

# Polar Nights, White Nights, and Normal Days and Nights

## Arctic Ground Target Identification and Engagement

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### Abstract

Most armies train to fight on their own soil or that of their neighbors. Some, like the British Army during the days of the British Empire, trained to fight on a variety of terrain and in differing climates. Today, the best-trained Arctic forces are those of Russia, Norway, Sweden, Finland, and Canada. With the reactivation of the 11th Airborne Division in Alaska, the United States will join the group of Arctic-specific forces. Arctic tactics and equipment differ from conventional tactics and equipment due to the different geography, climate, and peculiarities of the high latitudes. One of the striking Arctic peculiarities is that of visibility. Russia conducted visibility and detection tests on Russian equipment on the Arctic Kola Peninsula. These tests, aggregated with the local weather and climate, determined the effect of background conditions against which the soldier scout, forward observer, or gunner could detect and destroy targets. Although the results are very tactical, the operational impact of Arctic visibility on Arctic warfare is striking.

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A fundamental concept of contemporary conventional war under nuclear-threatened conditions is that combat will continue uninterrupted to deny the enemy the time to restore combat potential, maneuver reserves, and resupply. This is conditional on the ability to fight at any time of the day or night and under any climatic condition. Special features of the polar region challenge the “normal” concept of night and day. Polar nights occur in the northernmost and southernmost parts of the planet when there is night for more than 24 continuous hours. Polar days [Midnight Sun in the US and White Nights in Russia] occur when the sun stays above the horizon for more than 24 continuous hours. In the Russian Arctic, polar night runs from 2 December through 11 January (39 days), while polar days run from 22 May to 22 July (62 days). This leaves 264 days of relatively normal day and night.<sup>1</sup>

Polar days support round-the-clock artillery and aviation missions while increasing the need to camouflage the force and conceal its movement. Polar

nights complicate orientation, the conduct of accurate fire, limit the effectiveness of weapons at their maximum range of fires, and influences the use of aviation. For example, the engineer capability to build defensive fighting positions falls by 25–40 percent during darkness. Low temperatures, strong winds, and frozen soil further degrade engineer capability. Strategic outcomes may result from small-scale fights by battalions and brigades. Polar ground target identification and engagement is critical, as these Arctic targets are often vital due to their purpose, location, and difficulty in rapidly restoring or replacing them. Targeting visibility in daylight varies by the time of day, illumination, atmospheric precipitation, fog, terrain relief, smoke from fires, gun smoke, camouflage, vegetation, enemy technical interference with optical-electronic observation, and building density in cities and hamlets.<sup>2</sup> Electronic night-vision systems assist in night target engagement but are not as effective as daylight observation. The stabilized 30-mm 2A42 multipurpose autocannon on the venerable Russian airborne BMD-2 infantry fighting vehicle has a daylight maximum effective range of 1,400 meters but drops to 800 meters at night using night-vision systems.<sup>3</sup> Russia conducted visibility and detection tests on Russian equipment on the Arctic Kola Peninsula. The peninsula, located between the White and Barents Seas, has mountains, swamps, forest, tundra, and built-up areas (such as Murmansk). The peninsula has a relatively moderate climate for the Arctic. Tests, conducted on the Kola Peninsula, aggregated with the local weather and climate, determined the effect of background conditions against which the soldier scout, forward observer, or gunner could detect and destroy targets.

**Table 1. Physical target visibility under normal conditions depending on the background<sup>4</sup>**

Abbreviations: BMD (Russian: Боевая Машина Десанта, Boevaya Mashina Desanta) is an airborne amphibious tracked infantry fighting vehicle; BTR (Russian: бронетранспортёр, Brone-transportyor) is an armored transport; and AGTM (Russian: Корнет, Cornet) is a second-generation Russian man-portable antitank guided missile.

Background	Type of Target	Limit of Visibility, km	Background	Type of Target	Visibility
<b>Forest</b>	Tank	1.9	<b>Grass field</b>	Tank	2.6
	Dug-in tank	1.3		Dug-in tank	1.6
	BMD	1.7		BMD	2.2
	Dug-in BMD	0.8		Dug-in BMD	1.2
	BTR	1.7		BTR	2.2
	Dug-in BTR	0.7		Dug-in BTR	0.9
<b>Snow-covered Forest</b>	ATGM	1.5	<b>Snow</b>	ATGM	1.7
	Dug-in ATGM	0.8		Dug-in ATGM	1.2
	ATGM crew	0.65		ATGM crew	0.8
	Machinegun crew	0.45		Machinegun crew	0.5
<b>Snow-covered Forest</b>	Tank (white camo)	1.8	<b>Snow</b>	Tank (white camo)	2.2
	Dug-in tank white camo	1.1		Dug-in tank white camo	1.4
	BMD (white camo)	1.5		BMD (white)	2.0
	Dug-in white camo BMD	0.8		Dug-in BMD	1.0
	BTR (white camo)	1.5		BTR (white camo)	2.0
Dug-in BTR white camo	0.7	Dug-in BTR white camo	0.9		
<b>Snow-covered Forest</b>	ATGM white camo	1.4	<b>Snow</b>	ATGM white camo	1.9
	Dug-in ATGM white	0.9		Dug-in ATGM white	1.1
	ATGM crew	0.6		ATGM crew	0.7
<b>Snow-covered Forest</b>	Machinegun crew	0.4	<b>Snow</b>	Machinegun crew	0.5

Clearly, the range of day-lit visibility increases with the degree of target exposure and the contrast between the target and its background. Day-lit tests on the Kola Peninsula ranges had more than 2.5 kilometers visibility and measured the time that it took to detect different targets at different ranges over different backgrounds, first without the use of binoculars or other visual assistance and then with. The mathematical expectation was that, under normal circumstances, the unaided eye could detect a tank in a forest 2.5 kilometers away in 7 seconds when the observer and target were at the same altitude. Differences in background contrast, elevation, and terrain breaks affected the visibility findings. The BMD-2 with the 30-mm automatic cannon and the PKT 7.62-mm co-axial machine gun were used for the fire missions. With an increase in range, the average time expended engaging targets

increased 12–35 percent, for low hills 10–30 percent, and 5–20 percent on the plains. Some 40 percent of the test area involved hills and higher elevation. This required that the vehicle commander and gunner carefully select their observation and firing posts. Dug-in targets were difficult to detect and destroy.<sup>5</sup>

**Table 2. Mathematical expectation of the time to detect targets visually depending on the range and background<sup>6</sup>**

Abbreviations: BMD (Russian: Боевая Машина Десанта, *Boevaya Mashina Desanta*) is an airborne amphibious tracked infantry fighting vehicle; BTR (Russian: бронетранспортёр, *Brone-transportyor*) is an armored transport; and AGTM (Russian: Корнет, *Cornet*) is a second-generation Russian man-portable antitank guided missile.

Cannon Target						
Target	Background	Distance by meters and seconds				
		500m	1,000m	1,500m	2,000m	2,500m
Tank	Forest	3	4	5	6	7
	Grass field	9	10	11	12	13
BMD	Forest	7	7	8	8	9
	Grass field	10	11	12	14	16
BTR	Forest	11	12	13	15	17
	Grass field	10	11	12	13	15
ATGM launcher	Forest	11	12	13	15	17
	Grass field	10	11	12	13	15
Tank white camo	Snow-covered forest	11	13	17	23	44
	Snow	12	15	19	27	51
BMD white camo	Snow-covered forest	8	9	10	12	13
	Snow	15	21	37	46	66
BTR white camo	Snow-covered forest	13	14	19	27	50
	Snow	15	21	37	46	66
ATGM white	Snow-covered forest	13	13	15	19	49
	Snow	22	16	41	50	72
Machinegun Target						
Infantry ≤ squad	Forest	6	7	8	8	10
	Grass field	5	6	6	7	8
	Snow-covered forest	6	7	7	8	9
	Snow	5	5	6	7	8
ATGM crew	Forest	8	8	9	10	12
	Grass field	6	7	7	8	10
	Snow-covered forest	9	9	11	12	14
	Snow	8	8	9	10	12
Machinegun crew	Forest	8	9	14	33	.
	Grass field	6	8	12	25	.
	Snow-covered forest	10	9	16	33	.
	Snow	8	9	14	23	.

The tests determined that observers could detect small targets (ATGM and machinegun crews) without binoculars or other optics up to 900 meters away. The further the target was from the gunner, the less chance of a hit, and the expenditure of ammunition on distant targets increased. When only part of the target was visible, the shots fired were usually high of center mass. The less of the target that was visible reduced the probability of successful target engagement by 1.2 to 1.8 times.<sup>7</sup>

**Table 3. Visual distance is dependent on atmospheric transparency<sup>8</sup>**

Atmospheric Conditions	Coefficient of Weakening Emanation	Horizontal Meteorological Visibility Distance, meters
Heavy fog	86.6	20
Dense fog	85.5	50
Moderate fog	21.4	200
Light fog	8.54	500
Heavy haze	2.14	1,000
Light haze	1.07	4,000
Clear	0.427	10,000
Very clear	0.214	20,000
Exceptionally clear	0.0713	50,000

The Kola Peninsula has high humidity and is frequently cloud- or fog-covered, with overcast up to 180 days a year (20 days a month in winter, 10 days per month in the summer, and 5–10 days a month in the spring and fall). In the summer, daylight continues for 17 hours or more. Winter overcast is less than eight hours a day.<sup>9</sup>

**Table 4. Effective foreign systems to hide tanks and means of optical-electronic suppression (OEP)<sup>10</sup>**

Technical Upgrades	Countermeasures	Effectiveness of OEP
<b>M1A2 and Leopard 2 tanks</b>		
Camouflage paint patterns to mask signature. Laser illumination detectors. Automatic smoke-screen system. Optical-electronic jamming system.	Laser and television fire direction system for cannon and missile armaments with laser rangefinder and television aiming. Semi-active laser placement (GPS and target acquisition). Second-generation ATGM with semi-active command system for location and target acquisition.	Reduces probability of hit by 1.2–2.3 times.
<b>Future foreign tank systems</b>		
Laser and radar illumination indicator. Automatic systems to create smoke screens, portray false locations and traps. Active optical and radio-location jamming station. Use of “adaptive” technology.	Thermal and radio-location recce systems, ATGM with laser radial-command placement.	Reduces probability of hit by 2–3.5 times.

The tests used Russian weapons systems, which generally have lower silhouettes, less mass, less weight, and wider tracks than their Western counterpart systems. Furthermore,

the Russians design their equipment to function primarily on Russian terrain. However, the Russians are monitoring Western tank developments and their incorporation of optical-electronic suppression systems in current and planned tanks (table 4).

**Table 5. Time for a dust–smoke cloud from a 30-mm automatic cannon to disperse<sup>11</sup>**

Ground at firing position	Wind speed	Wind direction	Time for the cloud to disperse, sec		
			Minimum	Maximum	Average
Dry grassy ground	1.5	270	15	20.5	17.8
Dry ground w/o grass	1.5	180	8.5	12.4	10.2
Dusty ground	0.5	270	24.5	35	28.3
	1-2	45	16.5	23	18.8
	3-5	240	11.0	21.3	15.1
	3-4	40	3.6	4.5	4.0
Sandy ground	2-2.5	100	3.0	3.5	3.25
Grassy ground after rain	1.5	45	6.5	8.3	7.5
Soggy loamy soil	1.0	80	5	7	6
Caked snow 0.4–0.5 meters	2.5	50	3	5.2	4.1

Dust and smoke clouds are common on the battlefield. They can be deliberate smoke screens laid as part of the masking effort or incidental to the battle, usually formed by the impact and explosion of artillery rounds and large-caliber machine-guns firing on targets, as well as terrain fires sparked by explosion and tracer rounds. These dust and smoke clouds can obscure or completely hide the target, frustrating target tracking and fire corrections. Factors enhancing dust and smoke clouds include varying ground pressures from explosions, the ground composition and type of ground cover, the type of fires employed, and the wind direction of the surface winds. Table 5 shows the common types of ground and ground cover on the Kola Peninsula. In dry weather, it gets very dusty, and a moderate wind can create a dust cloud lasting 3–40 seconds. Explosions of different types of ordnance produce their own dust and smoke clouds. A 152-mm or 155-mm HE-fragmentation round cloud will last from 5–20 seconds and restrict visibility 6–7 times.<sup>12</sup> Table 5 shows the time for a dust–smoke cloud created by the stabilized 30-mm 2A42 multipurpose autocannon to disperse. Wind direction is indicated with the weapon laid on 0° of a 360° circle and is unrelated to geographic north.

Russia is a northern country, and winter training is normal training. The Russian tests indicate that the ability to detect and destroy enemy targets is often hostage to terrain background, atmospheric conditions, degree of target exposure, enemy optical-electronic suppression, dust, battlefield smoke, and available light. Night-vision devices are effective at close distances but not at longer ranges. Much of the Russian testing was against stationary targets. Movement is always a good indicator of enemy location. Consequently, necessary movement is often restricted to nights or

during adverse atmospheric conditions. One-sided illumination markers, direction azimuths, and ground guides are often necessary for nighttime movement. Thermal sensors are a threat to maintaining secrecy as warming tents, generators, and engine warmth can readily give away positions. Radar and radio transmissions also invite enemy counters. Noise carries over long distances of open snow-covered terrain, and acoustic targeting is still part of Russian training. The Arctic adds to normal cold-weather challenges, but a study of its special demands and characteristics aids in adapting effectively to the region. The ongoing fighting in Ukraine has demonstrated the value of satellite and unmanned aerial vehicle (UAV) reconnaissance on the contemporary battlefield. Polar satellite orbits are difficult to position and relatively short-lived. Russian Arctic ground forces train regularly with UAVs for visual and thermal reconnaissance and radio retransmission, but UAV coverage can only be partial and never constant in the vast Arctic. Arctic ground target identification and engagement remains a primary concern of the ground scout and artillery observer. 🌟

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#### **Notes**

1. A. Zelenov, “Ночью как днем: Факторы влияющие на ведение боевых действий в северных условиях” [Night is like day: Factors influencing military activity in the north], *Армейский Сборник [Army Digest]*, April 2017, 5.
2. Zelenov, “Ночью как днем, 6.
3. Zelenov, “Ночью как днем, 6.
4. Zelenov, “Ночью как днем, 7.
5. Zelenov, “Ночью как днем, 9.
6. Zelenov, “Ночью как днем, 8.
7. Zelenov, “Ночью как днем, 9.
8. Zelenov, “Ночью как днем, 10.
9. Zelenov, “Ночью как днем, 9.
10. Zelenov, “Ночью как днем, 11
11. Zelenov, “Ночью как днем, 11.
12. Zelenov, “Ночью как днем, 10–11.

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