnel are intact, the extreme heat will char all exterior weapons, optics, and materiel, blow out tires, and leave them engulfed in flames. Demolition power of RPO-A is considered equal to that of a 122-mm artillery round. Infantrymen often refer to it as “pocket artillery.” Thus RPO-A can be used as a multi-purpose grenade launcher—a bunker-buster, an anti-armor weapon, a shock weapon, and an extremely effective counter-sniper weapon.

A disposable flame weapon, such as RPO-A is easily carried and fired by one soldier. Any soldier can use an encapsulated flamethrower with minimal instructions. Within maneuver units, the OPFOR issues encapsulated flamethrowers more along the lines of ammunition rather

than as weapons; therefore, the basis of issue may vary. The OPFOR usually issues one encapsulated flamethrower to each mechanized infantry squad (one per IFV or APC). Tactical employment is the same regardless of whether the operator is an infantryman or comes from a flamethrower battalion. Support systems include the Russian BMO-1 "flamethrower combat vehicle", which holds racks of RPO-A launchers and has seating for flamethrower personnel. A replacement system is the Shmel-M reusable launcher with thermobaric grenades in disposable canisters.

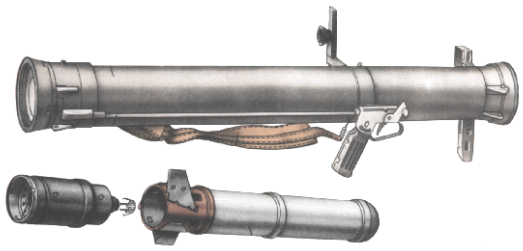
Other encapsulated thermobaric applications include: "high-explosive" warheads for most Russian ATGMs, thermobaric grenades for infantry anti-tank grenade launchers (ATGLs) such as RPG-7V and RPG-29, disposable RShG-1, RShG-2, air-to-surface rockets. The smallest Russian application is the 43-mm VGM-93 grenade used in the GM-94 magazine grenade launcher (pg 2-20). An increasing number of countries are purchasing or developing munitions using encapsulated thermobaric explosives.

Another volumetric technology with effects similar to thermobaric is "fuel-air explosive" (FAE). The differences are in the fill (liquid, such as fuel), which must be dispersed and then detonated. A thermobaric dry or slurry fill uses an explosive disperser, and detonates upon dispersion. The FAE liquid must be sprayed out of the munition in-flight, and then detonated with a second-stage igniter at the right moment. Because of these conditions and the greater weight of the liquid fill vs TBX, the FAE lends itself to aerial-delivered bombs, large missile warheads, and heavy rocket warheads. The Russians appear to have used FAE weapons against villages in Afghanistan, with devastating results. With proper design, FAE can be used in large bombs or IEDs, such the vehicle-borne IED used against the Murrah Building in Oklahoma City. This type of device is sensitive to a variety of factors, such as air conditions (air pressure, humidity, wind direction, etc.), and igniter design, flight dynamics, etc. Consequently, FAE is less reliable than thermobarics. However, an incomplete FAE detonation can be almost as deadly, because it may then produce a massive flaming inferno—consuming materiel and flesh over a wide area.

Some heavy multiple rocket launchers (MRLs) have encapsulated napalm and fuel-air-explosive munitions (such as Chinese Type 762 MRL and Russian 9A52-2). These can be used to support a variety of roles, including minefield clearance, anti-personnel use, counter-sniper fires and strikes, and demolition of buildings and bunkers. The most highly developed weapon of this type is the Russian TOS-1 Flamethrower Weapon used in Chechnya, which resembles an MRL, but is classified as a specialized flame system (see page13-12).

New flame technologies and applications of flame technologies will continue to appear. During fighting in Afghanistan, there were reports that the Russians demonstrated a particularly insidious weapon - aerial bombs which dispersed "Liquid Fire". That encapsulated gel landed on surfaces and lay dormant until disturbed by vehicles, animals, or personnel. When brushed or scraped, exposing air to the mix, it shot a stream of sticky flame upward and onto the intruder. Fortunately, significant use of this weapon has not been repeated.

Russian Infantry Rocket Flame Weapon RPO-A Series and Shmel-M



RPO-A Weapon System

Ammunition Types	Typical Combat Load
Rocket RPO-A: Thermobaric-flammable mixture RPO-Z: Incendiary RPO-D: Smoke	**2 (separate launchers)**
Rocket, Shmel-M: Thermobaric	**2 (canisters plus mini-grip stock)**

SYSTEM
Alternative Designations: Shmel (Bumblebee). Although "RPO" may be used generically to describe various infantry flame weapons, RPO-A is this specific multi-role flame weapon system.
Date of Introduction: 1984
Proliferation: Widespread
Description:
Crew: 1
Number of Weapons in a Package: 2
Weight of Package (kg): 12
Total weapon (1) weight (kg): 11
Length (mm): 920
Rate of Fire (rockets/min): 2
Reaction Time-Travel to Fire (sec): 30
Fire From Inside Building: Yes. It can be fired in enclosures of 60 m^3 or greater or with a barrier behind the weapon.
Components: Container, ejection motor, warhead.

PERFORMANCE
Range (m):
Direct Fire: 200 with iron sight, 850 with optical sight
Effective: 600
Minimum: 20
Indirect Fire: 1,000
Accuracy @ 200 m: .5 m^2
Muzzle Velocity (m/s): 125

SIGHTS
Name: OPO-1
Type**:** Optical calibrated to 600 m
Location**:** Left, next to grip
Magnification**:** None
Night Sights Available: INA

VARIANTS
Shmel-M/PDM-A Priz: This is a reusable upgrade system adopted in the Russian Army in 2003 to replace the disposable RPO-A. It Includes a reusable mini-grip stock launcher, with a reflex sight and pistol grip. Disposable canisters (with munitions) slide on and serve as the launcher tubes. The Shmel-M is more powerful (50 % more blast = 152/155-mm cannon round) and lighter in weight than RPO-A. Range is 800m, 300 direct fire. Specifications are: caliber 90 mm, length 940 mm, weight 8.8 kg for 2. In time other canister fills (e.g., smoke and incendiary) will be available. Standard issue (2 grenades/launcher) is more compact than 2 RPO-A launchers.

PF-97: Chinese licensed copy of RPO-A, with a lensatic optical sight mounted on some launchers.

BMO-1: Russian "flamethrower operator's combat vehicle". It seats 7 men and holds 30 RPO-A launchers. **BMO-T** is a fire support vehicle on a T-72-based heavy armored personnel carrier chassis.

BMO-T on HAPC chassis

AMMUNITION
Name: RPO-A
Type: Thermobaric (enhanced blast) explosive. The RPO-A is known as the infantryman's pocket artillery because the demolition effect corresponds to 122-mm HE artillery, and 120-mm mortar projectile. It can buckle armor, penetrate rubber seals and enter openings in vehicles, injure or kill personnel, and collapse roofs and doors on bunkers and buildings.
Caliber (mm): 93
Casualty Area: 50 m^2 personnel in the open, 80 m^3 enclosed space
Lightly armored materiel kill probability at 400 m: 0.70
Burn Temperature (°C): 800+
Warhead Explosive Type: Trotyl equivalent (2 kg)
Warhead Mixture Weight (kg): 2.1

Name: RPO-D
Warhead Weight (kg): 2.3
Smoke-Incendiary Type: Based on red phosphorous.
Smokescreen:
Time of Formation (min): 2
Length (m): 55 to 90
Depth and Height (m): INA
Duration (min): 3 to 5
Effective Against: Visual and infrared

Name: RPO-Z
Type: Incendiary
Warhead Mixture Weight (kg): 2.5

NOTES
Designed as a follow-on to the RPO, the RPO-A, -Z, and -D are one-shot, disposable, shoulder-fired, combat tested (Afghanistan, Tajikistan, Chechnya), flame weapons. They are reliable. Any soldier, infantryman, or paratrooper can use this close-combat weapon with minimal instruction. The RPO-A comprises three basic components: container, ejection motor, and case, which is filled, depending on its purpose, with thermobaric (enhanced blast explosive), smoke or incendiary rockets. At any range the blast effects of the thermobaric munitions are much more serious than the thermal effects. The RPO series of flame weapons also serves as an extremely effective counter-sniper weapon. The armor- and mechanized -based OPFOR usually issues one RPO-A per BMP (mechanized infantry squad). They are also found in the Flamethrower Bn (Encapsulated) at Corps or Army level. One squad per infantry platoon has a RPO-A in the infantry-based OPFOR. The RPO-A series of flame weapons are issued more along the lines of ammunition rather than a weapon, therefore the BOI may vary.

Russian 220-mm Flamethrower Weapon TOS-1

Original 30-rocket TOS-1
Current launcher holds 24 rockets

Weapons & Ammunition Types	Typical Combat Load
220-mm rockets (Original launcher) Fuel-Air Explosive	**30**
TOS-1A launcher Fuel-Air Explosive Incendiary	**24**

SYSTEM
Alternative Designations: Buratino
Date of Introduction: Early 1990s
Proliferation: Azerbaijan, Iraq, and Kazakhstan.
Description:
Crew: 3 in vehicle
Chassis/Carriage: T-72 tank chassis (data based on T-72M1)
Combat Weight (mt): 46.0
Chassis Length Overall (m): 6.91
Height Overall (m): INA
Width Overall (m): 3.59

Automotive Performance:
Engine Type: 780-hp Diesel
Cruising Range (km): 550 without external fuel tanks
Speed (km/h):
Max Road: 60
Max Off-Road: INA
Fording Depth (m): 1.2 Unprepared

Radio: R-173M
Protection:
Armor, Turret Front (mm): 500/560 against HEAT
Applique Armor (mm): Side of hull over track skirt
Explosive Reactive Armor (mm): Available
Self-Entrenching Blade: Yes
NBC Protection System: Yes
Smoke Equipment: Smoke grenade launchers (4x 81-mm front hull)

ARMAMENT
Launcher:
Caliber, Type: 220-mm rocket launcher
Number of Tubes: 30/24 current TOS-1A launcher
Launch Rate, Full Salvo Time: 30 rounds in 7.5 seconds/6 sec current
Loader Type: Crane hoist on truck transloader

FIRE CONTROL
Direct Fire: Unidentified gunner and commander sights
Laser rangefinder: Yes
Fire Control Computer: Ballistic computer with roll sensors

MAIN ARMAMENT AMMUNITION
Type: FAE rocket
Range (m):
Maximum Range: 3,500/6,000 current TOS-1A launcher
Minimum Range: 400
Area of effects, 30-rocket salvo (m): 200 x 400 assured destruction
Much larger area for suppression

NOTES
Launchers are maintained with chemical troops, but are often employed with artillery. Other applications include defoliation and mine clearing.

A variety of enhanced blast mixtures (varying from improvised from common materials to sophisticated) can be used to produce thermobaric or fuel-air explosive (FAE) effects. The sophisticated mix for TOS-1 may be enhanced with powdered tetranite. The primary FAE effect is a long-duration high-pressure blast wave which creates a vacuum - then precipitates a reverse wave. These pressure/vacuum surges (up to 427 pounds per sq inch) cause a ripping effect on soft materials (such as airplane skin, radar surface, human lung tissue). Walls and surfaces within the affected area do not necessarily shield victims, rather cause multiple pressure waves, which amplify the tearing effects and can topple structures. A secondary effect is high-temperature heat - 2,500-3,000° C. An incomplete explosion renders a near-devastating effect, wide-area long-duration high-temperature flame. Even those outside of the blast area will be rendered ineffective with debilitating mental and physical trauma.
Primary TOS-1 use considerations are: (1) it works best under conditions which normally protect targets from weapons:
(2) it has a high assurance of devastation within a large area. The TOS-1 is designed primarily for use against emplacements, defilade areas (such as terrain folds and tunnels), fighting positions, ships, buildings, as well as personnel and other soft targets. High angles-of-fire and steep impact angles support use in defilade and urban areas. Despite the seeming short range, the weapon was effectively used in Chechnya to disable defenders within a specific sector just prior to an assault, to halt assaults, and to level buildings.

Chinese Type 81 and Type 87 heavy rocket launchers employ FAE rockets for minefield clearing, and other missions (with lethal effects).

Chapter 14
Improvised Military Systems

The conflict spectrum in the Contemporary Operational Environment includes not only modernized systems in upper tier forces but also older systems in less developed forces. Forces all across the capability spectrum use improvised weapons and other applications. Improvised systems have always been in battle, from the first stick wielded by a proto-human to elephants used by Hannibal, to fire ships employed against the Spanish Armada. Often associated with less robust forces, they are also used by modern forces to accomplish their missions by the most effective method. There is no end to the list of improvised weapons available for use against U.S. forces. *The list of improvised weapons available is limited only by human imagination.*

Improvised weapons can be developed from military and non-military materials, to kill, or to degrade enemy capabilities. These materials can be particularly inviting to insurgents and terrorists, which cannot openly carry weapons and explosive devices. They can obtain the materials from a support network or by theft, and employ those materials as improvised weapons. Directed against military bases, key industries, transportation assets, contractors, and supporting infrastructure, attacks can damage U.S. interests at home, in supporting countries, and in occupied areas before, during, and after conflict. Industrial materials and critical infrastructures (dams, power grid, water supplies, nuclear facilities, etc) can be attacked to undercut public morale, as a form of psychological warfare.

The most populous class of improvised weapons is improvised explosive devices (IEDs) with wide variations in design and use. Discussion of IEDs can be found on pg 14-2.

Other improvised weapons can be fabricated without the need for explosives. Weapons can be created by using materials and tools found in civilian environments in innovative ways for accomplishment of military objectives. Many are characterized as "primitive", but continue to be effective, and have been around for millennia. They include inertial devices fabricated from natural materials. Such systems were encountered in Vietnam such as punji stakes, "Malayan Gates", blowguns, and bows and arrows. Automobiles, aircraft, and other transportation assets offer kinetic energy for impact threats, and as mobile platforms for application of other weapons. So-called ***Non-lethal Weapons*** can not only kill, but be used to degrade targets and aid weapons to increase their lethality. Natural materials and man-made structures invite use as weapons, as obstacles to enemy movement. Military or non-military materials could be used to trigger major disasters, such as forest or urban fires, breached dams or levees to initiate floods, environmental disasters, and conceivably trigger landslides or earth tremor-related disasters.

CBRN (Chemical, Bacteriological, Radiological, and Nuclear) weapons are described in Chapter 11. Improvised CBRN weapons include improvised chemical, bacteriological, and nuclear materials, and released radiological materials as "dirty bombs" (radiological dispersal devices). These pose a threat to military and non-military alike.

Chapter (8) in Volume 2 describes Improvised Aerial Systems. Questions and comments on this chapter should be addressed to the below POC.

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Improvised Explosive Devices

Any explosive devices can be used to make a type of IED. In conflict countries such as Chechnya, Vietnam, Iraq, etc., caches of munitions are available long after the end of major conflict for use in creating IEDs. A wide variety of common devices are available for innovative insurgents to modify into fuzes, to transform explosives into precision-detonated IEDs.

Military munitions can be modified into IEDs. One of the most common bases for IEDs is artillery rounds. Most methods of mine design, as noted in Chapter 8, can also be applied to IEDs. By removing the fuze, and replacing with a detonator and actuating mechanism, the munition and other military munitions can become an IED. Improvised explosive devices can have various designs of explosive fill and lethal mechanisms, and can be augmented by daisy-chaining (for simultaneous detonation with other explosive devices).

Historically, the most numerous IEDs encountered on the modern battlefield use hand grenades. These can be rigged by wedging them into tin cans, trees, or crevices in rocks or walls, and tying to trip wires. Often grenades are hidden on bodies, weapons, or objects to be picked up by soldiers. In a World War II account, German soldiers would attach grenades to pictures set askew. According to the account, enlisted soldiers tended to ignore the pictures; but officers would often be tempted to right the pictures, with disastrous results.

Mines have long had capability for sophisticated fuzing and remote control units seen in some IEDs. Both mines and IEDs can be converted for command-arming and detonation, and for precision sensor fuzing (see Chapter 8); but IEDs may rely more on common use materials.

Many IEDs are not made from military munitions. Bulk explosives (such as Dynamite, TNT, C-4, etc.) are used in IEDs. Terrorists such as the shoe bomber and anti-Israeli groups used Triacetone Triperoxide (TATP), precisely because it is highly sensitive. The most common explosive in the US is ammonium-nitrate fuel oil (ANFO, an insensitive slurry mixed onsite with the bulk of the mix as common fuel oil) for mining and road construction. The slurry can then be poured or pumped deep into spaces where other explosives cannot fit. Explosives can be improvised from common materials. In 1995 domestic terrorist Timothy McVeigh created a home-made variant of ANFO in a VBIED (vehicle-borne IED, with “volumetric explosive” effects) to blow up the Murrah Building in Oklahoma City. Chemical IED use is on the increase.

Another significant factor for IEDs is their container. Vehicle-borne IEDs (VBIEDs) can carry a massive amount of explosive. Dump trucks have been used for VBIEDs. Creative bomb-makers have been able to place explosives inside of building walls, foundations, and structures, for detonation years later. Even bicycles are used as containers for IEDs.

Flame weapons continue to threaten modern forces, vehicles, and materiel. Improvised weapons include flame and napalm sprayers, incendiary devices to ignite fuels and ammunition supplies, and fuel-air-explosive IEDs. "Molotov cocktails" have been employed in almost all conflicts, and continue to be a serious threat to vehicles, materiel, and personnel. Recent events in the operational environment have shown an air droppable version of incendiary devices known as “barrel bombs”. These improvised bombs include large containers filled with flammable and shrapnel producing material which is pushed from helicopters over a variety of military and civilian targets. Impact fuses ensure that the device explodes in a manner to achieve maximum effect while not damaging the aircraft.

Descriptions of IEDs can be found in Field Manual (Interim) FM 3-90.119, Combined Arms Improvised Explosive Device Defeat Operations, Sep 2007.

Improvised Military Obstacles

Obstacles include any mechanisms or materials used to delay and impede enemy movement. Primary reason for emplacing obstacles is to alter the tactical situation in response to the enemy situation. The OPFOR uses counter-mobility operations to control access and tempo by delaying, disaggregating, and canalizing enemy forces.

Tactical applications include:

- Close gaps
- Deny the enemy access to key terrain
- Block penetrations
- Protect the flanks
- Channel the enemy into kill zones, contain him, and inflict losses on him.

Some examples of improvised obstacles are:

- Crowds of civilians and animal herds on roadway
- Divert vehicle traffic to main supply routes and tamper with traffic control systems.
- Flooding or alter the flow of water (rivers, dams, etc.), open fire hydrants etc
- Punji stakes (innovation--place punji stakes and/or det cord in a ditch. When the enemy arrives ambush them from the same side of the road/trail. The enemy will turn towards the fire and jump into the ditch to return fire. When they enter the ditch and land on the stakes, blow the det cord).
- Blow (or cut) a hole in a frozen river. Put tree logs in the water, cover with sticks and tarp and camouflage (snow). The logs continually agitate the water to keep it from freezing. Armored vehicles drive across the frozen river and fall in the ice hole.
- Prepare (and camouflage) the frozen river with demolitions prior to the arrival of the enemy armored column. Detonate when the armored vehicles are in mid-stream. Artillery targeting with MRLs will have the same effect (or use both).
- Induce avalanches in snow covered passes.
- Topple boulders or initiate landslides at chokepoints
- Abatis (Fallen trees, telephone poles, etc.)
- Trench roads. Trenches can be concealed to cause high-speed accidents.
- Trenches, craters, or ditches (dug by hand or blown by demolitions)
- Debris (vehicles, rubble, including building rubble onto roads)
- Obscurants (smoke, dust, and mixed with man-made)
- In extreme cold, put water on dangerous portions (or steep grades) of roads
- Spread chemicals (oil, grease, etc.) on dangerous portions of roads
- Channel water systems and arroyos to flood roads and water crossing areas
- Damage or destroy bridges and dams.
- Spike strips to puncture tires
- Electronic and power lines and capacitors to short engine systems and harm personnel
- Coils of wire to tangle wheels and tracks
- Above-ground decapitation wires
- Materiel and IED decoys on roadways

The following selected list reflects technology applications which the OPFOR could use.

IMPROVISED TECHNOLOGIES AND MILITARY APPLICATIONS FOR USE BY OPFOR

TECHNOLOGY ATTACK CATEGORY	TECHNOLOGY	TECHNOLOGY APPLICATION
Electronic	Computer Network Attack Worms, viruses, trojan horses Net-centric warfare Spoofing sensors Internet corruption Vehicle radar/laser detectors COTS Vehicle GPS jammers	Attack electronic grid or nodes at critical times - disable switches diverting power Attack information/emergency networks. Attack financial system, reservoir and desalination water testing/treatment system, waste treatment, medical life support network, and infrastructure. Vehicle mounted CMs for early detection of RISTA Deny GPS based precision munitions in target areas
Chemical/ Biological/ Radiological	Dirty bombs, with nuclear waste/spent materials Toxins, industrial materials Chemical/bio agents created in scientific laboratories	Nuclear contamination of critical nodes. Agricultural attack (animal/plant stocks). Contamination of water and food stores. Contamination of ingestible health items. Destroy track to derail trains carrying NBC materials. Direct attack on transporters/LOC with NBC Attack storage facilities or derail trains with toxic industrial materials
Physical and Psychological	DEW RF interference systems Laser blinding of air crew Acoustics against personnel Explosives (including home-made enhanced blast/fuel-air) Flammable materials	Use radios, jammers, etc to detonate fuzes. Use laser devices (pointers, laser range-finders, etc, to dazzle optics and viewers) Use acoustics to sicken or distract personnel, or to preempt acoustic arming or fuzing devices Use IEDs, etc to attack first responders, bridges on LOCs. Sabotage, shut down/disrupt ocean, land, and air shipping and travel. Sink vessels in shipping channels, ports, canals. Damage airline traffic and navigation systems, and airfield structures. Blow, open, perforate pipelines, refineries, storage tanks to drain oil, fuel, water. Set fire to oil wells/tanks for obscuration in own AO, or toxic effects enemy AO Attack and/or deny access to records and resources, e.g., water, food supply, energy, medical systems and financial systems.
Geological	Use weather/environmental effects of storms, floods	Detonate oceanic methane deposits. Detonate nuclear weapons at seismic seams, to trigger earthquakes or volcanoes, volcanic landslides and cause tsunamis. Destruction of dams to cause flooding. Time operations during adverse weather, to neutralize RF-based sensors and C2, or to limit enemy access to critical battlefield or support areas.

Improvised Rocket Launchers

Insurgent prepares rockets against U.S. base in Ramadi, Iraq (AP Photos)

Afghani IRL improvised from aerial rocket launcher

Hamas improvised rockets and launchers used 2000-04

Improvised rockets and launchers can be fabricated using different levels of improvisation. The more common and successful approach is to acquire existing rockets of various types, such as artillery MRL rockets (107/122/130/132mm) and aerial rockets (57/68/80/81/122-mm), and to fabricate launchers. Launchers are fabricated using tubes, angle iron, or boards, which can be quickly erected at the launch site. Because these rockets are very imprecise, launchers may be moved within a few hundred meters of the target (such as the **Donkey Cart MRL** -see next page). When the goal is harassment, or the target is a large area, such as a base or city, the launcher may be 20 km away. Some launchers are set for remote detonation using electronic timers, RF triggered detonators, or pyrotechnic fuze. Timers or command detonation permit the launchers to maximize losses. Although electronic communications are not necessary, organized cells can employ observers with cell phones to monitor the targets and launch area to increase possibility of target vulnerability and to assure launch security. Additional multiple launchers or booby-trapped launchers with trip wires may be used to initiate a second attack in order to target military investigation/EOD teams.

SYSTEM: Kassam or Qassam-1, 2, or 3
Date of Introduction: 2000 for Kassam
Proliferation: Used in Palestine by the Hamas, and similar to hand-fabricated rockets employed by insurgents elsewhere. In the period 2000-2003 more than 140 Kassam rockets were launched.

Launcher: Sighting is based on tilt and pointing the launch ramp. Accuracy is inversely related to range. Targets are towns or cities, rather than specific buildings or point targets.
Type: Metal ramp, although boards or other surfaces could be used.
Number of Tubes: 1
Crew: 1-4 or more
Emplacement Time (min): 2-30 depending on configuration
Launch Rate: 1-5 minutes for launch salvo, one salvo per location

AMMUNITION
A **Kassam** rocket is made from available tubes with a variety of warheads. One source claimed that the Kassam or **Kassam-1** is fired by a mortar. Propellant for the rocket is a locally blended formula, with sugar, oil, alcohol, and fertilizer. Rockets are hand-fabricated of steel tubes with welded fins in "workshops". A 120-mm Kassam-2 weighs about 11 kg, is 1.8 m in length, with 6-10 kg of warhead and a PD fuze. Above mixture yields a 3-m hole on impact.

Range is 4-6 km for **Kassam-1** and 5-10 km for **Kassam-2**. It has been claimed that an extended range version (15-17 km), possibly **Kassam-4** was successfully test launched. However, the increased range is expected to increase targeting error 200-300%.

SYSTEM: Anti-Iraqi Forces (AIFs) Fabricated Rocket Launchers.
Date of Introduction: 2004, examples date from earlier conflicts, with AIF distributing counter-US TTP from the Vietnamese War
Proliferation: AIFs have fabricated field-expedient 122mm rocket launchers using sheet metal in Iraq and fired these rockets against US Bases in Iraq during the Iraq War.

Launcher: See launcher data noted at left. For other data needed for simulation of indirect fires, use 9P132/BM-21P (pg 6-36).

AMMUNITION
Caliber, Type, Name: The following are examples of widely disseminated rockets which can be used with improvised launchers.

68-mm SNEB French-designed aerial rocket HEAT, see pg 13-2
Range (m): <1aimed

68-mm SNEB French-designed aerial rocket Frag-HE, see pg 13-2
Range (m): 14 maximum

107-mm Frag-HE, Chinese Type 63 MRL rocket, see pg 6-37
Range (m): 8.1 km

122-mm Frag-HE, 9M22M (6-ft rocket, see pg 6-36)
Range (m): 0-10,800

122-mm Frag-HE, 9M22U (9-ft rocket, see pg 6-38)
Range (m): 0-20,380

NOTES
Munition/warhead alternatives include: gun rounds, air-to-surface rockets, mortar rounds, RPG-7V grenades, C-4, or improvised explosives.

Donkey Cart Multiple Rocket Launcher

Weapons &Ammunition Types	Typical Combat Load
Total Rockets	**30**
68-mm rockets Frag-HE	20
80-mm rockets Frag-HE	10

SYSTEM
Alternative Designations: Improvised Multiple Rocket Launcher (IMRL)
Date of Introduction: Used in Iraq in Sep-Nov 2003
Proliferation: Similar to IMRLs fabricated in other countries, and by various insurgent groups

Description:
Crew: 1 or 2
Configuration: Mounted on an auto-wheeled cart and pulled by a donkey. During at least one firing, the donkey was still hitched to the cart. Several insurgents/terrorist have recently used the donkey cart MRLs.
Emplacement Time (min): <5

Communications: Although communications are not necessary, organized cells can employ observers with cell phones to monitor the targets to assure maximum loss of target personnel and materiel.

ARMAMENT
Launcher:
Caliber, Type, Name: 68-mm and a reported 85-mm (?), apparently indigenously fabricated. No 85-mm rocket could be identified. Several near that size could have been used, such as the Italian 81-mm SNIA, a 1930s-vintage 82-mm RS-82, or an 80-mm Russian S-8.

Some launchers were adapted from aircraft rocket launchers
Number of Tubes: 20 x 68-mm, 10 x 85-mm (?)
Launch Rate: 1-30 rockets within minute
Loader Type: Manual, usually a single salvo
Reload Time: INA

FIRE CONTROL/TRIGGERING
Indirect/Direct Fire: Sighting is usually without a formal weapon sight. The IMRLs are usually triggered with a timer, permitting the operators to leave the scene prior.

The weapon is moved within 300-600 m of the target. In targeting hotels, the target size increases the likelihood of a hit. The weapon may be mounted on an adjustable launcher for aiming. In the case of the September-November 2003 Iraqi attacks, the launchers were fixed and canted upward, and the carts were shifted around to aim the launchers. During one launch, no more than 10 of the 30 rockets launched, with 6 hitting the hotel.

VARIANTS
Configurations will vary to avoid creating a recognizable pattern. Mounting on trailers or carts permits IMRLs to be configured to resemble a variety of common sights which can be seen and disregarded by passers-by. One IMRL was disguised to resemble a generator trailer. They can be pulled behind vehicles, or even be hand-drawn into launch position. The same launchers can be mounted in the back of vehicles.

At least one cart was wired for detonation as an improvised explosive device (IED). Some of the better equipped insurgents/ terrorists have used IED remote detonating systems (garage door openers, cell phones, stopwatches, mine command detonation systems, light beam triggers, seismic switches, thermal sensors, etc.). Addition of such a device would create additional hazard in dealing with these systems.

MAIN ARMAMENT AMMUNITION
Caliber, Type, Name:
68-mm SNEB French-designed aerial rocket
Range (km): 0-14, <1aimed
Rocket Weight (kg): 6.8
Rocket Length: (m): 0.94
Warhead Type: Frag-HE or HEAT
Warhead Weight (kg): 1-3
Fuze Type: PD

Caliber, Type, Name:
80-mm S-8 Russian aerial rocket (example)
Range (km): 0-4+, <1aimed
Rocket Weight (kg): 11.3
Rocket Length: (m): 1.57
Warhead Type: Frag-HE or HEAT
Warhead Weight (kg): 3.6
Fuze Type: PD

Other Ammunition Types: Other S-8 warheads are tandem HEAT, thermobaric, concrete penetrating, and illuminating.

A variety of rockets lend themselves to use in these IMRLs. Munitions include 107-mm or 122-mm artillery rockets, and 37-mm, 57-mm, and other air-launch rockets. Warheads and charges can be wired for command detonation.

NOTES
Similar systems designed for these kinds of attacks are older towed or portable rocket launchers, such as the Chinese 107-mm Type 63 rocket launcher, which can be easily disguised or concealed, placed on rooftops for launch, or mounted on vehicles as "transports" or "technicals".

Iraqi Insurgent 57-mm Improvised Rocket Launchers "C-5K"

Weapons &Ammunition Types	Typical Combat Load
57-mm rockets S-5 HEAT/Frag S-5K Frag-HE S-5 HE S-5M	**1-4**

SYSTEM
Alternative Designations: INA most variants. Name "C5K" is from a misreading of Cyrillic label on S-5K air-to-surface rockets (ASRs).
Date of Introduction: By 2000
Proliferation: At least two countries by insurgents

Description:
Crew: 1, 2 or more with reload rockets
Configuration: Shoulder launcher tube and rocket (s), with a battery-powered firing mechanism. Most launchers use a single tube; but versions have been with two, three, or four tubes. Versions have been seen with wood, metal, and plastic held with metal strap, tape, and welds. The better launchers employ one or two welded fore-grips and a rear brace or rear grip. Some also use a wooden shoulder stock.

ARMAMENT
Launcher:
Caliber (mm): 57
Weight (kg): <8 estimated, depending on configuration
Length (mm): 1.42 est, based on S-5 rocket. Designs vary.
Rifling: None
Rate of Fire (rd/min): <2, because of improvised nature. Most of the time, user launches a single rocket then relocates. Even multi-tube launchers require switching wires to initiate other rockets for launch.
Fire from inside building: No

FIRE CONTROL
Day Sight:
Type: A few may have no sight. Some use post sights front and rear. Others use strap metal with spaced holes as rear peep sight. Launchers have been seen with PGO-7 optical sight from an RPG-7V ATGL.
Magnification: 1x, or 2.7x as noted above.
Location: Left side

Night Sights: Available but unlikely, and not seen

Launch Controls: Trigger is used, with a wire connecting to a nine-volt battery in the hand grips or stock.

Aiming Limitations: Because the munition is a high-velocity rocket, it produces significant heat and ash, distracting the user and degrading user accuracy with the weapon.

VARIANTS
Launcher tubes are often extracted from UB-32 or other helicopter launch air-to-surface rocket pods. Tubes can be fabricated from pipe material. Some launchers employ a blast shield to deflect blast effects from the user's face. Earlier Chechen launchers were all-welded, including grips, and appeared to be of sturdy design.

In Tikrit a pedestal-mount 57-mm rocket launcher with 4 rockets in it was found unused in the street (see photo above).

Forces are now looking at factory-produced ground launchers for ASRs. A Russian display showed a 57-mm 12-tube Aviaagregat launcher for the S-5K on a BMD airborne/amphibious IFV. More lethal sizes are 80 mm and 122 mm. S-Cor SAL-homing fuzes can be mounted on them for precision AT/HE /DP fires to 6+ km.

MAIN ARMAMENT AMMUNITION
Caliber, Type, Name:
57-mm Russian aerial rocket S-5K
Rocket Weight (kg): 3.65
Rocket Length: (m): 0.83
Warhead Type: HEAT
Range (m): 100-400 est (depending on configuration)
Free flight range is 2,000 m.
Penetration (mm): 150+ CE estimated
Warhead Weight (kg): 1.13
Fuze Type: PD

57-mm Russian aerial rocket S-5
Rocket Weight (kg): 5.1
Rocket Length: (m): 1.42
Warhead Type: Frag-HE
Range (m): 100-400 est (depending on configuration)
Free flight range is 4,000 m.
Penetration (mm): INA, damage light armored vehicle
Warhead Weight (kg): 1.1
Fuze Type: PD

Other Ammunition Types: Other S-5 warheads are improved Frag-HE, improved HEAT, and HE

A variety of rockets lend themselves to use in improvised rocket launchers. Munitions include 37/57/68-mm air--to-surface rockets.

NOTES
Workshops have been set up for low-volume serial fabrication of these launchers. In at least one instance, they were painted with forest pattern camouflage paint. Substantial caches of rockets are available for this use.

The S-5K rocket's flat trajectory offers a more accurate munition for use over distance beyond 200 m than the high ballistic arc of an ATGL, such as RPG-7V. This weapon is not a threat to modern tank armor. However the concept has potential for development as a multi-role weapon system. A factory engineered version with better quality, accurate sights such as PG-7, a dependable ignition system, and improved blast deflection could present a challenge to the protection on most light armored vehicles such as armored tactical utility vehicles, APCs and IFVs.

Use of Toxic Industrial Chemicals

Toxic industrial chemicals (TICs) are chemical substances with acute toxicity that are produced in large quantities for industrial purposes. Exposure to some industrial chemicals can have a lethal or debilitating effect on humans. The near-universal availability of large quantities of highly toxic stored materials, their proximity to urban areas, their low cost, and the low security associated with storage facilities, make them a potentially attractive option for use as weapons of opportunity or weapons of mass destruction.

Employing a TIC against an opponent by means of a weapon delivery system, whether conventional or unconventional, is considered a chemical warfare attack, with the TIC used as a chemical agent. The target may be the enemy's military forces or his civilian population. In addition to the threat from intentional use as weapons, catastrophic accidental releases of stored industrial chemicals may result from collateral damage associated with military operations, electrical power interruption, or improper facility maintenance or shutdown procedures. These events are common in armed conflict and post-conflict urban environments.

The most important factors to consider when assessing the potential for adverse human health impacts from a chemical release are acute toxicity, physical properties (volatility, reactivity, flammability), and the likelihood that large quantities will be accidentally released or available for exploitation. Foremost among these factors is acute toxicity.

The following are examples of high- and moderate-risk TICs, based on acute toxicity by inhalation, worldwide availability (number of producers and number of countries where the substance is available), and physical state (gas, liquid, or solid) at standard temperature and pressure:

- High-Risk. Ammonia, chlorine, fluorine, formaldehyde, hydrogen chloride, phosgene, sulfuric acid.

- Moderate-Risk. Carbon monoxide, methyl bromide, nitrogen dioxide, phosphine. This list does not include all chemicals with high toxicity and availability. Specifically, chemicals with low volatility are not included. Low-vapor pressure chemicals include some of the most highly toxic chemicals widely available, including most pesticides.

Some of the high-risk TICs are frequently present in an operational environment. Chlorine (water treatment and cleaning materials), phosgene (insecticides and fertilizers), and hydrogen cyanide are traditional chemical warfare agents that are also considered TICs. Cyanide salts may be used to contaminate food or water supplies. Hydrogen chloride is used in the production of hydrochloric acid. Formaldehyde is a disinfectant and preservative. Fluorine is a base element that is used to produce fluorocarbons. Fluorocarbons are any of various chemically inert compounds that contain both carbon and fluorine. Fluorocarbons present in common products are refrigerants, lubricants, and nonstick coatings, and are used in the production of resins and plastics.

The table below lists high- and moderate-risk TICs based on acute toxicity by inhalation, worldwide availability (number of producers and number of continents on which the substance is available), and physical state (gas, liquid, or solid) at standard temperature and pressure. The current definition of TICs does not include all chemicals with high toxicity and availability. Specifically, chemicals with low volatility are not included. These low-vapor-pressure chemicals include some of the most highly toxic chemicals widely available, including most pesticides.

High- and Moderate-Risk Toxic Industrial Chemicals

High Risk	*Moderate Risk*	
Ammonia	Acetone cyanohydrin	Methyl chloroformate
Arsine	Acrolein	Methyl chlorosilane
Boron trichloride	Acrylonitarile	Methyl hydrazine
Boron trifluoride	Allyl alcohol	Methyl isocyanate
Carbon disulfide	Allyl amine	Methyl mercaptan
Chlorine	Allyl chlorocarbonate	n-Butyl isocyanate
Diborane	Boron tribromide	Nitrogen dioxide
Ethylene oxide	Carbon monoxide	Phosphine
Fluorine	Carbonyl sulfide	Phosphorus oxychloride
Formaldehyde	Chloroacetone	Phosphorus pentafluoride
Hydrogen bromide	Chloroacetonitrile	Selenium hexafluoride
Hydrogen chloride	Chlorosulfonic acid	Silicon tetrafluoride
Hydrogen cyanide	Crotonaldehyde	Stibine
Hydrogen fluoride	Diketene	Sulfur trioxide
Hydrogen sulfide	1,2-Dimethyl hydrazine	Sulfuryl chloride
Nitric acid, fuming	Dimethyl sulfate	Tellurium hexafluoride
Phosgene	Ethylene dibromide	Tert-Octyl mercaptan
Phosphorus trichloride	Hydrogen selenide	Titanium tetrachloride
Sulfur dioxide	Iron pentacarbonyl	Trichloroacetyl chloride
Sulfuric acid	Methanesulfonyl chloride	Trifluoroacetyl chloride
Tungsten hexafluoride	Methyl bromide	

Selected missions may require isolation of wide areas through chemical contamination, debilitation of personnel or animal stocks through contamination of food and water supplies, and other missions which require the use of low-volatility TICs. As noted above, factors to consider when assessing potential for adverse health impacts include level of toxicity, physical properties (volatility, reactivity, flammability), and availability of large quantities for exploitation. These may be mixed with oil or other chemical bases to extend their persistence and facilitate dispersal. Thus, there is a wide range of other TICs which could be employed for this use.

Household Chemicals. It is commonly recognized that some everyday household chemicals have incompatible properties which can produce a hazardous chemical reaction when mixed with other chemicals. This includes substances that will react to cause an imminent threat to health and safety, such as explosion, fire, and/or the formation of toxic materials. For example, chlorine bleach, when mixed with ammonia, will generate the toxic gases chloramine and hydrazine that can cause serious injury or death. Another example of such incompatibilities is the reaction of alkali metals, such as sodium or potassium, with water.

Sodium is commonly used in the commercial manufacture of cyanide, azide, and peroxide, and in photoelectric cells and sodium lamps. It has a very great latent heat capacity and is used in molten form as a coolant in nuclear breeder reactors. The mixture of sodium and water produces sodium hydroxide, which can cause severe burns upon skin contact.

Chapter 15
Equipment Upgrades

Armed forces worldwide employ a mix of legacy systems and selected modern systems. In the current era characterized by constrained military budgets, the single most significant modernization trend impacting armed forces worldwide is upgrades to legacy systems. Other factors impacting this trend are:

- A need for armed forces to reduce force size, yet maintain overall force readiness for flexibility and adaptability.
- Soaring costs for modern technologies, and major combat systems.
- Personnel shortages and training challenges.
- Availability of a wide variety of upgrade packages and programs for older as well as newer systems.
- New subsystem component technologies (lasers, GPS, imaging sensors, microcircuits, and propellants), which permit application to platforms, weapons, fire control systems, integrated C2, and munitions old and new.
- An explosion of consortia and local upgrade industries, which have expanded worldwide and into countries only recently introduced to capitalism.

The upgrade trend is particularly notable concerning aerial and ground vehicles, weapons, sensors, and support equipment. From prototype, to low-rate initial production (LRIP), to adoption for serial production, minor and major improvements may be incorporated. Few major combat systems retain the original model configuration five or more years after the first run. Often improvements in competing systems will force previously unplanned modifications.

Upgrades enable military forces to employ technological niches to tailor their force against a specific enemy, or to integrate niche upgrades in a comprehensive and well-planned modernization program. Because of the competitive export market and varying requirements from country to country, a vehicle may be in production simultaneously in many different configurations, as well as a dozen or more support vehicle variants fulfilling other roles. In light of this trend, OPFOR equipment selected for portrayal in simulations and training should not be limited to the original production model of a system, rather a version of the system that reflects the armed forces strategic and modernization plans and likely constraints that would apply.

The adaptive OPFOR will introduce new combat systems and employ upgrades on existing systems to attain a force structure that supports its plans and doctrine. Because the legacy force mix and equipment were selected in accordance with earlier plans and options, use of upgrades versus costly new acquisitions will always be an attractive option. A key consideration is the planned fielding date. For this document, the most widely portrayed OPFOR time frame is the current Contemporary Operational Environment. Only upgrades currently available (or marketed with production and fielding expected in the near term) are considered in COE Tiers 1-4. Also, system costs and training and fielding constraints must be considered. However, in the Emerging Technology Trends chapter (17), we anticipate a wide variety of upgrades that could be currently applied to fielded systems.

The selection of equipment upgrades is not a simple matter. Most forces have limited budgets, competing upgrade priorities, and a substantial inventory of outdated equipment. A specific subsystem upgrade (gun, fire control system, etc.) may only slightly improve a generally obsolete system. Another option is an upgrade package, with compatible subsystem upgrades. The surest approach is to refurbish a system into a new model with all application problems resolved. A critical factor is assurance that the modernized equipment is tested and successful. The best test remains performance in combat.

The following tables describe selected upgrades available for system modernization. The lists are not intended to be comprehensive. Rather, they are intended to highlight major trends in their respective areas. For instance, for armored combat vehicles, the focus is on upgrades in mobility, survivability, and lethality.

The category of survivability upgrades includes countermeasures (CM). The CM upgrades can apply not only to branch-specific systems (tanks, IFV, and artillery), but to general use systems subject to similar threats. An example of this is the proliferation of smoke grenade launchers on artillery and reconnaissance vehicles. Please note that the section on CM has been expanded into the Countermeasures Chapter - Chapter 16.

Implementation of all upgrade options for any system is generally not likely. Because of the complexity of major combat systems and need for equipment subsystem integration and maintenance, most force developers will chose a mix of selected upgrades to older systems, as well as limited purchases of new and modern systems. Please note that systems featured in this document may be the original production system or a variant of that system. On data sheets, the **VARIANTS** section describes other systems available for portrayal in training and simulations. Also, equipment upgrade options (such as night sights) and different munitions may be listed, which allow a user to consider superior or inferior variants. Within the document chapters, multiple systems are listed to provide other substitution options. Of course there are thousands of systems and upgrade options worldwide, which could be considered by an adaptive OPFOR.

An OPFOR trainer has the option to portray systems or upgrade packages not included in the OPFOR Worldwide Equipment Guide, to reflect an adaptive thinking OPFOR. In future WEG updates, the authors will expand on the upgrade tables with names and descriptions of upgrade options and specific systems applications which have been noted in the current document. Chapter authors are available to assist users in selecting reasonable upgrade options for system configuration in specific force portrayals.

Questions and comments on tables and data in this chapter should be addressed to the below POC, or to the author of the respective chapter for systems impacted in the tables.

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OPFOR ANTITANK WEAPON UPGRADES

GRENADE LAUNCHER	TOWED AT GUN	GROUND ATGM LAUNCHER
Improved AT and dual-purpose rifle grenades permit riflemen to supplement shoulder-mount grenade launchers. Accurate low trajectory longer range grenades for shoulder launchers Parachute-drop overhead camera grenades for shoulder/ground launch Tripod, bipod, pintle mounts convert launchers for vehicle/ground use Take-apart AT grenade launchers or disposable launch tubes Larger, more lethal disposable AT grenade launchers supplement grenadier reusable launchers at critical times. Reduced noise, smoke, and flash signature grenades for AT launchers Improved reusable sights for disposable launchers, including ballistic computer/laser rangefinder sights Image intensifier/thermal night sights Counter -charge AT grenades for firing from inside of buildings Dual-purpose (HE/AT) longer range rounds HE longer range rounds Multi-purpose (HE/AT/anti-bunker) rounds Tandem shaped-charge (HEAT) warhead Thermobaric Frag-HE warhead Guided (SAL-H) grenades for shoulder/ground/vehicle launchers **UPGRADE PRIORITY** Computer/LRF FCS II night sights Tandem AT grenades, HE/DP grenades, thermobaric grenades	Auxiliary propulsion unit for local movement Take-apart capability for lighter guns Improved gun and recoil system Ballistic computer/laser rangefinder sights MMW radar target auto-tracker day/night FCS Image intensifier/thermal night sights Automated battle management system with graphic flat panel display Indirect fire rounds/FCS for fire support role Increased DF range, new tank/AT gun rounds Improved, heavier , more lethal , and longer range APFSDS-T round Tandem or triple-charge HEAT round Improve Frag-HE round and DPICM submunition Canister/flechette round New type lethalities (DPICM submunition, etc.) Gun-launched ATGM (100 mm+) , including tandem HEAT **UPGRADE PRIORITY** APU and take-apart for lighter guns Improved gun and recoil system Improved sights, 1st gen thermal night sights Automated battle management system Improved ammunition, inc ATGM.	Man-portable/ground launch and shoulder launch Take-apart launcher and sub-systems Pintle mount/dismount for variety of vehicles/platforms 1st or 2nd generation thermal night sights Extended range missiles Soft-launch for use from bunkers and buildings Launcher countermeasures (CM), such as reduced noise, smoke, flash SACLOS Guidance CCM, e.g., pulsed codes Increased ATGM velocity/reduced flight time New guidance modes: Semi-active laser beam rider and laser-homing, Fiber-optic guided missile (FOG-M) guidance, Fire and forget imaging infrared seeker, Radar homing, Multi-mode (FOG/IR homing, etc.) Helicopter stand-off launch using ground guidance High velocity MANPADS missiles used for AT Larger warhead/tandem warhead HEAT ATGM Sensor-fuzed EFP/HEAT top-attack Thermobaric HE warhead, for new applications **UPGRADE PRIORITY** Take-apart launcher, with pintle mount Improved 1st gen thermal night sights SACLOS CCM Reduced signature Improved ATGMs (tandem HEAT, etc.)

OPFOR LIGHT ARMORED VEHICLE UPGRADES

COMBAT SUPPORT VEHICLE	APC/IFV, INFANTRY FIRE SUPPORT VEH	ATGM LAUNCHER VEHICLE
Used/adapted for various roles, e.g., infantry (less than squad), combat support, and support vehicles. Most are light, 4x4 wheeled, van or light utility vehicle; but auxiliary wheel, 6x6 or tracked versions exist. Many of these are being converted to or replaced by mine-resistant vehicles. Included are motorcycles, ATVs, and light strike vehicles (e.g., jeep-type 4x4 vehicles or recreational dune buggies). Gun trucks, riot control vehicles, and amphibious/over-snow all terrain vehicles are used. Add encrypted voice and digital data capability. Graphic display battle management system Central tire inflation system and/or run-flat tires GPS hand-held or bracket mount Ford capability, swim capability desired Hybrid (diesel/electric) drive kits Add-on light armor, mine protection desired CM, such as multi-spectral smoke grenades Laser warning receiver desired 7.62-14.5-mm MG or 20-40-mm automatic grenade launcher main weapon Remote or overhead weapon station (RWS/OWS) Individual weapons, RPG, MANPADS, or ATGM launcher for secondary weapons Daysight and II or thermal night sight **UPGRADE PRIORITY** Light armor and smoke grenade launchers Remote MG or auto grenade launcher Day/night (thermal sights), RPG GPS, secure comms	Must be able to carry a squad Higher horsepower diesel engine GPS and inertial land navigation, graphic display battle management system, IFF Swim or deep ford (due to armor increases). Amphibious conversion with compartments for high sea state capability. Add-on armor, ERA, and improved mine protection. Fire and blast suppression CM, e.g., multi-spectral smoke grenades, LWR Firing ports (or forego due to armor increases, use periscopes or side and rear view cameras) IFV/IFSV: 20-100 mm stabilized gun, and 2-man turret. Active protection system (APS) or defensive aids suite (DAS). Upgraded FCS: Cdr's independent viewer, 2-plane stabilized TV sights, 1 - 2 gen FLIR. Upgraded secondary MG or grenade launcher with superior sights (integrated, high-angle, night). Additional remote MGs/AGLs for high-angle fires security. Improved KE, HEAT, Frag-HE rounds, ATGMs APC/IFSV: Includes truck/light vehicle conversions Remote weapon station or 1-man turret with high-angle-of fires 7.62-23 mm MG, grenade launcher (some with 20-30-mm auto-cannon and ATGM launcher) **UPGRADE PRIORITY** Add-on armor, ERA, LWR, new grenades Add auto grenade launcher, upgrade ATGM, and KE round to APFSDS. FCS, stabilized sights, Imp 1st gen FLIR	Use APC/IFV wheeled/tracked chassis or tank chassis, with mobility and protection upgrades, Side and rear-view cameras Graphic display battle management system CM, e.g., multi-spectral smoke grenades, LWR Active protection system or other DAS. 1-2 man turret, or turretless design. Alternative design: 1-5 pedestal/turret or mast-elevated ATGM launchers on remote or overhead weapon station (RWS/OWS) Autoloader or manual loader under armor Multiple ATGM launch and targeting capability Improved ATGMs, as noted in above table, or RF, laser-beam rider, SAL-H/IIR ATGMs 7.62-12.7-mm MG secondary arms FCS with commander's independent viewer, 2-plane stabilized sights, TV, and target tracking. Use 1st or 2nd gen FLIR Most common ATGM vehicles are combat support vehicles with pintle-mount ATGM launcher (see above table for ground launcher). Recent development: motorcycle with sidecar and pintle-mount ATGM launcher **UPGRADE PRIORITY** RWS multiple ATGM launchers (APC/IFV/tank conversion), pintle-mount for light combat support vehicles (motorcycle, ATV, LSV, TUV, truck, etc.) Stabilized sights and 1st gen thermal sights Improved ATGMs

OPFOR RECONNAISSANCE AND ASSAULT VEHICLE UPGRADES

RECONNAISSANCE VEHICLE	HEAVY ARMORED COMBAT VEHICLES	MAIN BATTLE TANK
Light recon vehicle: Combat support vehicle with light armor and TV, thermal sights, Add encrypted voice and digital data capability Combat recon vehicle: See IFV upgrades, e.g.: GPS and inertial land navigation. Digital real-time link to subscriber map overlay display, IFF, force tracker battle management system, Swim capability, winch, central tire inflation for wheeled Upgraded FCS: Cdr's independent viewer, 2-plane stabilized TV camera sights, 1 - 2 gen FLIR Elevated battlefield surveillance radar/TV/FLIR sensor suite with TV, encrypted voice, and digital data transmission capability Launch UAVs and/or robots (unmanned ground vehicles) CM, e.g., multi-spectral smoke grenades, LWR, IR/radar skirts Active protection system (APS) or other defensive aids suite (DAS). 20-100 mm gun with 2-plane stabilization, and 2-man turret. Improved secondary MG or automatic grenade launcher and sights. Man-portable SAMs (MANPADS) for self-protection Named and targeted areas of interest link to indirect fire and missile units for real-time targeting. Laser target designator guides munitions. Sensor vehicle: APC/IFV or combat support vehicle and mast- mounted sensor pod: radar, thermal and TV Encrypted voice SATCOM/digital data systems **UPGRADE PRIORITY** Add higher HP diesel engine Add-on armor, ERA, LWR, new grenades Imp 1st gen FLIR, gunner and commander, Add auto grenade launcher, upgrade ATGM, and KE round to APFSDS. Elevated sensor suite and transmission capability.	Distinction among heavy recon, infantry fire support, assault gun, light tank has blurred APC/IFV chassis with increased armor and higher horsepower diesel engine. GPS and inertial land navigation, graphic display battle management system, IFF Swim or deep ford capability Add-on armor, ERA, improved mine protection, fire and blast suppression. CM, e.g., multi-spectral smoke grenades, LWR Side and rear-view cameras for security Active protection system (APS) or other defensive aides suite (DAS). 76-125 mm tank gun with 2-plane stabilization, Improved MG or auto grenade launcher, sights FCS with commander's independent viewer, 2-plane stabilized sights, TV, and target tracking. Use of 1st or 2nd generation FLIR. Side and rear-view cameras Improved KE, electronic fuzed Frag-HE, and tandem HEAT rounds Gun-launched ATGMs (100+ mm) **UPGRADE PRIORITY** Add higher HP diesel engine Add-on armor, ERA, LWR, new grenades Imp 1st gen FLIR, gunner and commander, Larger stabilized gun, gun-launch ATGM, and KE round to APFSDS.	Higher horsepower diesel engine power packs and add-on reserve fuel tanks GPS and inertial land navigation, graphic display battle management system, IFF Deep ford snorkel capability Welded turret, blow-out panels, ERA, improved mine and turret protection, fire and blast suppression. CM suite, including multi-spectral and vertical smoke grenade mix, LWR, VEESS capability Active protection system (APS) or other defensive aides suite (DAS), self-entrenching blade Side/rear-view security cameras Tank gun with 2-plane stabilization FCS with commander's independent viewer, 2-plane stabilized sights, TV, and target tracking. 2nd or 3rd generation FLIR. Auto-tracker. Hunter-tracker FCS. Heavier and longer range APFSDS-T rounds, electronic fuzed Frag-HE, and tandem HEAT rounds Gun-launched ATGMs and IR homing rounds (100+ mm). Semi-active laser homing munitions permit ATGMs to deliver indirect fire precision strikes. Improved remote-firing MG, high-angle AD sights **UPGRADE PRIORITY** Add higher HP diesel engine Land navigation and deep ford snorkel Add-on armor, ERA, CM suite Imp stabilization and FCS, 1st gen FLIR, Remote MG, Imp ammo (sabot, Frag-HE, and HEAT) Gun-launch ATGM.

OPFOR ARTILLERY UPGRADES

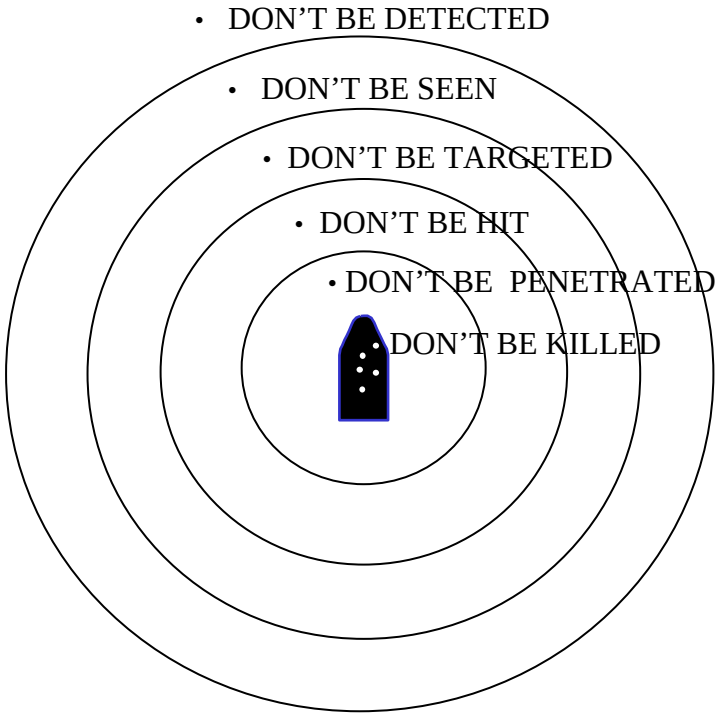
ARTILLERY RSTA/C2 SUPPORT	TOWED AND SELF-PROPELLED CANNON	MULTIPLE ROCKET LAUNCHER
Automated secure digital joint C2 network with SATCOM, linking artillery, air, EW, and reconnaissance units Integrated artillery recon vehicle with sensor mast Reconnaissance strike and fire complexes Forward air controllers linked to artillery units Artillery surveillance vehicles with ground surveillance radars, sensor suite and networked Observation teams with goniometers, thermal sights, digital comms, and laser target designators Artillery links to selected special purpose forces Acoustic vehicle detection and location Phased array counter-battery radars, networked to automated artillery net, with increased range, lower probability of error, windows-based man-machine interface Target-acquisition UAVs, networked to artillery net Automated battle management equipment use for towed and SP guns, mortars and MRLs Navigation system with GPS/inertial update, linked to automated net <u>UPGRADE PRIORITY</u> Integrated artillery recon vehicle, sensor mast Reconnaissance strike and fire complexes Target-acquisition UAVs, networked Observation teams, radars, acoustic sensors	Conventional munitions, e.g., controlled fragmentation, proximity and multi-option fuzes, special munitions, and propellant s (modular propellants) Artillery delivered high precision munitions e.g., SAL-H, sensor-fuzed, course corrected, terminal-homing IR <u>Self-Propelled:</u> Automated fire control with barrel cooling and thermal warning systems Auxiliary power unit Mobility and weight improvements, Muzzle velocity analyzer CM, such as smoke grenade launcher and LWR Upgrade to 52-caliber cannon for longer range Truck-mounted high-mobility systems with long-range cannons <u>Towed:</u> Addition of auxiliary propulsion unit On board technical fire control computer Reduced weight and emplace/displace times Muzzle velocity analyzer Onboard or portable digital linked fire control computer Upgrade to 52-caliber cannon for longer range <u>UPGRADE PRIORITY</u> Mobility and weight improvements On-board navigation and fire direction systems Use of modular propellant Procurement of ADHPM Overall range and accuracy improvements	Mobility and weight improvements, truck-based launchers which conceal the MRL signature Rapid emplace-displace and response capabilities CM, such as smoke grenade launcher and LWR On-board computer-based fire direction and land navigation systems, which permit autonomous launcher, platoon, and battery operations Tube-launched UAVs linked to the launchers and to the fire control network for real-time acquisition Improved lethality improved conventional munitions and special purpose (mines, jam, etc,) munitions Extended-range and course-corrected rockets, as well as addition of artillery/cruise missiles Computer-based fire control system for electronically-fuzed rockets Artillery delivered high precision munitions (ADHPM), e.g., sensor fuzed, laser-homing rockets Special munitions, such as FASCAM, chemical warhead, RF jammer rockets Mine clearer and fuel-air explosive rocket MRLs <u>UPGRADE PRIORITY</u> Autonomous/ semi-autonomous launcher Countermeasures Improved munitions, e.g., extended range, DPICM and thermobaric ADHPM, e.g., sensor-fuzed munitions and course corrected rounds or rockets

Chapter 16
Countermeasures

Countermeasures (CMs) are survivability measures to preserve the integrity of assets and personnel by degrading enemy sensors and weapons effectiveness. These measures often fit within the US Army term CCD (camouflage, concealment and deception) or within the OPFOR term C3D (camouflage, cover, concealment and deception). Decoys used by tactical units within branch operations are designed to aid survivability, and are considered to be countermeasures. Countermeasures can take the form of tactical CMs (or reactive measures), or they can be technical CMs. The variety of tactical CM changes with new unit tactics techniques and procedures (TTP), to adapt to a given situation, within rules of engagement. This document focuses on technical CM. In specialized branches new technical CMs continue to appear.

Modern forces will upgrade systems with selected countermeasures. Many CMs noted are intended to protect combat vehicles from anti-armor sensors and weapons. Although the below CM can be used to counter precision weapons, many were developed for use against conventional weapons. Priorities for countermeasures are dictated by the goals of survival, mission success, and maintaining effectiveness. The first CM priority is to avoid detection until you can control the events. Among goals for using countermeasures, highest is mission success.

COUNTERMEASURE PRIORITIES



Survival ("Don't Be Killed") is defined holistically, including the following requirements in order of priority: operating system or network survival, vehicle survival, vehicle avoidance of major damage, crew survival, and vehicle avoidance of minor repair. A compatible suite of countermeasures may be limited to a more modest goal, to preserve a measure of effectiveness, even at the risk of system survival. Effectiveness in this context could be defined as - ability to

effectively execute the immediate and subsequent missions, until system or subsystem failure interrupts this process. Effectiveness includes: crew effectiveness, mission success, operating system effectiveness, and vehicle/soldier readiness for employment.

Several factors must be considered when selecting countermeasures.

- Countermeasures should be fielded and mounted on systems with a holistic and rational approach to assure survivability. The rational developer will focus his countermeasures with the highest priority given to assure protection against the most likely and most lethal threats. However, with changing threat capabilities over time, and conflicting priorities, the current CM mix may not be successful. Most CM are responses to specific perceived threats, and are limited by cost and weight budget concerns. With the modern reliance on precision weapons, military forces may develop complex and expensive countermeasure "suites" to degrade their effects.

- Some countermeasures can degrade a variety of sensors and weapons capabilities. They can be grouped by threat to be countered, such as artillery or ATGM CMs. Others are more adversary and technology-specific, and may not be fielded until that technology is fielded. Driven by threatening technologies, designers may launch a short-response program to produce or purchase countermeasures for rapid mounting.

- The R&D process has led to the development of counter-countermeasures, intended to negate the effects of CMs. However, at some level, these are also CMs. To avoid confusion on labeling, these will also be called countermeasures.

- When countermeasures are added to a vehicle or within close proximity, they must be mutually compatible and compatible with other subsystems. Thus issues such as electromagnetic interference and self-blinding with smokes must be considered.

- Although a variety of countermeasures are now marketed, many technical and financial factors can negate their advantages. Countermeasure development may be restricted due to resource, technology, and fabrication limitations, which vary by country and time frame. Budget limitations may limit fielding of feasible and valuable CM, or compel selection of less capable countermeasures. For instance, active protection systems can counter some weapons; but they are expensive, hazardous to soldiers, and ineffective against many weapons. Thus they may be unsuitable and unlikely for application to many systems. OPFOR users should consult the POC below for assistance in selecting CMs for a specific system.

- Countermeasures will not replace the need for armor protection and sound tactics.

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LETHALITY COMPONENT VERSUS COUNTERMEASURE RESPONSES

Intent of this table is to assist in selection of CM and understanding the categorization for use in upgrade schemes. Many of the more widely-fielded countermeasures are designed to degrade a variety of sensors and munitions, for minimal upgrade cost. Thus, countermeasure types may be repeated under several functions. Because new technologies are emerging rapidly, and systems are finding applications which can place them in several CM types, the placement of CMs can be somewhat arbitrary. Use against artillery vs ATGMs vs ground vehicle weapons will vary. The following list of CM can be used for artillery, air defense, antitank, armor, aircraft, theater missile, and other systems, depending on the platform, gun, sensor, and munition configuration of the system.

Capability to Be Degraded	Type of Countermeasure
Detection and location	Camouflage: nets, paints, fasteners for added natural materials Cover: entrenching blades, hole-blast device, underground facilities Concealment: screens, skirts, thermal engine covers, scrim, other signature reduction Deformers, engine exhaust diversion, other signature alteration measures Aerosols: smoke and flares, water spray systems Decoys, clutter, and acoustic countermeasures Counter-location measures: GPS jammers, laser and radar warning systems
C2/sensor-shooter links	See Information Warfare (IW) Chapter
Platform or weapon	Counterfire: directional warning systems, laser radars, for rapid response Directed energy weapons (DEW), such as high-energy lasers System prioritization for hard-kill, e.g., anti-helicopter mines (See Ch 7)
Weapon sensors and fire control	CCD as noted above. Directed energy weapons, such as low-energy lasers (LEL) Electro-optical countermeasures (EOCMs)
Submunition dispensing/activation	Global positioning system (GPS) jammer Fuze (laser/IR/RF), RF barrage jammers, acoustic jammers
Precision munition and submunition sensors	CCD as noted above. False-target generator (visual, IR, RF/acoustic) Electromagnetic mine countermeasure system, to pre-detonate or confuse Fuze jammers (laser/IR/RF), RF barrage jammers, acoustic jammers
Munition/submunition in-flight, and its effects	Sensors to detect munitions: MMW radars, RF/IR/UV passive sensors Air watch and air defense/NBC warning net, to trigger alarm signal Active protection systems, for munition/submunition hard kill Cover, additional armor to reduce warhead effects
Other system effects	Miscellaneous CM (See below)

COUNTERMEASURES AGAINST SENSORS

Type Countermeasure	Countermeasure	Example	Application
Camouflage	Camouflage nets	Russian MKS and MKT	Variety of vehicles
	Camouflage paints, IR/radar/and laser-absorptive materials/paints	Salisbury screen rubber epoxy	Variety systems
	Fasteners, belts for attaching natural materials	Chinese "grass mat" set	Uniforms and vehicles
Cover	Natural and manmade cover, civilian buildings	Tree cover, garages, underpasses	TELs, vehicles, troops
	Entrenching blade to dig in vehicles	T-80U tank, BMP-3 IFV, 2S3 arty	IFVs, tanks, SP arty
	Hole-blast devices for troop positions, spider holes		Infantry, SOF
	Underground facilities, bunkers, firing positions	Hardened artillery sites, bunkers	Iraqi and NK sites
Concealment	Screens, overhead cover for infantry (conceal IR/visible signature)	Colebrand netting	Infantry, weapon, sensor
	Canvas vehicle cover, to conceal weapons	Cover on Chinese Type 90 MRL	Truck-based weapons
	Thermal covers, vehicle screens	Kintex thermal blanket over engine	For combat vehicles
	Scrim, side skirts and skirting around turret	French "Ecrim" track cover scrim	Combat vehicles
Deformers/ signature modification	"Wummels" (erectable umbrellas to change/conceal shape/edges)	Barracuda RAPCAM/TOPCAM	Vehicles, sites, weapons
	Exhaust deformers (redirect exhaust under/behind vehicle)	Russian exhaust deflectors	Combat vehicles
	Engine and running gear signature modification (change sound)	Track pads, road wheel/exhaust change	Tracked, other vehicles
	IR/radar deformers (in combination with RAM and RAP, etc)	Cat-eyes, Luneburg lens	Tracked, other vehicles
Aerosols	Visual suppression measures, smokes, WP rounds	Smoke generators, fog oil, S-4, RPO-D	Blinding, screening
	Multi-spectral smokes for IR and or MMW bands,	ZD-6 Smoke grenades (visual/IR)	Vehicle protection
	Flares, chaff, WP, to create false targets, disrupt FLIR	WP rounds, Galix 6 flare system,	Combat vehicles, arty
	Toxic smokes (irritants to disrupt infantry and weapons crews)	Adamsite and CN in smoke mix	Smoke generators
	Water spray systems (to reduce thermal contrast)	Add-on kits for vehicles	Recon, C2, AD, arty
Decoys	Clutter (civilian/military vehicles, structures, burning equipment)	Log site, truck park, tank farm, derricks	Artillery, combat vehicles
	Low to high-fidelity (multi-spectral) decoys	IMT-72 “dummy tank”, Shape Intl	TBM, vehicle decoys
	Radar/IR decoy supplements (to add to visual/fabricated decoys)	Corner reflectors, KFP-1-180 IR heater	Vehicle/site radar decoys
	Acoustic countermeasures (to deceive reconnaissance, sensors)	Acoustic tape/speaker systems	Vehicles, sites
Counter-location measures	Degrade GPS by jamming to reduce precision location capability	Aviaconversia GPS jammer	Infantry and others
	Jam radars/IR sensors	SPN-2 truck-borne jammer set	tactical/operational area
	Laser, IR, and radar warning systems (to trigger move/CM)	Slovenian LIRD laser warner	Combat vehicles

COUNTERMEASURES AGAINST WEAPONS AND WEAPON SENSORS

Type Countermeasure	Countermeasure	Example	Application
Added protection (supplements to armor in reaction to specific capability)	Armor supplements (ERA, screens, bar or box armor, sand bags) Armor skirts over road wheels Mine rollers, plows and flails Vehicle belly armor, raised or redesigned belly design, skirt Vertical smoke grenade launchers (to counter PGM top attack)	Barracuda, SNPE ERA KMT-5, KMT-6	
EOCM	Use EOCMs such as IR jammer/IR searchlights to redirect ATGM	KBCM infrared CM system	Combat vehicles
False-target Generators	Acoustic jammers and directed acoustic countermeasure Laser false-target generator (against semi-active laser homing) Electromagnetic mine countermeasure system, counters fuzes	In development, can be improvised In development	To distract acoustic seekers Combat vehicles
Jammers	Altimeter jammer (counters submunition dispersion altimeter) Fuze jammers (to spoof RF proximity fuzes on munitions) Incoherent infrared jamming (to jam IR fuzes on munitions) GPS jammers to confuse navigation and course correction systems	SPR-1 armored ECM vehicle	High priority sites, CPs etc.
Active countermeasures	Active protection systems, for munition hard kill. High energy laser weapons to destroy munitions or sensors Low energy lasers to blind or dazzle. Radio-frequency weapons to burn electronics and detonate munitions Directed MGs	Arena hard-kill system ZM-87 laser weapon VEMASID counter-mine system	Tanks, recon vehicle, IFVs AT, AD systems
Counterfire/ Threat response warners	Directional warning system (locate laser/radar, to direct weapons) Employ sensors (RF/IR/UV - to detect munitions) Acoustic directional systems (to detect munitions) Laser radars (laser scanner to locate optics and direct weapons) Directed energy weapons (against optics) Anti-helicopter mines (against aircraft) Employ air watch/security, AD, NBC, nets to trigger alarm signal Dazzle grenades (temporarily blind personnel)	Pilar acoustic detection system Star-burst grenades	 Infantry
Miscellaneous CM	Optical filters to degrade effect of battlefield lasers. Pulse code/thermal CCM beacons on SACLOS ATGMs (to counter EOCM)	HOT-3 ATGM	

COUNTERMEASURES BY FUNCTIONAL AREA AND TYPE SYSTEM

Functional Area	System	Type Countermeasure	Countermeasure
Infantry, Special Forces, Reconnaissance, Military Police/Security	Dismounted soldier, Utility vehicle troops	Camouflage	Camouflage nets
			Fasteners, belts for attaching natural materials
		Cover	Natural and manmade cover, civilian buildings
			Hole-blast devices for troop positions, spider holes
			Underground facilities, bunkers, firing positions
		Concealment	Screens, overhead cover for infantry (conceal IR/visible signature)
		Aerosols	Visual suppression measures, smoke grenades, WP rounds
			Multi-spectral smokes for IR and or MMW bands,
			Flares, chaff, WP, to create false targets, disrupt FLIR
			Vertical smoke grenade launchers (to counter PGM top attack)
		CM Operational Technologies	Toxic smokes (irritants to disrupt infantry and weapons crews)
			Acoustic directed counterfire system
			Dazzle grenades (temporarily blind personnel)
Mechanized Infantry, Reconnaissance, Military Police/Security, Antitank	Armored personnel carrier Armored scout cars (Less costly LAVs) Light tanks Self-propelled AT Guns (HACVs)	Camouflage	Camouflage paints, IR/radar/and laser-absorptive materials/paints
			Fasteners, belts for attaching natural materials
		Cover	Natural and manmade cover, civilian buildings
			Underground facilities, bunkers, firing positions
			Armor supplements (stand-off screens, bar armor, sand bags)
			Thermal covers, vehicle screens
		Concealment	Scrim, side skirts and skirting around turret
			Exhaust deformers (redirect exhaust under/behind vehicle)
		Deformers/signature modification	Engine and running gear signature modification (change sound)
			IR/radar deformers (in combination with RAM and RAP, etc)
			Visual suppression measures, smokes, WP rounds
			Multi-spectral smoke grenades for IR and or MMW bands,
		Aerosols	Flares, chaff, WP, to create false targets, disrupt FLIR
			Toxic smokes (irritants to disrupt infantry and weapons crews)
			Clutter (civilian/military vehicles, structures, burning equipment)
			Laser, IR, and radar warning systems (to trigger move/CM)
			Beyond line-of-sight modes
		Counter-location measures	Remote-controlled missiles and guns
			Mine rollers, plows and flails
		CM Operational Technologies	Air watch/security, AD, NBC, nets to trigger alarm signal
			Optical filters to degrade effect of battlefield lasers.
			Encoded SACLOS ATGMs (to counter EOCM)

COUNTERMEASURES BY FUNCTIONAL AREA AND TYPE SYSTEM (CONTINUED)

Mechanized Infantry, Reconnaissance, Armor, Antitank,	Infantry fighting vehicle Combat recon vehicles Main battle tanks ATGM launcher vehicles (More costly Systems)	Camouflage	Camouflage paints, IR/radar/and laser-absorptive materials/paints Fasteners, belts for attaching natural materials
		Cover	Natural and manmade cover, civilian buildings Entrenching blade to dig in vehicles Underground facilities, bunkers, firing positions
		Concealment	Conformal camouflage materials for moving vehicles Thermal covers, vehicle screens
		Deformers/signature modification	Scrim, side skirts and skirting around turret "Wummels" (erectable umbrellas to change/conceal shape/edges) Exhaust deformers (redirect exhaust under/behind vehicle) Engine and running gear signature modification (change sound) IR/radar deformers (in combination with RAM and RAP, etc)
		Aerosols	Visual suppression measures, smokes, WP rounds Multi-spectral smoke grenades for IR and or MMW bands, Flares, chaff, WP, to create false targets, disrupt FLIR Toxic smokes (irritants to disrupt infantry and weapons crews) Water spray systems (to reduce thermal contrast)
		Decoys	Clutter (civilian/military vehicles, structures, burning equipment)
		Counter-location measures	Mobile decoys and quick construction decoys Degrade GPS by jamming to reduce precision location capability Laser, IR, and radar warning systems (to trigger move/CM)
		CM Operational Technologies	Beyond line-of-sight modes Remote-controlled missiles and guns Acoustic-directed counterfire system Mine rollers, plows and flails EOCMs such as IR jammer/IR searchlights to redirect ATGM Acoustic jammers and directed acoustic countermeasure Laser false-target generator (against semi-active laser homing) Electromagnetic mine countermeasure system, counters fuzes Active protection systems, for munition hard kill. Low energy lasers to blind or dazzle. Directional warning system (locate laser/radar, to direct weapons) Employ sensors (RF/IR/UV - to detect munitions) Laser radars (laser scanner to locate optics and direct weapons) Air watch/security, AD, NBC, nets to trigger alarm signal Optical filters to degrade effect of battlefield lasers. Encoded CCM beacons on SACLOS ATGMs (to counter EOCM)

COUNTERMEASURES BY FUNCTIONAL AREA AND TYPE SYSTEM (CONTINUED)

Functional Area	System	Type Countermeasure	Countermeasure
Air Defense , Artillery, Radar units, Theater Missile Units , Aviation, Headquarters,	Command and communications vehicles, Radars, missile launchers, Aircraft (High value targets)	Camouflage	Camouflage paints, IR/radar/and laser-absorptive materials/paints
		Cover	Natural and manmade cover, civilian buildings
			Entrenching blade to dig in vehicles
			Underground facilities, bunkers, firing positions
		Concealment	Canvas vehicle cover, to conceal weapons when not in use
			Thermal covers, vehicle screens
		Deformers/signature modification	Scrim, side skirts and skirting around turret
			"Wummels" (erectable umbrellas to change/conceal shape/edges)
			Exhaust deformers (redirect exhaust under/behind vehicle)
			Engine and running gear signature modification (change sound)
			IR/radar deformers (in combination with RAM and RAP, etc)
		Aerosols	Visual suppression measures, smokes, WP rounds
			Multi-spectral smoke grenades for IR and or MMW bands,
			Flares, chaff, WP, to create false targets, disrupt FLIR
		Counter-location measures	Degrade GPS by jamming to reduce precision location capability
			Jam radars/IR sensors
			Laser, IR, and radar warning systems (to trigger move/CM)
		Decoys	Clutter (civilian/military vehicles, structures, burning equipment)
			Low to high-fidelity (multi-spectral) decoys
			Radar/IR decoy supplements (to add to visual/fabricated decoys)
			Acoustic countermeasures (to deceive reconnaissance, sensors)
		CM Operational Technologies	Anti-helicopter mines (against aircraft)
			Beyond line-of-sight modes
			Non-ballistic launch modes
			Anti-radiation missiles
			Low energy lasers to blind/dazzle optics on designators/aircraft
			Encoded laser target designators to foil false target generators
			Radio-frequency weapons - burn electronics/detonate munitions
			High energy laser weapons to destroy munitions or sensors
			Laser false-target generator (against semi-active laser homing)
			Altimeter jammer (counters submunition dispersion altimeter)
			Fuze jammers (to spoof RF proximity fuzes on munitions)
			Incoherent infrared jamming (to jam IR fuzes on munitions)
			GPS jammers to confuse navigation and course correction systems
			Optical filters to degrade effect of battlefield lasers

COUNTERMEASURES BY FUNCTIONAL AREA AND TYPE SYSTEM (CONTINUED)

Functional Area	System	Type Countermeasure	Countermeasure
Aircraft Units **Reconnaissance UAVs** **Theater Missile Units**	Helicopters Fixed-wing aircraft UAVs Attack UAVs Missiles	Camouflage Decoys Counter-location measures CM Operational Technologies	Camouflage paints, IR/radar/and laser-absorptive materials/paints Launcher decoys Flares, chaff, WP - decoy seekers, create false targets, disrupt FLIR Clutter (civilian/military vehicles, structures, burning equipment) Jam radars Stealth materials and coatings GPS jammers to confuse navigation and course correction systems Jam IR sensors and seekers with laser/IR devices Fuze jammers (to spoof RF proximity fuzes on munitions) Radio-frequency weapons - burn electronics/detonate munitions Laser, IR, and radar warning systems (to trigger move/CM) Low energy lasers to blind or dazzle Optical filters to degrade effect of battlefield lasers. Encoded CCM beacons on SACLOS ATGMs (to counter EOCM) Stand-off precision munitions (maneuvering Beyond line-of-sight and over-the-horizon modes Non-ballistic launch modes for missile launcher/missile survival Anti-radiation missiles to counter radars and aircraft Maneuvering re-entry vehicle (with warhead) for ballistic missiles
Information Warfare/ **Deception Units**	IW vehicles	Camouflage Cover Deformers/signature modification Aerosols Counter-location measures Decoys	Camouflage paints, IR/radar/and laser-absorptive materials/paints Natural and manmade cover, civilian buildings Underground facilities, bunkers, firing positions "Wummels" (erectable umbrellas to change/conceal shape/edges) IR/radar deformers (in combination with RAM and RAP, etc) Visual suppression measures, smokes, WP rounds Multi-spectral smoke grenades for IR and or MMW bands, Flares, chaff, WP, to create false targets, disrupt FLIR Degrade GPS by jamming to reduce precision location capability Jam radars/IR sensors Laser, IR, and radar warning systems (to trigger move/CM) Clutter (civilian/military vehicles, structures, burning equipment) Low to high-fidelity (multi-spectral) decoys Radar/IR decoy supplements (to add to visual/fabricated decoys) Acoustic countermeasures (to deceive reconnaissance, sensors)

COUNTERMEASURES BY FUNCTIONAL AREA AND TYPE SYSTEM (CONTINUED)

Functional Area	System	Type Countermeasure	Countermeasure
All Units	Combat support vehicles (Light strike vehicles, Tactical utility vehicles, Motorcycles, ATVs, Armored CSVs, etc), Trucks	Camouflage	Camouflage paints, IR/radar/and laser-absorptive materials/paints
			Fasteners, belts for attaching natural materials
		Cover	Natural and manmade cover, civilian buildings
			Underground facilities, bunkers, firing positions
			Armor supplements (ERA, screens, bar or box armor, sand bags)
		Concealment	Thermal covers, vehicle screens
		Deformers/signature modification	Engine and running gear signature modification (change sound)
			IR/radar deformers (in combination with RAM and RAP, etc)
		Aerosols	Multi-spectral smoke grenades for IR and or MMW bands,
			Flares, chaff, WP, to create false targets, disrupt FLIR
		Decoys	Clutter (civilian/military vehicles, structures, burning equipment)
		CM Operational Technologies	Air watch/security, AD, NBC, nets to trigger alarm signal
			Acoustic directed counter-fire system

Chapter 17
Emerging Technology Trends

In order to provide a realistic OPFOR for use in Army training simulations, we must describe the spectrum of contemporary and legacy OPFOR forces in the current time frame, as well as capabilities in emerging and subsequent operational environments (OEs). This chapter does not predict the future, rather notes emerging adversary capabilities which can affect training.

The OPFOR timeframes for emerging OPFOR are: 2014-2020 (Near Term) and 2021-2028 (Mid-Term). The subsequent time frame is "future" OPFOR time frame. Time lines were determined in part to assist in building OPFOR systems and simulators and for use in Army training simulations. The timeframes are arbitrary and selected for ease in focusing and linking various trends. However, they also generally match force developments for U.S. Army forces, as well as thresholds in emerging and advanced technologies which will pose new challenges to military force planners and developers.

In these time frames, the mix of forces will continue to reflect tiered capabilities. The majority of the force mix, as with all military forces, will use legacy systems. Periods 2014 and after will also see new OPFOR systems and whole new technologies. The most notable difference between the OPFOR force mix and U.S. forces is that the OPFOR will have a broader mix of older systems and a lower proportion of state-of-the-art systems. Rather, OPFOR will rely more on adaptive applications, niche technologies, and selected proven upgrades to counter perceived capabilities of their adversaries. Force developers for OPFOR will retain expensive legacy systems, with affordable upgrades and technology niches. A judicious mix of equipment, strategic advantages, and sound OPFOR principles can enable even lesser (lower-tier) forces to challenge U.S. military force capabilities.

The OPFOR systems must represent reasonable responses to U.S. force developments. A rational thinking OPFOR would study force developments of their adversaries as well as approaches of the best forces worldwide, then exploit and counter them. Thus worldwide and adversary equipment upgrades will trigger OPFOR forces to modify their equipment and tactics to deter, match, overmatch, or counter those changes.

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OPFOR TECHNOLOGIES AND EMERGING OPERATIONAL ENVIRONMENTS

As noted in Chapter 1 on COE OPFOR, the adaptive OPFOR will introduce new combat systems and employ upgrades on existing systems to attain a force structure which supports its plans and doctrine. Because a legacy force mix and equipment were historically selected earlier in accordance with plans and options, upgrades versus costly new acquisitions will always be an attractive option. A key consideration is the planned fielding date. To project OPFOR capabilities in the future, we should look at the technologies in various stages of research and development today, as well as those in the concept stage for applications in the Future OPFOR time frame. Military engineering experience has demonstrated that the process of formulating military requirements, as well as technology, engineering, and budgeting factors can dramatically affect equipment modernization time lines. In addition, scientific discoveries and breakthroughs in the civilian sector have greatly contributed to the so-called "Revolution in Military Affairs", which has increased the capability for battlefield awareness, integration, timeliness, and lethality.

The table below shows OPFORs in emerging and Future OEs, and some considerations.

Considerations in Determining Emerging OPFOR Technologies by Time Frame

OPFOR Consideration	Near-Term (2014-2020)	Mid-Term (2021-2025)
Challenging OPFOR	Emerging OPFOR	Objective OPFOR
Technology Source	Current marketed/fielded systems and subsystems	Recent major weapons, upgrade applications
Budget	Constricted but available for niche technologies	Improved, some major system acquisitions
Implications for OPFOR equipment	Many subsystem upgrades, BLOS weapons, remote sensors, countermeasures	More costly subsystems, recent major weapons, competitive in some areas.
Implications for OPFOR tactics and organization, Implications for U.S.	COE tactics with contingency TTP updates. Slight subunit changes add BLOS and AT systems for integrated RISTA and strikes.	Integrated RISTA with remotes. Strikes all levels. Combined arms integrated in small units for increased lethality and autonomy.

The information revolution has also decreased response time in which system developers in the military marketplace can seize a new technology and apply it in new systems or in upgrades to older systems. The following technologies and possible applications of those technologies will influence R&D as well as fielding decisions for future force modernization and expected OPFOR capabilities to be portrayed in future operating environments.

TECHNOLOGIES AND APPLICATIONS FOR USE BY OPFOR: NEAR AND MID-TERM

TECHNOLOGY CATEGORY	TECHNOLOGY	TECHNOLOGY APPLICATION
Psychological Operations	Mood altering aerosols Reproductive terrorism Non-lethal technologies	Military and civilian targets, for short-term and long-term goals.
Information Operations: Sensors	Higher-resolution multispectral satellite images New sensor frequencies for acquisition New sensor frequencies operational security Use of other light bandwidths (ultraviolet, etc) Passive detection technologies and modes Auto-tracking for sensors and weapons Image processing and display integration Micro-sensors/imaging system miniaturization Unmanned surveillance, target acq/designation Multispectral integrated sensors and Multispectral integrated transmission modes Precision navigation (cm/mm three-dimension) Undersea awareness (sensors, activity) Underground awareness (sensors/mines)	High-intensity use of LITINT (internet, periodicals, forums) Increased use of information from commercial, industrial, scientific and military communities Increased use dual-use technologies
Information Operations: Computers and Comms	Low-Probability-of-Intercept communications New power sources and storage technologies: Micro-power generation Energy cells Advanced Human/Computer Interface Automatic Language Translators	New communities (Blogs, flash mobs, etc, to coordinate and safeguard comms) Secure encryption software New communications tools (inter-net and subscriber links)
Electronic Attack	Anti-Satellite weapons for RF, EMP, Hard kill Wide area weapons (EMP graphite bombs, etc) EMP Precision (small area) weapons Computer Network Attack Worms, viruses, trojan horses Net-centric warfare Spoofing sensors Spoofing/Intercepting data stream/ spyware	Attack electronic grid or nodes at critical times
Chem/Bio/ Radiological Attack	Dirty bombs Genetic/Genomic/DNA tagging to assassinate Genetic/Genomic/DNA targeting for Bio attack Designer Drugs/Organisms/Vectors Biologically based chem (Mycotoxins) Anti-materiel corrosive agents and organisms	Agricultural attack (animal and plant stocks and supplies) Use of tagging to incapacitate po-litical leaders.

TECHNOLOGIES AND APPLICATIONS FOR USE BY OPFOR (CONTINUED)

TECHNOLOGY CATEGORY	TECHNOLOGY	TECHNOLOGY APPLICATION
Physical Attack	Mini-cruise/ballistic missiles for precision, surgical strikes, and widespread use Atk UAVs (land, sea, undersea-UUV, Micro-aerial vehicles-widespread use Swarming for coordinated attack Notebook command semi-autonomous links Vehicle launch for NLOS attack/defense Multi-mode guidance: pre-programmed/ guided/homing New types of warheads Wider area/different effects Tailorable warhead effects Precision Munitions Course-corrected/guided/homing Widespread - almost all weapons Loiter/IFF DEW Blinding/high energy lasers RF Weapons against electronics RF against people, vs structures/systems Directed acoustic weapons	
Sustainment, Protection	New battery/power cell technologies Neurological performance enhancers Better lightweight seamless body armor Personal actuators, exoskeletons, anti-RF suits Active armor and active protection systems Countermeasures to defeat rounds and sensors Counter-precision jammers, esp GPS All-spectrum low observable technologies Anti-corrosives Biometric prosthesis and cybernetics Robots assist dismounts, sensors, and logistics Robotic weapon systems	Battlefield fabrication of spare parts Airborne/ship borne refineries Potable water processing systems Transportable power generation systems

OPFOR CAPABILITIES: NEAR-TERM AND MID-TERM

The next table provides projected system description and capabilities for analysis of the OPFOR environment facing U.S. forces in subsequent time frames. Data for the first timeframe (2013-2019) reflects generally known systems and subsystems, with their introduction to the emerging OPFOR adversary force. Timelines reflect capability tiers for systems which may be fully fielded (not Interim Operational Capability or First Unit Equipped) in brigade and division unit levels during respective time frames.

The systems projections are not comprehensive, and represent shifting forecasts. They may accordingly shift as we approach the specified time frames. Once we get beyond the turn of the decade, our current view of the future trends becomes less specific. Therefore, the second column (Mid-Term 2021-2028) focuses more on technologies—less on defined systems.

The columns can be treated as capability tiers for specified time frame OPFOR. Please note: ***No force in the world has all systems at the most modern tier.*** The OPFOR, as with all military forces worldwide, is a mix of legacy and modern systems. Thus the emerging OPFOR force comprises a mix of COE time frame Tier 1-4 systems and newer systems. One would expect that some Near- or Mid-term adversaries with lower military technology capabilities could move up one or two capability tiers from (for instance) current COE capability Tier 4, to COE Tier 2. The most likely upgrade for emerging OPFOR used in most training simulations would be to move the OPFOR from COE Tier 2 to Tier 1, with added niche emerging systems.

We have previously stated that an OPFOR force can portray a diverse force mix by separating brigades and divisions into different tiers. The OPFOR also has the option of incrementally adding higher tier systems to lower tier units, as selective upgrades. Because most of the below systems in the 2014-2020 column are currently fielded, an adversary might also incrementally upgrade COE Tier 1 or 2 units by adding fielded assets from 2014-2020 as described in that column. However, until that time frame, we cannot assure beforehand when all of those technologies will appear. Again, the tables are not predictive. The OPFOR force designer may choose a middle road between current Tier 1-4 and future systems; in many countries they are upgrading legacy and even recent systems to keep pace with state-of-the-art systems. Thus they may look to subsystem upgrades such as noted in Chapter 15.

If a specialized system for specific role is missing from the table below, continue to use the OPFOR system noted in Tiers 1-4. Please remember that these projections reflect "possible" technology applications for future systems. They incorporate current marketed systems and emerging technologies and subsystems, may be combined in innovative ways. The table below is not a product of the U.S. intelligence community, and is not an official U.S. Army forecast of future "threats". It is approved only for use in Army training applications and simulations.

Future OPFOR (2028 and after) is described in various portrayals. But it is generally FOUO or classified and is not included in the WEG.

OPFOR CAPABILITIES: NEAR- AND MID-TERM

SYSTEM	NEAR-TERM OPFOR (FY 14-20)	MID-TERM OPFOR (FY 21-28)
INFANTRY WEAPONS		
Infantry Assault Rifle	Rifle 6.8mm to 600 m day/night, w/EO LRF/pointer computer sight. Fire around corner sight EO link. Under-barrel grenades 600 m (CS gas, HEDP, EO recon, starburst, HE airburst, concussion). Rifle grenades 400m: HEAT, DP, smoke	On-bipod range 600 m. Sight on all weapons link to laptop/PDA/NVG/ helmet viewer w/real-time RF link. Multispectral smoke, TV/II recon/ atk rd, tandem HEAT grenades. Remote fire platform, 60m link.
Thermobaric grenades and Magazine grenade launcher	43-mm 4-round hand-held launcher for urban fight to 350m. Thermobaric grenades, also for hand throw, underbarrel.	Range 600 m for hand-held and under-barrel launchers, night sight. Add flechette, TV/II recon grenade.
AT/AP Hand Grenade	HEAT/Frag, 165-mm penetration, 20 m Frag radius, 20 m range, weighs 1.1 kg. Rifle grenades: HEAT 150mm to 300m	Hand grd to 40 m. Dual purpose bullet-thru rifle grd, no recoil, 150mm/Frag 20 m, 3 in belt pack.
Squad Machinegun	7.62x54 mm, frangible/sabot rds 1,300m. EO/3 gen II computer LRF sight 1,500m.	Add MMW radar, 5 km detection.
Combat Shotgun (replace one assault rifle)	12-gauge pump or semi-auto, 12 rds. Short and long change-out barrels, day/ night sights. Variable choke. Shells: HE, AP-sabot, door-buster, starburst, slug, concussion, frangible, flechette/anti-UAV	Time fuzed focused fragmentation airburst rd for use against dug in personnel, aircraft and UAVs. Multispectral smoke, CS grenades. TV/II recon rounds to 400 m.
Sniper Rifle Light	Bolt action, 7.62 mm rd, 15 lbs max weight with ammo. 10X optic w/2 gen II night channel. Range to 1000m.	Ballistic EO holographic LRF sight. Fused IR/FLIR channel 1,500m. Remote fire robot. Laser designator
Anti-Material Rifle (AMR) or Sniper Rifle (Heavy)	Semi-auto .50 cal. Weight 25 lbs. AMR/ anti-armor range 1,800 m. Armor pen 20 mm. As sniper rifle, range 1,000-1,500 m. Frangible multipurpose rd (AP 11 mm, incendiary 20 fragments). EO sight (20x) with 3 gen II night channel.	Ballistic EO holographic laser range-finder sight. Night sight fused IR/FLIR. Range 2,500+ m. Remote fire platform-60m link or weapon robot option. Laser designator.
Automatic Grenade Launcher (AGL)-Light	35mm manportable launcher with 6/9/12-round drums. HEAT grenade range 600 m 80mm penetration. Frag-HE grenade range 1,500m. Buckshot grenade. EO day/ 3 gen II night sights. 1 per infantry squad	Air-burst munition (ABM), ballistic sights. EO and Fused IR/FLIR sight. Remote fire. Multispectral smoke grenades. Recon, HEAT/HE TV-guided atk grenades to 1,000 m
Automatic Grenade Launcher (AGL)-Heavy Weapons squads and vehicles	40 x 53 mm weight 17 kg. Range 2,200m. Ballistic fire control computer w/ EO sight. Dual-purpose grenade, HE with 60mm armor penetration. Buckshot round. Electronic fuzed HE air-burst munition (ABM). 32/48-round cans. Thermal night sight, range 2,200 m.	HEAT rd defeats 200+ mm armor. EO/ fused IR/FLIR sight. Multispectral smoke, unattended ground sensor (acoustic, seismic RF), and comms jam grenades. Robot option. Mount on all maneuver/recon vehicles. TV/IR attack grenades.
Multi-purpose Grenade Launcher (disposable)	76mm thermobaric HEAT, 250m range, 440 mm penetration. Reusable II sight.	Range to 400m. Fire from enclosed spaces. Nil smoke, little noise.
Antitank Grenade Launcher (disposable)	125mm tandem HEAT 300m range, 1000+ mm. Shoulder fired. Nil smoke.	Multipurpose DP effects, 500 m. Reduced recoil-enclosed spaces.
Antitank Grenade Launcher (ATGL - medium range) Mid-Term: Expand to AD/AT Missile Launcher	60mm launch tube, from enclosed spaces. Tandem warhead (1,150 mm to 600m), dual purpose 1700m. Ballistic LRF/3 gen II night sight to 1,500 m. Remote launch tripod. Nil smoke. High velocity 57-mm DP high vel rocket 1,000m, 300 mm pen	SAL-H, TV/IR-guided grenades to 1,000 m. Fused IR/FLIR night sight. ADAT KE dart fits converted launcher. Range 4 km. Laser designator 5 km, including artillery and mortar rounds.

SYSTEM	NEAR-TERM OPFOR (FY 14-20)	MID-TERM OPFOR (FY 21-28)
Antitank Grenade Launcher (long range) Mid-Term: Expand to AD/AT Missile Launcher	125mm tandem HEAT 800+m range, 1100+ mm. HE-Thermobaric grenade to 1700 m. LRF computer sight. EO day/3 gen II Night sight. Nil smoke. Remote-fire platform option. Tripod and bipod.	SAL-H/TV/IR-guided: HEAT and HE grenades 1,200 mm. ADAT SAL/LBR KE dart to 4 km. EO and fused IR/FLIR sight, laser designator to 5 km for arty/mortar rds.
Remote-fire Platform and Weapon Robot or Laser Target Designator (LTD) Robot	Man-portable, <15 kg, 60m Laptop/PDA link. EO/3 gen II sight. MG/AGL/rifle. LTD robot TV/2nd gen FLIR, 10km range	Tracked, 24 kg, 2 hour charge, fused II/FLIR 10 km, 10 km rg RF link. LTD has 3rd gen FLIR, range 15km
Acoustic Targeting System (ATS)	Backpack/vehicle triangulates on aircraft, vehicle weapons to 6 km, MGs 2.5 km. Helmet mount to 800 m. Light display.	Increased range (10 veh weapon, 5 MG). Add auto-return fire for MG. Link to veh weapons/nets auto-slew
General Purpose and Air Defense Machinegun	12.7mm low recoil on ground tripod. Chain gun version on light vehicles, ATV, motorcycle, etc. TUV/LAV use RWS. Remote operated ground or robot version. Frangible rd 2 km, sabot 2.5 km. RAM/RAP/IR camouflage/ screens. TV/FLIR fire control. Lightweight MMW radar 5 km. Display link to AD azimuth warning net. Emplace in 10 sec. RF/radar DF set. ATS control option.	Stabilized gun and sights. Remote-operated computer FCS with PDA or laptop. Fused FLIR/ II to 5 km. Frangible, sabot rds to 3 km. Laser dazzler blinds enemy. Micro-recon/ heli atk UAVs. Robot version. Some light/AD vehicles replace w/ 30-mm recoilless gun on RWS. AHEAD round 4 km, FCS 10 km. Add-on ADAT missile launcher
Man-portable attack UAV (NLOS Backpack Munition)	2.5 kg tube launch with PDA, CCD/IR image, 10 to km and 155 m altitude, at 100-160 km/hr, with 10 min loiter, in-flight arm for HE charge, NLOS dive attack vs moving/static targets	Ranges to 20 km with 40 min loiter. Remote, air, ground, water craft, vehicle launch. 3rd gen thermal view. AT/AP remote sensor mines.
Infantry Flame Weapon	Reusable thermobaric 90-mm grenade (2/lchr) to 800 m. Effects = 152mm artillery rd. Targets personnel, bunkers, LAVs, etc. Nil smoke. EO/II night sight	Precursor (200 mm pen) DP grd. Computer LRF day/night sight. SAL-H guided. Remote fire and robot option. Use in enclosed space
Vehicle/Man-portable Close Protection System (CPS)	Smoke grenade launchers can use multi-spectral smoke, CS smoke, Frag-HE grenades, range 3-40 meters, depending on angle. ATS control. Man-portable.	Man-portable remote control launcher. Quick load 3-6 grenades. Other Grds: CS gas, HE, AT/AP mines. 2-4 pods/vehicle.
Infantry Weapon Night Sight (Night Optical Device- NOD)	3d gen II night vision goggles/sights/ IR pointers for riflemen range 1,000. AGLs, MGs, sniper rifles/AMRs, ATGLs to 1,500m. FLIR recon sensors 3,000 m.	Uncooled 3rd gen FLIR (thermal and II combined) NVGs and weapon sights infantry 600m. Priority weapon sights 2,000+ m.
MANEUVER		
Armored Personnel Carrier (APC)	8x8 wheeled chassis. Add ERA. 30-mm gun (and imp rd), coax MG. FOG NLOS ATGM lchr 4 km. Thermobaric ATGM. FLIR. 2 remote 7.62-mm MGs and 40 mm ABM AGL. CPS and ATS. Attack UAV launch	10x10 wheeled hybrid drive. Box ERA. CPS. Fused FLIR/II sight 13 km. 30-mm recoilless chain gun, RWS. Air-burst rds. ADAT KE missile and NLOS ATGM to 8 km. TV/IR attack grenades.
APC Fire Support Vehicle (Weapons Squad APC or Infantry Support Vehicle [1/ pltn or company], or Company Command Vehicle in Mech APC Bn)	Wheeled 8x8 chassis with ERA. 100mm & 30mm guns, 40 mm ABM AGL, auto-tracker, hunter-killer FCS. Gun-launch ATGM NLOS (SAL) 8 km fire on move. 30 and 100-mm HE elec fuzed rd 7 km. Imp 30-mm rd. 12.7 mm AD MG, 2 remote 7.62 MG. ADAT KE msl lchr 7+ km. Laser designator 10 km. CPS, ATS.	Above chassis & drive, ERA, fused FLIR/II sight. 100mm KE/600 CE protection. Cased telescoped gun 45-mm. ADAT KE dart rd 4 km, SAL/LBR ATGM 8-12 km. CPS. Micro-UAVs recon/attack. Tunable laser designator to 15 km. Radar/ MMW radar. SATCOM. Atk grds

SYSTEM	NEAR-TERM OPFOR (FY 14-20)	MID-TERM OPFOR (FY 21-28)
APC Air defense/Antitank (ADAT) Vehicle	APC Bn and Bde MANPADS btry, selected other units	See AIR DEFENSE
Infantry Fighting Vehicle	2-man turret, amphib tracked. Add ERA. 30mm gun (sabot, 110+mm pen). Frag-HE Electronic-fuzed ammo 5 km. Buckshot rd for UAVs. 40-mm ABM AGL, 4 x fiber-optic guided ATGM 8 km launch on move, 2nd gen FLIR. Auto-track, hunter-killer FCS. Remote MGs 12.7mm, 2 x 7.62. Laser designator 15 km. CPS/ATS	Hybrid drive. Box ERA 100mm KE /600 CE. 45-mm CTG. Fused FLIR /II sight 13 km. ADAT dart rd 4 km. SAL/LBR ATGM 8-12 km. MMW radar. Micro-UAVs recon/atk. Radar warner, laser radar. Tunable LTD 15 km. CPS. 2 remote MGs, 1x 12.7. TV/IR attack grenades
IFV ADAT Vehicle IFV Bn/Bde MANPADS	IFV chassis and APC ADAT weapons and upgrades	See AIR DEFENSE, APC ADAT for weapons and upgrades
Heavy Infantry Fighting Vehicle (Heavy IFV in Heavy Bn, Infantry Fire Support Vehicle, or IFV Company Command Vehicle, as Required)	2-man turret, amphib tracked, Box ERA. Auto-track, hunter-killer FCS, ATGM lch on move. 100 and 30mm guns. 100 mm HEAT, DPICM rounds. 40mm ABM AGL, NLOS (LBR/SAL) ATGM 8+km lch-on-move. 30/100-mm HE electronic fuzed rd 7 km. 30-mm buckshot rd for UAVs. AD 12.7mm MG, 2 remote 7.62 MG. Laser designator 15 km. CPS/ATS	Hybrid drive. Armor and box ERA protects 300mm KE/800 CE. 45-mm CTG, KE, HE, ADAT rds. KE missile 8 km. Micro-UAVs recon/ atk. CPS. Fused FLIR/II sight 13 km. ATGM 8-12 km. Tunable laser designator to 15 km. Radar/ MMW warners. AGL, 2 remote MGs, 1x 12.7. TV/IR atk grds
HIFV ADAT Vehicle HIFV and Amphib Bn/Bde	HIFV chassis with APC ADAT weapons and upgrades	See AIR DEFENSE, APC ADAT for weapons and upgrades
Main battle tank	Welded turret, 3rd gen ERA, more armor. 125mm gun, bigger sabot (800+mm pen), LBR ATGM 6 km. SAL/IR-homing rd to 5 km in 1 sec, SAL-H ATGM 8 km.. Improved 2nd gen FLIR (7 km) and 50X Day/night sights. ATGM fire on move. Auto-tracker, laser radar, laser dazzler blind sights. Focused frag HE rd for heli, light AT targets. HEAT-MP, DPICM submunitions rds. IR/MMW CM. Active suspension. CPS/ATS. Controls robot	Reduced remote turret, compartmented crew, electronic/ceramic armor, 500 mm top/mine armor. Laser/radar warners. Hybrid drive. CPS/ATS/APS. Sabot defeats 1000 mm KE. KE ATGM to 12 km. Tunable LTD to 15 km. ADAT msl 8 km. Fused 3rd gen FLIR/II sight 100 X to 13 km. MMW FC. Atk/recon micro-UAV, atk grds. Controls a robot tank.
Tank Robot (Near Term) Robotic Tank (Mid-Term)	Tracked LTD tank robot fits on platoon cmd tank when unused. Light armor, MMW/ IR screens - no signature. It designates SALH ATGMS and rds.	1/2 size MBT. Driver seat for pre-battle. Armor, weapons, mobility/ survivability (CPS/ATS/APS) same as tank. ATGM launch veh version
Tank ADAT Vehicle Tank Bn/Bde MANPADS	Tank chassis and APC ADAT weapons and upgrades	See AIR DEFENSE, APC ADAT for weapons and upgrades
Armored Tactical Utility Vehicle (TUV)	4x4 swims, 1/4 mt amphib trailer, Remote 12.7-mm MG and 40-mm AGL). Multirole (mech/recon/C4/AD/AT/security/ log). Run-flat, central tire inflation. CPS/ATS	6x6 hybrid drive, mine protection. 30-mm gun, RWS (see APC). Recon masted radar/fused FLIR/II sights. Smoke, recon/atk grenades. CPS.
Armored TUV ADAT Vehicle Infantry, SF, other units	12.7-mm MG, 2x lchr FOG/ IR-homing ATGM, EO/FLIR sight, manpack ADAT lchr. AD net azimuth warning. CPS/ATS	See above. Tunable laser designator, range 15 km. Radar warning receiver. MMW radar.
MANPADS Vehicle	Bn/Bde, insurgents. Truck, TUV, ATV. Remote launch, EO/thermal sight. Azimuth warner. Smoke/ATS	See Air Defense
Light Strike Vehicle	4x4 rear engine, 4-person, 2 m ford. 35-mm AGL, 12.7-mm MG, and 40-mm ATGL. ATS	Light armor/mine shields. Hybrid drive. Amphib (Bladders). 30-mm gun RWS (see APC). ATGM 8 km.

SYSTEM	NEAR-TERM OPFOR (FY 14-20)	MID-TERM OPFOR (FY 21-28)
Light Strike Vehicle ADAT	4x4 rear engine, 4-person, 2 m ford. 35-mm AGL, 12.7-mm MG, KE LBR Msl. FOG/IR-hom ATGM 4 km. ATS	Light armor/mine shields. Hybrid drive. Amphib (Bladders). 30-mm gun RWS (see APC). ATGM 8 km.
Tactical Motorcycle Motorcycle ADAT version	Low noise diesel engine, 35-mm AGL Swim sacks. MMW/IR camouflage and screen. ATS	Continuous rubber track. FOG/ IR-homing ATGM, imp MANPADS. Track conversion in snow/swamp.
All-Terrain Vehicle (ATV) and ATV ADAT	6x6, 4-person capacity, 3.5 mt payload. Swim. Has 12.7-mm MG, 35-mm AGL. ADAT, AT, other roles. Amphib trailer. Track conversion in snow/swamp. ATS	8x8. Mine protection. Hybrid electric/diesel drive. Snap-on cab for cold weather etc. 23-mm light chain gun on pintle mount.
RECONNAISSANCE, INTELLIGENCE, SURVEILLANCE, TARGET ACQUISITION		
Binocular Laser rangefinder and Goniometer	Handheld 20km detection, 5-7km recognition, GPS. Thermal channel (below) goniometer, computer - digital transmit	See Thermal Binoculars (below). Heads-up display links to terminal. Transmit images to net.
Helmet Cam	Soldier camera link to laptop/PDA 2 km. NVG feed. Remote mast-mount.	Improved night viewer with 3 gen II or thermal. Nigh range 2 km.
Thermal Binoculars	Uncooled 2 gen FLIR. 2x electronic zoom (EZ), image stabilization. Detect 9 km (13 EZ), recognition 3.5 km (5.5 EZ)	Add LRF, laser pointer, internal GNSS. Fused FLIR/II camera. FOs call indirect fires 10-13 km, 6+ with precision, direct fire 5.5 km+. IDs heli at 7 km w EZ, detects at 13 km
Laser Target Designator/ Rangefinder (Manportable)	Man-portable, encoded, designate SAL-H rounds, bombs, ATGMs to 10 km. 2 gen thermal sight. Mounts on sensor robot	Tunable laser designator with encoded pulse to 15 km. Mounts on sensor robot
Observer Sensor Suite For Recon, SPF, Security, Anti-tank, Air Defense, Artillery (Dismount, ATV, Motorcycle, Vehicle)	Goniometer/laser designator base. Laptop or radio link. GPS, thermal laser range-finder binoculars, manpack radar. Aircraft azimuth warner. Net with UGS, remote camera, micro-UAVs.	Mount on Sensor Robot. Increased range, encryption, SATCOM. Fused FLIR/II night sight. Tunable encoded LTD to 15 km designates for all SAL-H munitions.
Laptop Computer for Digital Sensor Network	System accesses sensor links: video cameras tactical units, UGS monitor, maps/unit status displays, azimuth and alert nets. Digital data links, microphones for discussion, ground station terminal. Access encrypted internet links, long- range cordless and SATCOM phones. Terminal to remote-detonate mines and control minefields.	Personal data assistant for dismount use or for mounting in or linking to weapon FCS. Solar rechargeable batteries, extended range on links with retransmission UAVs. Use for hand-off control of UAVs, in-flight munition retargeting. Fuse UAV, weapons, cameras, TV recon grde image, battle management data.
Surveillance radar	Man-portable low probability of intercept GS radar to detect/classify vehicles 30km, detect personnel 18km. Netted digital/graphic display.	Remotely operated, on a mast, with man-portable day/night EO sensor suite or from concealed base.
Mortar and Grenade Recon Rounds TV/IR attack grenades: Mid-Term	82 mm mortar round with a CCD TV camera to 5,700 m, aerial NLOS zoom view to laptop for 20 sec. Rifle/hand-held/AT grenades with TV cameras send video to PDA or laptop on descent.	Mortar rds (81/120), grenades with slewable fused FLIR/II and zoom. 40mm AGL grd 2,200 m. Shotgun grds. Recon, TV/IR attack grenades (HEAT/HE) from vehicle 82-mm smoke grenade launchers to 1,000m
Unattended Ground Sensor Set	Netted, acoustic, seismic, magnetic, IR. Acoustic sensor UGS array extends 12 km, for accuracy within 3m.	Robotic sensors with sleep mode, underground concealed hide position (self-relocate, dig in). Nil visual/IR/MMW signature.

SYSTEM	NEAR-TERM OPFOR (FY 14-20)	MID-TERM OPFOR (FY 21-28)
Remote Cameras and Sensors	Motorized, masted, with constant-on, command-on or acoustic/seismic wakeup. 20-30km link range. CCD measures and in-ground mount. 2 gen FLIR day/night passive scan.	Robotic sensor entrenched and concealed. On wake-up, mast rises to RISTA mode. Integrated net digital display, link to sensor robots and robotic weapons.
Smart Dust	Rocket/UAV/aircraft scattered crush sensors emit for 1/2 hour.	Scatterable, attach to metal. Acoustic/crush/seismic. Emit 1 hour.
Sensor Robot	Man-portable tracked robot w/cameras in multi-sensor pods (acoustic/EO/ seismic) w/wake-up. Transmits image to monitor. Camera range 3 km. RAM. Laser designator direct munitions 10 km	Solar charge and vehicle quick charge, longer charge capability. Camera/link range 20-30 km. Self-entrench. Composition chassis and RAM is undetectable to sensors.
Acoustic sensor vehicle	Vehicle mounts microphones or dismount array, DFs/acquires aircraft, vehicles, or artillery. Rapid queuing and netted digital display. Range 10 km, accuracy 200m. Three vehicle set can locate artillery to 30 km with 1-2% accuracy in 2-45 sec. DF/ cueing rate 30 targets/min.	Range extends to 20-30 km with 10 m accuracy. Micro-UAVs with microphones to supplement the network in difficult terrain. Track and engage multiple targets. Range and accuracy SAB. Hybrid electric/diesel drive.
Wheeled Armored Reconnaissance Vehicle (ARV)	4x4 and 4 aux wheels, low profile. 12.7-mm AD MG. NLOS FOG ATGM 8 km Multi-sensor mast, 2nd gen FLIR. GS radar classify vehicles 30 km, detect person 18km, laser designator 15 km, UGS, laser radar, MANPADS, ATGM. CPS/ ATS. Conformal MMW-IR net, MMW/IR grds. Canister UAV 10 km.	Hybrid drive. IFF. Fused FLIR/II to 24 km. Micro-UAV range 35 km. 30 mm recoilless chain gun on RWS (see APC). SAL/LBR ATGM 8-12 km. Tunable LTD 15 km. Multi-spectral smoke launcher and recon and TV/IR attack grenades to 1,000 m. Sensor robot. CPS.
Tracked Reconnaissance Vehicle	2-man turret, 30-mm gun, 12.7-mm AD MG, MANPADS, ATGM. Masted multi-sensor suite, 2 gen FLIR, laser radar, auto-tracker, laser target designator direct arty /mortar rds/bombs, ATGMs 15 km. GPS/ inertial nav, digital data. Radar detects vehicles 30 km, personnel 18. UGS net. Canister UAV. CPS/ATS	Hybrid drive. Fused FLIR/II to 24 km. IFF, Micro-UAVs to 35 km. 45 mm CT gun. ADAT KE round 4 km. SAL/LBR ATGM 8-12 km. Multi-spectral smoke launcher and recon and TV/IR atk grenades. Tunable laser designator 15 km. Sensor robot. CPS.
Long-range sensor vehicle	Tracked vehicle with elevated sensor suite on pod. Day/night TV, MMW radar detect to 45 km vehicle, 20 km personnel. 2 gen FLIR Net to UGS, UAVs, etc. Digital links to arty, AT, AD, recon, etc. 12.7-mm AD MG. Laser target designator to 15 km. CPS/ATS.	Longer range, increased target handling/transmission capacity. Manpack AD/AT LBR missile to 8 km. Fused FLIR/II to 24 km. Tunable laser designator to 15 km. Hybrid electric/diesel drive. CPS. Recon and TV/IR atk grenades.
Ground or Vehicle Launch Mini-UAV	2-backpack system. Man-portable ground launcher, and laptop terminal. Vehicle-launch from rail or canisters. TV/FLIR. Range 35 km, 3-hr endurance.	IR auto-tracker. Laser designator. Cassette launcher for vehicles. Signal retransmission terminal. Bus dispense micro-UAVs, UGS, mines
Micro-UAV	Hand-launch 4-rotor, 4 kg, 5 km/1 hr, GPS map/view on PDA/netbook. Atk grenade	< 1 kg for dismount sqd/tm, 2 km range. Add grenade for atk UAV
Heliborne MTI Radar	Range 200 km, endurance 4 hrs.	Range 400 km. Add SAR mode.
Commercial Satellite Imagery	Resolution 5 m for IR, SAR also available. <2 days for request. Terminal on tactical utility vehicle at division. Can be netted to other tactical units.	Response time reduction (to <6 hours). 1-m resolution.

SYSTEM	NEAR-TERM OPFOR (FY 14-20)	MID-TERM OPFOR (FY 21-28)
ANTI-TANK		
Manpack Air Defense and Antitank (ADAT) Kinetic-Energy Missile Launcher (also listed in Air Defense)	Co/Bn substitute for ATGMs and AD. Targets helicopters and LAVs. Shoulder launch missile with 3 KE LBR submissiles 8 km, 0 m altitude. Submissiles have 25-mm sabot/HE warhead. Nil smoke. Mount on robotic launcher (below). FLIR night sight.	Fits in 45-100mm guns. Defeats all targets up to 135 mm KE. Range 8 km, time of flight 6 sec. Fused FLIR/II sight 10 km. Launch from enclosed spaces. Can mount on robotic ADAT launcher or ADAT Robot vehicle (below).
Man-portable ATGM Launcher (Also pintel/vehicle dismount)	SACLOS guided to 3 km. Tandem warhead defeats 1,200mm. Thermal sight. Jam-proof low noise/smoke. Fire from enclosed spaces. Can mount on robotic launcher (below)/vehicles.	Twin ATGM remote ground veh/ launch station with auto-tracker. Fused FLIR/II sight 5 km. NLOS /IIR homing missile to 4 km. Can use ADAT missile. Laser dazzler
Ground Turret	Ready-made hole mount turret for hoist installation, w/12.7 mm MG, 4 km ATGM launcher, thermal night sight, and radar absorbent/IR reflective paint on cover. Invisible until activated.	Add remote/unmanned pop-up turret. FOG-M top-attack or IIR-homing attack 8 km. Tandem warhead 1,300 mm. Fused FLIR/II sight to 10 km. CPS
Ground/ Vehicle Pintle Mount ATGM Launcher	Combat support vehicle with portable robotic twin launcher (below). FOG-M top-attack or IIR-homing direct attack 4 km. Tandem warhead defeats 1,000+ mm. Thermal sight 5 km range. Low noise/smoke, countermeasure-resistant.	Range increase to 8 km and 1300 mm penetration. Thermobaric ATGM. Fused FLIR/II sight to 10 km. Launch from enclosed spaces. Laser dazzler. ADAT robot vehicle.
Robotic ADAT Launcher ADAT Robot Vehicle	Pintle mount shoulder/ground/ATV/ vehicle launch. Robotic launcher-60 m link. Twin auto-tracker. Operator in cover/spider hole. MMW/IR absorbent screen and net for operator, launcher and surrounding spall. CPS/ATS.	Masted 4-launcher, hybrid drive to self-entrench, then move to launch point. Fused FLIR/II sight to 10 km. Remote link 10 km. Most AD and AT host vehicles have 2 control stations and 2 robots. ATGM same as above. CPS.
Towed Antitank Gun	125mm gun, larger sabot (700+mm), LBR/SAL-homing ATGM 8 km. Stabilized FCS sights, auto-tracker. Auxiliary propulsion unit. TV daysight with (32x). Combined MMW radar and 2nd gen thermal night sight (5-7 km). Add SAL-H/IR HEAT rd 5 km in 1 sec, HEAT-MP, DPICM submunition round. ATS.	Remote unmanned gun with cassette, towed, dug into position, netted into AT net. Concealed position (retractable base and IR/MMW concealed). Fused FLIR/II sight to 10 km. KE ATGM (8 km), direct link to micro-UAVs and UGVs). Laser dazzler
Heavy Recoilless Gun, 106 mm and Recoilless Gun Vehicle (RGV)	TOW or RGV on TUV. Tandem HEAT round 700+mm 3 km. SAL-H, tandem ATGM (1,000+ mm), 8 km dive attack. .50-cal spotter rifle to 2,500 m. Laser designator. Computer sight, 2gen FLIR. HE, flechette rounds. RGV CPS/ATS.	HEAT rd 900+mm. Remote weapon system mount for APC, IFV, and TUV chassis. Fused FLIR/II sight to 10 km. Nil smoke/noise. Tunable laser designator for SAL munitions 15 km. Hybrid drive for RGV.
Self-Propelled Antitank Gun	Amphibious airborne tracked, 125 mm gun, larger sabot (700+ KE), SAL ATGM to 8 km. SAL-H/IR HEAT rd 5 km in 1 sec, DPICM submunition round , focus frag HE rd. Stabilized TV daysight (32x), 2 gen FLIR 5 km, auto-tracker. Laser designator 15 km. CPS/ATS.	Hybrid drive. MMW FC radar, NLOS ATGMs (8/12 km), direct link to micro-UAVs, UGVs). Fused FLIR/II sight 10 km. Micro-UAVs recon/atk. Laser dazzler. Tunable LTD 15 km. CPS, TV/IR attack grenades

SYSTEM	NEAR-TERM OPFOR (FY 14-20)	MID-TERM OPFOR (FY 21-28)
Tracked ATGM Launcher Vehicle	Box ERA 300mm. NLOS/IIR ATGM launcher on IFV. 1,300 mm dive attack, 8 km. HE Thermobaric ATGM. Low noise/ smoke signature. 12.7-mm AD MG. Laser designator to 10 km. CPS/ATS. Manport ADAT KE missile launcher.	Imp ERA (300mm KE, 600 CE). Hybrid drive. NLOS/KE ATGMs LBR/SAL defeats 1,300mm at 8/12 km. EMP option. Fused FLIR/II 13 km. 2-target auto-track. Launch on move. Laser dazzler. Micro-UAV atk/ recon. 2 robots. Atk grds.
Wheeled ATGM Vehicle	4x4 Armored TUV with same launcher system as above. CPS/ATS.	Same launcher as above. Hybrid drive. Robot vehicle.
Airborne Infantry ATGM Launcher Vehicle	Airborne/amphib tracked light armored. Same launcher as above. CPS/ATS.	Same launcher as above. Hybrid drive, ERA, atk grds. Robot veh.
Heavy ATGM launcher Vehicle	Tracked, 6 lchrs, SAL-homing ATGM 1,400mm dive attack, 10 km. Warheads HEAT, Multi-purpose (HEAT/Frag-HE). 12.7-mm MG. Jam-proof auto-tracker, Laser designator 15 km. CPS/ATS.	Hybrid drive. Add IIR homing, 12 km range, EMP, and thermobaric. Warheads. Fused FLIR/II 13 km. Laser dazzler. Designator UAV 30 km range and 3-hr loiter. Atk grds
Heavy ATGM Launcher Vehicle (and Land Attack Cruise Missile - LACM)	Tracked vehicle with 16 x SAL-homing ATGMs, Hybrid drive. RF-guided phase, 40 km. Fused FLIR/II acq to 10 km. MMW TA radar to 40 km. Warhead: 28-kg Frag-HE=1,300 mm penetration. UAV to 40 km with LTD (15 km range). FW and boat mounts. Anti-heli radar guided or SAL-homing. Atk grds.	Hybrid drive. Guidance adds radar or IIR homing. Warheads: Multi-purpose (HEAT/ Frag-HE) defeats 1,400mm), Bus for sensor-fuzed submunitions, EMP warhead. Laser designator UAV range 100 km, 3-hr loiter time.
Attack UAV	Hit-to-kill system. Day/night 60+ km, up to 2 hours. GNSS/inertial navigation, TV/FLIR, Frag-HE warhead. They include an anti-radiation variant.	Cargo UAV 100 km dispenses IR/ MMW/SAL DP (600mm HEAT) submunitions, EMP munitions, SAL ATGMs – UAV LTD 30 km.
Attack UAV Launcher Vehicle	Hit-to-kill UAV launch from modular launcher, 18 UAVs. GNSS/inertial nav, to 500 km. First version anti-radiation homing. Added TV guided and multi-seeker attack (hit-to-kill) UAV. Laser designator range 15 km. CPS/ATS.	Hybrid drive. Bus reusable UCAV with 4 ATGMs to 10 km, SAL-H bombs, or bus dispensing 16 terminally-homing submunitions (with MMW/ IR seekers, or laser-homing DP submunitions). CPS. LTD
Micro-Attack UAV	Hand or canister -launch UAV with TV and FLIR guidance to 10 km, 100-600 m altitude, with .25-.5 kg warhead.	Cassette/smoke grenade launcher launch for tactical vehicles. Recon and attack (top-attack) UAVs.
Mini-Attack UAV	Hand or vehicle canister -launch UAV with TV and FLIR guidance to 35 km, 100-600 m altitude, 1-4 kg warhead.	Cassette launcher launch for tactical vehicles. Recon and attack (DP with tandem 600 mm top-attack).
FIRE SUPPORT		
Man-portable Mortar	Conventional munitions, 82mm FRAG-HE 6.7 km, RA 13.0 km. SAL-H 6.7 km. Day/night direct/indirect fire sight. GPS. Prox fuze. Tandem ATGM 7 km.	Increased range and accuracy. Ballistic computer sight. Fused FLIR/ II 10 km.Self-lay. Dual guided (diff GNSS course correct/SAL) 13 km
Towed Mortar Upgrade	120-mm FRAG-HE – 9 km. Prox fuze. ADHPM: SAL-H and IR-homing HEAT – 9 km, Sensor-fuzed – 7 km. Night capable direct/indirect fire sight, self-lay.	Improved range/precision. Ballistic computer sight. Fused FLIR/II 10 km. Dual guided round (differential GPS corrected, SAL) to 12 km.
Towed Combination Gun	GPS gun lay/nav system. Frag-HE range 8.1 km (and prox), RAP 12.8, HEAT 1 km, SAL-H 12.8. Mortar rds SAB.	Automated fire control, Fused II/ FLIR 13 km. Autonomous lay, diff GNSS. Auxiliary propulsion unit.

SYSTEM	NEAR-TERM OPFOR (FY 14-20)	MID-TERM OPFOR (FY 21-28)
Self-Propelled Combination Gun	120-mm gun/mortar system. GPS gun lay. Cannon Frag-HE (prox fuze option) 13 km, -RAP 18, HEAT 1 km. All mortar rounds. ADHPM: Mortar SAL-H and IR-homing 9 km, Sensor-Fuzed 7 km. Cannon SAL-H rd 9 km. CPS/ATS.	IFV chassis. Hybrid drive. Laser designator 15 km, diff GPS, automated FCS, autonomous lay. Fused FLIR/II 13 km. SAL-H, GPS rounds 12 km. SAL tandem HEAT ATGM to 20 km. APS
Towed Medium Gun-Howitzer	FRAG-HE - 30 km, FRAG-HE BB - 39 km, Artillery delivered high precision munitions (ADHPM): SAL-H - 25 km, Sensor-Fuzed – 27 km. GPS 40 km	Autonomous lay/fire direction. Enhanced lethality, differential GPS corrected munitions (and sensor-fuzed) 60 km.
Self-Propelled Medium Gun-Howitzer	45-cal gun. GNSS/inertial land nav, self emplace, FC. Munitions: FRAG-HE – 30 km, FRAG-HE base bleed - 39 km. ADHPM: SAL-H - 25 km, Sensor-Fuzed – 27 km, GPS-corrected 40 km.	Automated fire control. Barrel cooling, thermal warning systems. Autonomous lay/fire direction. Differential GNSS corrected rds (and sensor-fuzed) 60 km.
Self-Propelled Medium Gun-Howitzer Tracked	Ford depth 5.5 m. 40-cal gun. GPS/ inertial land nav, self emplace and FC. FRAG-HE 23 km, FRAG-HE rocket ast 31.5 km. SAL-H rd 25 km, Sensor-Fuzed rd 27 km, GPS corrected 40 km	Automated FC. Autonomous lay/FD. Barrel cooling, thermal warning systems. Differential GNSS course corrected rds (and sensor-fuzed) 60 km.
Self-Propelled Medium Gun	Conventional munitions, FRAG-HE-BB – 30.5 km, FRAG-HE-RA–40 km. ADHPM: SAL-H - 25 km, Sensor-Fuzed – 24 km. GPS corrected 40 km.	Automated FC, barrel cooling and thermal warning, autonomous fire direction. Diff GNSS corrected rounds (and sensor-fuzed) 60 km.
Manportable Single Round Rocket Launcher	122mm FRAG-HE – 10.8 km. SAL-H, Sensor fuzed 10.8 km. On tripod	Increased range and accuracy. Enhanced lethality.
Rocket Launcher Pod (107mm) For Use on Improvised/ Modified Launch Platforms	6-tube (2x3 rockets) pod mounts on cart, vehicle (e.g., amphibious/airborne APC), or ground stand. Remote launch fire control. Cart/vehicle 1-3 pods. GNSS. Range 8.5 km. Limited lateral launcher adjustment (move vehicle). Mines and DPICM warhead option.	Improved launcher mount with servo-motors and remote computer FCS and in-view GNSS data. Munitions include: EMP, smoke, UGS, SAL-homing HE, tandem HEAT, recon, chem. Use with laser designator. Range 10 km.
SP Medium Rocket Launcher (100mm to 220mm)	122mm 50-tubes. Self-emplace (GNSS/ inertial nav). Onboard FCS. Munitions: Frag-HE 90° precision fall 40 km, GPS course-corrected DPICM and Frag-HE 36 km, RF jammer rd 18.5, SAL-H rkt 32 km, Sensor fuzed 33 km.	Extended range. Increased accuracy and lethality. Course corrected diff GPS/ inertial) in DPICM, multi-role (HEAT, HE, incendiary). Motorized spades for quick displace.
SP Heavy Rocket Launcher (220-240 mm)	Self-locating launcher, 16 tubes. GNSS/ inertial nav. Onboard fire direction. Rockets: 220mm FRAG-HE –43 km, DPICM, Chemical. Thermobaric – 43 km ADHPM: Sensor-Fuzed – 43 km	Increased accuracy. Enhanced lethality. MRL can launch cruise missiles, UAVs. Diff GNSS Course corrected munitions (DPICM, sensor fuzed, mines) to 70 km.
SP Heavy Rocket Launcher (240-300 mm and larger)	Self-emplace 300-mm 12-tube launcher. GNSS/inertial nav, onboard FCS. Inertial course-corrected rockets 100 km: mines, DPICM, Chemical, and Thermobaric. Sensor-Fuzed 90 km, UAV rocket 90 km	Range (100+ km). Differential GPS lnchr, GNSS course-corrected rkts. Enhanced lethality. Launch cruise missiles (attack UAVs) and recon UAVs to 470 km.
Weapon Locating Radar Vehicle (Counter Mortar/ Counter-Battery Radar)	Detection range with low error rate Mortar: 30 km, Cannon artillery: 20-25km, Rocket: 40km, Tactical Missile: 55km.	Faster computer processors with digital links, differential GNSS, and decreased radial error

SYSTEM	NEAR-TERM OPFOR (FY 14-20)	MID-TERM OPFOR (FY 21-25)
ENGINEER		
Improvised Explosive Device (IED)	Command (RF, wire) arm/detonate. Also sensor armed/fuzed. Large shaped charge, EFP, daisy chain arty rds, large IED, mine converted to cmd/SF. Defeat RF jammers, magnetic detectors.	Fuzes and radio links which can convert explosive devices and materials into intelligent IED fields (see intelligent minefield)
Minelayer, Towed	Lays 10 to 12 mines per min. Lines 20/40 m apart. Can also lay controllable minefields.	Advanced sensors. Target discrimination. Can lay intelligent mines.
Minelayer Vehicle	Armored chassis w/7.62mm MG, lays 1,000 m AT field with 5m between mines. Lay controllable mines. CPS/ATS	Add vehicle mount mine launchers. Also lays intelligent minefields. Hybrid electric/diesel drive.
Infantry Portable Scatterable Minelaying System	Remotely lays AT/AP mixed minefield 200-400m square from a distance up to 1090m. At platoon. 6 lb, 5 min set-up. Controllable mines.	Add intelligent mines. ATGL and AGL-delivered mines.
Scatterable Mines	Deliver by artillery, cruise missile, UAV, rotary or fixed-wing aircraft. Non-metallic case, undetectable fill, resistant to EMP and jammers, w/self-destruct.	Advanced multi-sensor mines with wake-up and target discrimination. Prox fuze mines. Controlled minefields and intelligent mines.
Artillery Scatterable Mine Rounds and Rockets	Cannon, MRL, mortar, gun/mortar. 122-mm MRLs can fire AT and/or AP mines and covers 24-81 hectares.	Extended range. Controlled minefields (RF link)
Remote Mine Launcher Pod System (Vehicle, trailer, ground)	APC w/180 x 140-mm pods, scatters mines, UGS, jammers, CS gas, and smoke grenades, 30-60m from pod. Can lay field AT/AP 1-1.2km x 30-120m. CPS/APS	Multi-sensor mines with wake-up, target discrimination. Controlled minefields, intelligent mines. Prox fuze mines (up to 540) 2 km 10 sec
Off-Route Mines (Side-Attack and Top-Attack)	Autonomous weapons that attack vehicles from the side as the vehicles pass. 125-mm Tandem HEAT (900+ mm). Target speed 30-60 km/h, range 150m acoustic and infrared sensors.	Sensor-fuzed EFP 600mm KE top attack. Remote or sensor actuated (controller turn-on/off), 360-degree multi-sensor array. Hand/ heli/ UAV/arty/ATGL mortar emplace.
Controlled Mines and Minefield	AT/AP, machine emplaceable. Armed, disarmed, detonated by RF command. Chemical fills and non-metallic cases are undetectable. With CM and shielding, negate jammers/pre-detonating systems.	Control may be autonomous, based on sensor data and programmed in decision logic, or by operators monitoring with remote nets.
Smart Mines	Wide-area munitions (WAM) smart autonomous, GPS, seismic/acoustic sensors. AT/AV top-attack, stand-off mine. Lethal radius of 100 m, 360°. Hand-emplace	Discriminate targets. Reports data to a monitor, evaluate target paths, built-in logic. Use GPS to artillery/ heli-emplace. Non-nuclear EMP or HPW options
Unexplosive Ordnance (UXO)	Artillery cannon or rocket DPICM submunitions in impact pattern.	Unused blue remote-launch precision munition pods may be seized and used against them.
Intelligent Minefields (including Non-nuc EMP, Jam, and HP Microwave)	Developmental programs and not proliferated	Self-healing, autonomous monitoring of obstacle integrity. Advanced sensors, target discrimination, built-in logic. Non-nuclear EMP or HPW.

SYSTEM	NEAR-TERM OPFOR (FY 14-20)	MID-TERM OPFOR (FY 21-25)
Engineer Reconnaissance Vehicle	Tracked IFV chassis. Amphibious- recon equip: sonar, NODs, rangefinder, soil analyzer, gyrocompass, underwater mine detection. CPS/ATS	Hand-held and vehicle-mounted ground-penetrating radars for mine detection. Hybrid electric/diesel drive. CPS
Obstacle Clearing vehicle	Tank chassis, NBC-protected, dozer (3.8m), crane (2mt), scoop/ripper, and mine detonator. CPS/ATS	Hybrid electric/diesel drive.
Vehicle or Towed Line Charge Mineclearing System	Mounted on truck, IFV, APC, TUV or tank. Rocket launch 10 tubes HE or FAE, to 3km. Breach lanes 10x60m.	
Line-Charge Mineclearing Vehicle	Clears lane 6x9 m. 2 line charges. CPS/ATS.	Hybrid electric/diesel drive.
INFORMATION WARFARE		
Lightweight Mobile ESM/DF	0.7-40 GHz, ESM/DF	SATCOM intercept capabilities
Electronic Warfare Radio Intercept/DF /Jammer System, VHF	Intercept, DF, track & jam FH; identify 3 nets in non-orthogonal FH, simultaneous jam 3 fixed freq stations (Rotary/fixed wing/UAV capable)	Integrated intercept/DF/jam for HF/VHF/UHF
Radio Intercept/DF HF/VHF/UHF	Intercept freq range 0.1-1000 MHz. (Rotary/fixed wing/UAV capable)	Wider Freq coverage. SATCOM intercept. Fusion/cue w/other RISTA for target location/ID
Radio HF/VHF/UHF Jammer	One of three bandwidths; 1.5-30/20-90/100-400 MHz, intercept and jam. Power is 1000W. (Rotary/fixed wing/UAV capable)	Increased capability against advanced signal modulations. UAV and mini-UAV Jammers.
Portable Radar Jammer	Power 1100-2500W. Jam airborne SLAR 40-60km, nav and terrain radars 30-50km. Helicopter, manpack.	UAV and long range fixed wing jammers.
High-Power Radar Jammer	Set of four trucks with 1250-2500 watt jammers at 8,000-10,000 MHz. Jams fire control radars at 30-150 km, and detects to 150 km.	UAV jammer and airship jammer. Hybrid electric/diesel drive.
Portable GNSS jammer	4 -25 W power, 200-km radius. Man-portable, vehicle & airborne GNSS jammers, airship-mounted jammers	Manportable, vehicle & airborne (UAV) GNSS jammers-increased range and power, and improvements in antenna design
Arty-delivered and ATGL-launch Jammer	HF/VHF (1.5-120 MHz), 700m Jamming radius, est. (1-hr duration). 300 m for ATGL-launched version	Increased capability against advanced signal modulations
Missile and UAV-delivered EMP Munition	Cruise missiles and ballistic missile unitary warhead and submunition.	Increased capability against advanced signal modulations
Artillery-delivered and Manpack EMP Munition	Cannon (152/155-mm), rocket (122/220 /300-mm), and mortar (82/120-mm).	Increased power, capability, and range.
Cruise Missile Graphite Munitions and Aircraft "Blackout Bombs"	400-500 kg cluster bombs/ warheads with graphite strands to short out transmission stations and power grids.	Rocket precision and UAV-delivered munitions.
EMP Mine	Larger EMP mine. Effective radius 350 m, irregular/ disruptive 500 m.	See intelligent minefields and smart mines

SYSTEM	NEAR-TERM OPFOR (FY 14-20)	MID-TERM OPFOR (FY 21-28)
COMMAND AND CONTROL		
Radio, VHF/FM, Frequency-hopping	30-88 MHz, 100 hps, channels: 2,300, Mix of analog and digital radios, tactical cellular/digital phone, all nets digitally encrypted. Burst trans. UAV Retrans	Digital radios, tactical cellular/digital phone, and satellite phones, all nets encrypted
Radio Relay Station, VHF/UHF,	60-120/390-420 MHz, range 30-40km per hop LOS	Digital communications networks. Network management station, automated battlefield management system
Command Post Vehicle, Division (wheeled and tracked versions)	4xHF/VHF high power, 1x VHF, 75-2000km. Digital comms, graphics, voice back-up. SATCOM digitally encrypted.	Completely digital comms net thru all levels, fiber-optic cables. Networked automated, secure, and integrated battle management system
DECEPTION & COUNTERMEASURE SYSTEMS		
Armored Vehicle Decoy, Mobile	Towed trailers & decoy heater units, and flares. Used in concert with obscured target vehicle for positioning near target to divert homing munitions. Radar (and motorized) corner reflectors. Inflatables, tethered, move w/air currents.	Acoustic decoys w/seismic effects. Multi-spectral (high-fidelity) decoys powered for acoustic and IR signatures. Linked to vehicle warning systems
Armored Vehicle Decoy, Stationary	Multi-spectral (high-fidelity) erectable/ inflatable vehicle mock-ups, w/heaters & motorized radar corner reflectors	Acoustic decoys w/seismic effects. Multi-spectral decoys powered acoustic/IR signatures
Vehicle and Weapon System Camouflage and Concealment	Tactical vehicles have MMW/IR paint and conformal nets, multi-spectral grenades, side skirts, thermal blankets, Thermal screens, laser/radar warners, acoustic engine & track noise modifiers.	Add mist thermal image concealment systems.
Camouflage and Concealment for Dismounts	Thermal screens and pop-up stands conceal from overhead, front, side visual/ thermal day/night vs MMW & IR. Face masks/ gloves. Foxhole blast devices.	Ready-made spider hole covers, invisible to visual/ MMW/ IR sensors. Remote control option
Air Defense System Decoy	Manufactured and improvised decoys used with decoy emitter. Covered by AD systems in air defense ambushes.	Multispectral simulators of varied gun and missile systems mounted on robotic chassis.
Air Defense System Decoy RF Emitter	Expendable RF remote emitters with signal to match specific nearby radars, to trigger aircraft self-protection jammers.	Mounted on robotic chassis.
Non-Lethal (or Less Lethal) Weapons	Acoustic directed energy system, sticky foam, rubber bullets, acoustic disrupters	RF crowd disruption emitter. Water cannons. Laser dazzlers
ROTARY WING AIRCRAFT		
Attack Helicopter	30-mm auto-cannon, 8 NLOS FOG/IIR-homing ATGMs, range 8 km. Two pods semi-active laser homing (SAL-H) rockets 80mm (20x 8 km) or 122mm (5x 9 km). 2x LBR KE ADAT msl (warhead w/3 KE submissiles, 8 km range). Laser designator 15 km. UAVs to 30 km. 2nd gen FLIR auto-tracker. Radar and IR warners and jammers, chaff, flares	Tandem cockpit, coax rotor, 30-mm auto-cannon. 8 x RF/SAL-H ASMs to 18 km (28+kg HE=1300+mm), 2x SAL-H rocket pods (80mm or 122mm), 2 ADAT KE msl 8 km, and 2x MANPADs. 1/3 have ASM to 100 km. Fire control with fused II/ FLIR to 30 km, and MMW radar, link to ground LTD. Radar jammer. Atk and LTD UAVs to 30 km.

SYSTEM	NEAR-TERM OPFOR (FY 14-20)	MID-TERM OPFOR (FY 21-28)
Multi-role Medium Helicopter and Gunship	24 troops or 5000kg internal. Medium transport helicopter. Range 460km. 30-mm auto cannon, 8 FOG-M/IIR ATGMs to 8 km, 40 x 80 mm laser-homing rockets, 4 AAMs. ATGM launchers can launch mini-UAVs and more AAMs. Mine pod option. Day/night FLIR FCS.	Fused FLIR/II to 15 km. 6x SAL-H ATGMs 18 km, 2 AAMs, 2 x 80/ 122-mm SAL-H rocket pods (20 or 5 ea). Laser designator to 15 km, and links to ground LTD. Aircraft survivability equipment (radar jammers and IR countermeasures).
Multi-role Helicopter and Gunship	12 troops (Load 400 kg internal, 1,600 external. Range 860 km. 23 mm cannon, 2 AAM, 4 SACLOS ATGMs to 13 km, TV/FLIR, day/night. Mine delivery pods	Launch 6x SAL-H ATGM to 18 km, 28+kg HE warhead. 2 x AAM Air-to-surface missile to 100 km. Pod w/7x SAL-H 90-mm rockets. Fused FLIR/II to 15 km. ASE
Light Helicopter and Gunship	3 troops (Load 750 kg internal, 700 external). Range 735 km. 20 mm cannon, 1 x 7.62mm MG, 6 SAL-H ATGMs to 13 km, 2 AAMs. FLIR night sight. Laser target designator. Mine pods	Launches 4x SAL-H ATGMs, to 18 km range. Fused FLIR/II to 15 km.
Helicopter and Fixed-Wing Aircraft Mine Delivery System	Light helicopter pod scatters 60-80 AT mines or 100-120 AP mines per sortie. Medium helicopter or FW aircraft scatters 100-140 AT mines or 200-220 AP mines per sortie.	Controllable and intelligent mines for aircraft delivery. Larger aircraft can hold multiple pods.
FIXED WING AIRCRAFT		
Intercept FW Aircraft	30-mm auto-gun, AAM, ASM, ARMs TV/laser guided bomb. 8 pylons Range 3,300 km. Max attack speed: Mach 4.	Stealth composite. ASE. Max G12+ All weather day/night. Unmanned option
Multi-Role Aircraft	30-mm gun, AAM, ASM, ARM pods, guided, GPS, sensor fuzed bombs, 14 hard points. Thrust vectoring. FLIR	Improved weapons, munitions. Unmanned option. ASE all radars. Max G12+ All weather day/night
Ground-Attack Aircraft	Twin 30-mm gun, 8 x laser ATGMs 16 km 32 kg HE, 40 SAL-H 80mm rockets, ASMs, SAL-H and GPS sensor fuzed bombs, AA-10 and KE HVM AAM. 10 hard points. Range 500+km. FLIR	Stealth composite design. ASE. Unmanned option. Max G12+ 80-mm/122-mm rockets SAL-H, SAL-H ASM (28+kg HE=1300+ mm), to 40 km, 2 gen FLIR, radar jammer, day/night
OTHER MANNED AERIAL SYSTEMS		
High-altitude Precision Parachute and Ram-air Parachutes	High-altitude used with oxygen tanks. Ram-air parachute includes powered parachute with prop engine.	Increased range and portability. Reduced signature. Increased payload.
Ultra-light Aircraft.	Two-seat craft with 7.62-mm MG, and radio. Folds for carry, 2 per trailer.	Rotary-winged, two-seat, MG, 1/ trailer. Auto-gyro, more payload.
UNMANNED AERIAL VEHICLES		
UAV (Brigade) It may also be employed in other units (e.g., artillery, AT missile, and naval)	Rotary wing, TV/FLIR/auto-tracker, with LRF and LTD designates targets to 15 km. Flies 180 km/6 hours, 220 km/hr, 2-5,500 m alt, 100 kg payload. Can carry 2 AD/anti-armor missiles+MG for atk	Range extends to 250 km. Increased payload. Attack version can carry 2 SAL-H ATGMs (12 km range) or 1+ 4 70-mm SAL-H rockets (7 km, defeats 200 mm).
UAV (Divisional)	Day/night recon to 250 km. GNSS/inertial nav, digital links, retrans. SLAR, SAR, IR scanner, TV, ELINT, ECM suite, jammer/ mine dispensers. Laser designator 15 km.	Increased range, endurance. Diff GNSS. Composite materials, low signature engine. SATCOM Retrans relay links. Attack submunitions.

SYSTEM	NEAR-TERM OPFOR (FY 14-20)	MID-TERM OPFOR (FY 21-28)
UAV (Operational)	Day/night recon to 400+km. GNSS/ inertial nav with digital links. SLAR, SAR, TV, IR scanner, ELINT, ECM suite. Jammer option. Mine dispense. Laser target designator 15 km. Retrans/relay	Increased ranges, endurance. Diff GNSS. High altitude ceiling (35 km) option. Retrans/ relay/SATCOM links. UAV attack submunitions. Laser target designators.
Unmanned Combat Aerial Vehicle (on Operational UAV platform)	Medium UAV with 4 ATGMs (fly out 10 km), laser guided bombs. Laser designator 15 km. Mine dispensers. GPS jammer, EW jammers. Range 400+ km.	Stealth composite design. ASE. Twin dispensers (pylons) with 16 terminally-homing submunitions, MMW/IR seekers. Range 500+ km
	THEATER MISSILES	
Short-Range Ballistic Missile Transporter-Erector Launcher (TEL) and Cruise Missile (CM) Launcher	Twin launch autonomous vehicle (GPS/ inertial nav, self-emplace and launch). Range 450 km. Non-ballistic launch, separating GPS corrected reentry vehicle (RV) with decoys, CCD, 10-m accuracy. ICM, cluster, nucs. EMP warhead. CM option. TEL may convert to 6 x CM TEL (500 km, 3-m accuracy, below radar). Vehicle decoys. Vehicle has visual/MMW/ IR signature of a truck.	Missile improve range (TBM 800 km, cruise 1,000), with 1-m accuracy. TBM has GNSS-corrected maneuvering RV. Warheads for both include terminal-homing submunitions, precision cluster munitions, EMP. Cruise missiles preprogram or enroute waypoint changes. Countermeasures include penetration aid jammers.
Medium-Range Ballistic Missile	Autonomous vehicle. Separating maneuvering warhead to 1300 km. GNSS,10-m CEP. Warheads include ICM, cluster, EMP, nucs. Penaids include decoys, jammers. Visual/MMW/IR signature of a truck.	Range 2,300 km, 1-m CEP. Differential GNSS, terminal homing, separating warhead. Warheads include EMP, terminal-homing cluster munitions. Non-ballistic launch and trajectory
Land-attack SAM system (secondary role for system)	The SAM system uses its EO sight and LRF (short/med range, strat "hittiles")	Range extends with SAM ranges. Passive operation with TV/FLIR.
Cruise Missile Launcher Vehicle (Multi-role) Category includes specialized cruise missiles, long-range ATGMs, and SAM systems to engage targets at 12+ km.	Includes truck with 24 missile launchers. Range is 40 km. 28-kg Frag-HE warhead =1,300 mm penetration. Pre-program phase GNSS/inertial nav is used. LTD to 25 km range. Thermal night camera to 10 km. Support UAV with LTD is used. FW, RW, and sea-launch options.	Range 100 km. Penetration aids (countermeasures). IR Terminal-homing warhead or IR-homing submunitions can be used. Armored/ tracked launcher will mount 16 x 40 km missile launchers.
Cruise Missile Cassette launcher Vehicle	Off-road truck, GPS nav for autonomous ops. 16/lchr. Range 470 km; preprogram GNSS inertial guidance, with in-course correction, 10 CEP. Munitions include cluster munitions, thermobaric, chemical, DPICM/mine submunition scatter.	Launcher fire direction. Supersonic missile Diff GNSS/ inertial nav, 1-m CEP. Range 900 km. EMP warhead option. Warheads include homing cluster munitions. Penetration aids-countermeasures.
	AIR DEFENSE	
General Purpose and Air Defense Machinegun	12.7mm low recoil for ground tripod. Chain gun light strike vehicle, ATV, motorcycle, etc, on pintle. TUV/LAV use RWS. Remote operated ground or robot option. Frangible rd 2 km, sabot 2.5 km. RAM/RAP/IR camouflage/ screens. TV/FLIR fire control. Lightweight MMW radar 5 km. Display link to AD azimuth warning net. Emplace 10 sec. RF/radar DF set. ATS control option.	Stabilized gun and sights. Remote-operated computer FCS with PDA/ laptop. Fused II/ FLIR 5 km. Frangible, sabot rds to 3 km. Laser dazzler blinds sights. Micro-recon/ heli atk UAVs. Robot mounts MG. Some light and AD vehicles replace gun with 30-mm recoilless chain gun on RWS, fires AHEAD round 4 km, plus Add-on ADAT missiles.

SYSTEM	NEAR-TERM OPFOR (FY 14-20)	MID-TERM OPFOR (FY 21-28)
AIR DEFENSE		
Improvised Multi-role Man-portable Rocket Launcher (AD/Anti-armor)	4-tube 57-mm launcher with high-velocity dual-purpose rockets. EO day/ night sight. Blast shield. Range 1,000 m. Penetration 300 mm, 10 m radius.	Prox fuze, 1,500 m range. Penetration 400 mm, 20 m radius.
Man-portable SAM launcher	6 km day/night range/ 0-3.5 km altitude all aircraft, velocity mach 2.6. Thermal night sight. Proximity fuze, frangible rod warhead (for 90% prob hit and kill). Approach/ azimuth link to AD warning net. Twin launcher vehicle quick mount. Nil smoke. Mount on robotic AD/AT launcher. RF/radar DF set on helmet.	Warhead/lethal radius increased air/ground targets. Improved seekers - not be decoyed by IR decoys/jammers. Fused II/ FLIR 10 km. Launch from enclosed spaces. Laser dazzler. Optional AD/AT LBR KE warhead missile – 8 km. Mount on AD/AT robot vehicle
MANPADS Vehicle Conversion Kit (Lt Stk Veh, Van, recon TUV, truck, etc)	Twin launcher and ADMG on improvised IR SAM vehicle. Day/night IR auto track FCS, MMW radar. Display link AD net. RF/radar DF set to 25 km. Camouflage	Replace launcher with 3-missile launcher: 2x ADAT KE SAMs, 1x IR SAMs. Total 6 missiles, (3+3)
Manpack Air Defense and Antitank (ADAT) Kinetic-Energy Missile Launcher (also listed in Anti-tank)	At company/Bn, can replace ATGMs and SAMs. Targets heli and LAVs. Missile has 3 KE LBR darts (submissiles) 8 km, 0 m altitude. Camo screen. Dart is 25-mm sabot with HE sleeve. Nil smoke. Fits on robotic ADAT launcher. Helmet RF/radar DF.	Larger sabot kills all targets up to 200 mm (KE) armor. Range 8 km, time of flight 5 sec. Fused II/ FLIR 10 km. Launch from enclosed spaces. Can mount on 3x remote launcher w/ IR auto-tracker, which. fits on AD/AT robot vehicle
Towed/Portee/Vehicle Mount AA Short Range gun/missile system	2x23mm gun. MMW/IR Camou/screen. Frangible rd to 3,000 m (17mm pen). Onboard radar/TV fire control, ballistic computer, 5 km MMW radar, thermal night sight, auto-tracker, net azimuth warner. Add twin MANPADS. RF/radar DF set, 25 km. RWS on veh hull/turret. CPS/ATS.	Replace with twin 30-mm recoilless chain gun, range. Frangible, sabot, AHEAD rds to 4 km. TV/fused II/FLIR auto-tracker 10 km. MMW radar, Twin MANPADS/ADAT KE missile 8 km) lchr. APU to 15-kph self relocation. Robotic option. Laser dazzler.
Air Defense System Decoys (visual decoy, decoy emitter)	See DECEPTION & COUNTERMEASURE SYSTEMS	
Brigade gun/missile turret for mount on tracked mech IFV, wheeled mech APC, truck (motorized) chassis	Twin 30-mm gun, APFSDS/frangible rds 4 km. 30-mm buckshot rd for UAVs. Mounts 4x hyper-velocity LBR-guided SAMs to 8 km, 0 m min altitude. Passive IR auto-tracker, FLIR, MMW RADAR. 2/battalion. Track/launch on move. Targets: air, LAVs, other ground targets. RF/radar DF set with 25 km range. CPS/ATS.	Dual mode (LBR/radar guided) high velocity missile, 12 km, 0 m min altitude. Auto-tracker, to launch and fire on move. Phased array radars. Fused II/FLIR to 19 km. Twin 30-mm recoilless chain gun with AHEAD-type rds to 4 km. Micro recon/heli atk UAVs. TV/IR attack grenades.
Divisional gun/missile system on tracked mech IFV, wheeled mech APC, truck (motorized) chassis	Target tracking radar 24km. TV/FLIR. 8 x radar/EO FCS high velocity missiles to 18 km/12 at 0 m min altitude. Auto-track and IR or RF guided. 2 twin 30mm guns to 4 km. 30-mm buckshot rd for UAVs. RF/radar DF. CPS/ATS	Hybrid drive. Missile 18 km at 0 m, can kill LAVs. Fused II/FLIR auto-tracker 19 km, launch on move. Radar 80 km. Home on jam. Twin 30-mm recoilless chain gun with electronically fuzed air-burst rds to 4 km. Micro-recon/heli-atk UAVs. TV/IR attack grenades.

SYSTEM	NEAR-TERM OPFOR (FY 14-20)	MID-TERM OPFOR (FY 21-28)
APC Air defense/AT Vehicle in APC Bn (Company Command Vehicle, MANPADS Vehicle in Bn/Bde)	1-man turret on 8x8 chassis. 30mm gun, 30-mm buckshot rd for UAVs. 100-X TV, 2 gen FLIR. 2x LBR ATGM lchrs 6 km, 2x veh MANPADS lchrs. Two dismount teams. 1x MANPADS lchr, 1x ADAT KE lchr. Total 18 msls. 12.7-mm MG. RF/radar DF to 25 km. CPS/ATS.	10x10 chassis, hybrid drive, box armor. Gun 30-mm recoilless gun on RWS. Ammo includes AHEAD-type to 4 km. Add 2 veh launchers for 5 HVM AD/AT (KE LBR) missiles, 8 km. Anti-helicopter surveillance/attack micro-UAVs. Fused II/FLIR 10 km. MMW radar. TV/IR attack grenades.
IFV ADAT Vehicle IFV Bn/Bde MANPADS	IFV chassis with features noted above. APC ADAT weapons and upgrades	See AIR DEFENSE, APC ADAT for weapons and upgrades
HIFV ADAT Vehicle HIFV Bn/Bde MANPADS	HIFV chassis with features noted above. APC ADAT weapons and upgrades	See AIR DEFENSE, APC ADAT for weapons and upgrades
Tank ADAT Vehicle Tank Bn/Bde MANPADS	Tank chassis with features noted above. APC ADAT weapons and upgrades	See AIR DEFENSE, APC ADAT for weapons and upgrades
Towed Medium Range AA gun/missile system	35mm revolver gun 1,000 rd/min. Gun rds: frangible, HE prox, electronic-fuzed. 4 SAMs/lchr, 45 km, 0 min altitude. Radar 45 km for 4 tgts. Resists all ECM. 2 gen FLIR auto-tracker to 20 km. RF/radar DF 25 km. SAM modes include active homing, home-on-jam. RAP/RAM/IR camo. CPS/ATS	Hybrid-drive auxiliary power units for local moves. Improved FCS, phased array radar, low probability of intercept, and acq to 80 km. Fused II/3rd gen FLIR auto-tracker to 35 km in day/night all-weather system. Ability to track and engage 8 targets per radar.
Medium-range ground SAM system	Tracked lchr. Radar to 150 km. 4 x radar-homing SAMs to 45km, 0 m min altitude (4 targets at a time). Home on jam. Use as cruise missile - priority ground tgts to 15 km, water 25 km. Fused 3rd gen FLIR auto-tracker. RF/radar DF. CPS/ATS	Hybrid drive. Improved FCS with radars and EO fused II/3rd gen FLIR day/night all-weather system to range 50 km. Radar range 200 km.
Strategic SAM System	Cross-country truck launchers, 1 x track-via- missile SAMs 400 km, at Mach 7. 1x ATBM/high maneuver missile to 200 km. Also 8 x "hittile" SAMs to 120 km. Modes are track-via-missile and ARM (home-on-jam). All missiles 0 m to 50 km altitude vs stealth aircraft/UAVs/ ASMs. All strat/op missiles in IADS. Local IADS all AD. Battery autonomous option. Over-the-horizon TA radar veh to 400 km. Mobile radar to 350 km. Site CM, decoys.	Off-road trucks and tracked with hybrid drive. All missiles Mach 7. 1 x "big missile to 500 km. OTH radar to 600 km range with 5-min emplace-displace. Targets include all IRBMs. Increased target handling capacity (100/ battery in autonomous operations).
Operational-Strategic SAM System	Same as above on tracked chassis. Mobile FOs all batteries. AD radars on airships.	Same as above on tracked chassis.
Anti-helicopter Mines (Remote and Precision Launch)	In blind zones force helos upward or deny helo hides and landing zones. Range 150m. Acoustic and IR fuse, acoustic wake-up, or cmd detonation. Directed fragmentation. Precision-launch mines use operator remote launch, proximity fuze for detonation. RF/radar DF.	Stand-alone multi-fuse systems. Remote actuated hand-emplaced mines with 360-degree multi-sensor array, pivoting/orienting launcher, 4-km IR-homing missile. Operator monitors targets and controls (turns on or off) sections, mines or net.
Helicopter Acoustic Detection System	Early warning of helicopters. Acoustic sensors to 10km, 200m CEP. IR sensors can also be linked to air defense net.	Range 20 km, 50 m CEP. Track and engage multiple targets. Digital link to AD net, AD unit, IADS.

MILITARY TECHNOLOGY TRENDS 2028

Year 2028 is a demarcation line for focusing on future military technologies. Even with the "Revolution in Military Affairs", most major technology developments are evolutionary, requiring one or more decades for full development. Subsystem upgrades can be added in less time. Most of the technologies noted below are in conceptual or early developmental stage or fielded at this time. Many exist in limited military or commercial applications, and can be easily extrapolated to 2028 and the near future time frame. Over this period and beyond, military forces will see some legacy systems fade to obsolescence and be replaced, or be relegated to lesser roles or lower priority units. Most will be retained and updated several times. New systems and technologies will emerge, be developed, become widely implemented, mature, and reach evanescence, requiring updates.

INFANTRY

- Infantry with improved weapons/sensors as primary lethal agent for combined arms
- Weapon-delivered remotely-guided submunitions and sensors for infantry weapons
- Day/night sensors integrated, netted, with UAVs, robotics, and direct links to fire support
- Visual/IR/MMW materials with signature management to avoid detection
- Increased lethality weapons and precision for man-portable and vehicle weapons, robotic weapons
- Increased range and effectiveness for use in Beyond Line-Of-Sight (BLOS) and MOUT operations
- Tube launch UAVs, UCAVs, and remote overhead camera munitions for vehicles and dismounts limit collateral damage

ARMOR

- Tank crew in hull, with insensitive ammunition, electromagnetic armor, and active protection systems
- Hybrid (diesel/electric) drive, and MMW/IR signature management
- Overhead guns and missiles, electro-thermal chemical gun, and cased telescoped rounds
- BLOS precision 12+km, 1,500+ mm lethality, KE missiles, and sensor/attack UAVs and robots
- Infantry carrier remote weapons manned by passengers for 360° all-aspect protection
- Heavy combat support vehicles/Heavy IFVs option to accompany tanks/IFVs
- Micro-UAVs, attack UAVs, and UCAVs for vehicle launch

ANTI-ARMOR

- Increased penetration (1,500+ HEAT/1,000+ KE), including lightweight capability for infantry
- Infantry homing grenades with top-attack EFP or tandem
- KE hypervelocity missiles/missile rounds 10+ km vehicles. KE ATGMs for infantry
- Laser designators on AT grenade launchers, also used for precision artillery/air/naval rounds/ATGMs
- Attack UAVs and laser target designator UAVs for precision strikes throughout the battle zone

SENSORS

- Multi-spectral immediate all-weather sensor transmission with real-time display
- Remote unmanned sensors, weapon-launch and robotic sensors and manned sensors
- Sensor nets integrated and netted from team to strategic and across functional areas
- Micro-UAVs and remote overhead camera munitions for vehicles and dismount teams

ARTILLERY

- Autonomous operation/rapid self-emplace/displace with integrated netted FCS
- Precision munitions: laser/IR/MMW homing, EFP multi-sensor fuzed
- Inertial/GPS/muzzle-velocity radar course-correction on conventional rounds/rockets
- Combination guns integrate tactical unit BLOS fires and strikes

AIRCRAFT

- Continued but selective use of FW and rotary wing for stand-off weapons, sensors
- Aircraft critical for transport, minelaying, jamming, other support missions
- Laser designators on AT grenade launchers, also used for precision artillery/air/naval rounds/ATGMs

OTHER AERIAL SYSTEMS

- High-altitude UAVs, long-endurance UAVs, and UCAVs seamlessly integrated with other intelligence and support systems
- Recon/attack low-signature UAVs and UCAVs and stand-off munitions at all levels down to squads
- Ballistic missiles with non-ballistic trajectories, improved GNSS/homing re-entry vehicles, precision submunitions, EMP
- Shift to canister launchers of tactical cruise missiles with precision homing and piloted option, cluster warheads, EMP
- Laser designators on AT grenade launchers, also used for precision artillery/air/naval rounds/ATGMs
- Airships and powered airships for long-duration and long-range reconnaissance, and variety of other roles
- Increased use of ultra-lights and powered parachutes

AIR DEFENSE

- Integrated Air Defense System with day/night all-weather RISTA access for all AD units
- Improved gun rounds (AHEAD/guided sabot) and missiles (anti-radiation homing, jam-resistant)
- Autonomous operation with signature suppression, counter-SEAD radars and comms
- Shoulder-launch multi-role (ADAT) hypervelocity missiles/weapons immune to helicopter decoys and jammers,
- Micro-UAVs and airships for multi-role use includes air defense recon and helicopter attack
- Acquisition/destruction of stealth systems and aerial munitions and ground rockets to 500+ km

INFORMATION WARFARE

- Jammer rounds most weapons, electro-magnetic pulse rounds, weapons of mass effects
- UAVs, missiles and robots carry or deliver jammers/EMP/against point targets and for mass effects
- Multi-spectral decoys for most warfighting functions
- Computer network attack and data manipulation

ACCESS DENIAL

- Use of nuclear/bacteriological/chemical weapons to deny entry, access to areas or resources
- Use of media and public opinion for access denial
- Remotely delivered RF-controlled, smart and wide-area remote delivered sensor-fuzed and mines and IEDs defeat jamming

NON-LETHAL WEAPONS

- EMP/graphite/directed energy weapons to degrade power grid, information networks, and military systems
- Space-based data manipulation to deny adversary use of satellite systems
- Population control effects (acoustic devices, bio-chemical and genetic weapons, resources attack, dirty bomb)
- Anti-materiel agents and organisms (microbes, chemicals, dust, and nanotech)
- Countermeasures, tactical and technical, in all units to degrade enemy sensor and weapon effectiveness.