

## MISSILE DEFENSE REVIEW

MDAA Spotlight Series on Drone and Missile Warfare

### *Russia’s Advancing Geran Family of Attack Drone Capabilities*

#### Key Points

- **The Geran is a mass weapon, not a precision one.** Its operational value comes from volume and cost asymmetry — launched in the hundreds to exhaust air defenses — rather than from accuracy or sophistication.<sup>[1]</sup>
- **Wartime employment of the Geran has scaled by roughly two orders of magnitude.** From a handful of imported drones in late 2022 to a reported ~57,000 cumulative launches by March 2026, with daily strike-drone averages exceeding 130 and single-night salvos often surpassing 700 aerial weapons.<sup>[2]</sup>
- **The Geran is the foundational component of a layered strike doctrine.** It is routinely combined with Gerbera or Italmas decoys and with cruise and ballistic missiles to fragment, saturate, and exhaust Ukrainian defenses.<sup>[3]</sup>
- **The Geran family is iterating faster than the defense.** Heavier warheads, jam-resistant Kometa navigation, Starlink control, AI-assisted seekers, air-to-air variants, and jet-powered Geran-3/4/5 models have all reached the battlefield, eroding Ukraine’s high interception rates against Russian attack drones in 2024.<sup>[4]</sup>
- **Cost asymmetry is the strategic core.** A Geran attack drone costing tens of thousands of dollars routinely draws interceptors costing many times more, making sustained defense cost prohibitive and offering a template Russia could apply against NATO.<sup>[5]</sup>

#### Executive Summary

The Geran-2 is the Russian-produced derivative of Iran’s HESA Shahed-136 — a low-cost, propeller-driven, one-way attack drone that has become the signature stand-off strike weapon of Russia’s war against Ukraine. Since its combat debut in September 2022, the system has evolved from an imported Iranian munition fired in small numbers into a domestically mass-produced weapon launched in nightly salvos of several hundred, deployed as the saturating core of layered strike packages that also include cruise and ballistic missiles and dedicated decoy drones.<sup>[6]</sup>

Russia’s achievement is industrial rather than technological: it has paired a deliberately cheap airframe with serial production at scale, forcing Ukraine to expend far costlier interceptors and steadily depleting its air-defense capacity. As the threat has matured, Russia has iterated the system rapidly — fielding heavier and thermobaric warheads, hardened anti-jam navigation, mobile-network and Starlink control links, onboard cameras with AI-assisted targeting, air-to-air variants built to hunt the helicopters defending against the drones, and jet-powered Geran-3/4/5 models with near cruise-missile speeds. This brief assesses the system’s employment history as its primary focus, with supporting analysis of its capabilities, technical characteristics, and trajectory.



*Figure 1. Recovered wreckage of a Russian Geran-2 (Iranian Shahed-136) loitering munition downed over Ukraine, showing the composite delta-wing airframe and rear pusher-propeller mount. (Open-source imagery.), Russian Geran-3, and captured image of an aerial Geran-4.*

## Origins and Designation

The Geran airframe is derived from the Iranian HESA Shahed-136, developed by Shahed Aviation Industries as a cheap, mass-employable loitering munition. In Russian service it is designated Geran-2 (“Geranium-2”); the smaller Shahed-131 is the Geran-1. The drone first appeared as a Russian weapon in Ukraine on 13 September 2022, when wreckage marked “M412 Герань-2” was recovered. The crude markings were intended to disguise the weapon’s Iranian origin, but the delta-wing planform revealed its provenance. The first confirmed strikes followed days later, including an attack on Odessa around 23–25 September 2022.<sup>[6]</sup>

The baseline Geran-2 is a pusher-propeller delta-wing roughly 3.5 meters long, weighing over 200 kilograms, powered by an MD-550-class 50-horsepower two-stroke piston engine that produces the distinctive buzzing signature Ukrainians nicknamed it the “flying moped.” Its original 50-kilogram warhead can be increased to about 90 kilograms at the expense of fuel and range. Nominal range is frequently cited at up to roughly 2,500 kilometers, though warhead-heavy variants trade range for payload.<sup>[7]</sup>

## Employment History

Russian employment of the Geran has moved through three broad phases. In the **initial Iranian-supplied phase** (late 2022 into 2023), drones arrived from Iran and were used in comparatively modest numbers

against energy infrastructure and cities, with Ukraine often intercepting entire waves. Domestic Russian production at the Alabuga Special Economic Zone in Tatarstan began in 2023, opening the **scaling phase**. In the 2024-2025 winter, mass assaults of 100, 200, 400, and even 700 drones in a single night became routine, and the Geran shifted from a supporting munition to the centerpiece of Russia’s strategic strike campaign.<sup>[8]</sup>

By 2025, the campaign had entered a **saturation phase**. Ukrainian data indicate more than 38,000 Shahed-type drones launched across 2025, including some 5,000 in September alone; the SBU reported nearly 50,000 cumulative launches of all Shahed types by September 2025, and open sources placed the figure near 57,000 by March 2026. Daily volumes climbed accordingly: averages of roughly 175 Shahed-type drones per day across summer and fall 2025, peaking near 203 per day in July, with strike-model (Geran) averages around 135 per day into early 2026.<sup>[9]</sup>

The defining tactical feature is the **layered, saturating strike package**. Gerans are launched alongside Gerbera and Italmas (BM-35) decoy drones — which absorb interceptors and conduct reconnaissance — and synchronized with cruise missiles (Kh-101, Iskander-K) and ballistic and aeroballistic missiles (Kinzhal). The 9 July 2025 strike exemplifies the employment method: 741 aerial weapons in a single assault, of which 728 were Shahed-type UAVs, layered with seven cruise missiles and six Kinzhals to fragment and overwhelm defenses.<sup>[10]</sup>

Flight tactics are being adapted continuously. Russia alternates extremely low-altitude ingress to defeat radar with high-altitude profiles above four kilometers to escape machine-gun and small-arms fire, forcing Ukraine to adopt mobile fire groups, electronic warfare, and increasingly interceptor drones to counter Geran attack drones. The effect on the defense is measurable: interception rates that held at 94–97 percent from August 2024 through February 2025 fell to roughly 82 percent in May and 86 percent in June 2025 as numbers and sophistication rose — and the small share penetrating defenses inflicts serious damage on the power grid and civilian areas.<sup>[11]</sup>

Target sets have broadened beyond fixed infrastructure. Russia has used Gerans against merchant shipping, including vessels in open water (a capability requiring specialized seekers), and has fielded air-to-air variants — a Geran-2 “series E” carrying a 9K333 Verba MANPADS and a Geran-3 mounting a 45-kilogram R-60 infrared missile — expressly to hunt the helicopters that Ukraine’s commander-in-chief credited with roughly 40 percent of drone kills in September 2025. By January 2026, Russia was remotely piloting Starlink-linked Gerans against moving targets, including a strike on a passenger train near Kharkiv.<sup>[12]</sup>

## Capabilities and Technical Characteristics

Guidance combines commercial-grade satellite navigation (GPS/GLONASS) with an inertial measurement unit. The decisive technical upgrade has been navigation hardening: the Kometa / Kometa-M controlled-reception-pattern antenna — a multi-channel (reportedly 12-channel) jam-resistant module — has become standard, materially degrading the GPS jamming Ukraine relied upon early in the war. Command and control measures have expanded from autonomous pre-programmed flight to networked operation via 2G/3G/4G mobile modems on Ukrainian cellular networks and, increasingly, Starlink terminals enabling real-time remote control and video.<sup>[13]</sup>

Warhead options have grown from the 50-kilogram baseline to a 90-kilogram variant (with reduced fuel and a shorter ~650-kilometer range), a roughly 52-kilogram thermobaric option, and warheads packed with tungsten-ball shrapnel to maximize damage against soft targets and infrastructure. Onboard autonomy is

improving: in mid-2025 Ukrainian intelligence examined an “MS” series fitted with an infrared camera and an Nvidia Jetson computer capable of video processing and autonomous target recognition, and in early 2026 a reconnaissance variant was found carrying a Raspberry Pi 5 and a China-built mini-PC running Windows 11 as part of a vision-processing chain.<sup>[14]</sup>

The system remains heavily dependent on foreign components despite sanctions. Recovered drones consistently contain electronics sourced from the United States, China, Switzerland, Taiwan, Japan, Germany, and the United Kingdom, reaching Russian production lines through intermediaries and re-export channels. This dependence is a recurring theme in Ukrainian and Western technical exploitation and a focal point for sanctions enforcement.<sup>[15]</sup>

### **Variant Evolution: Toward Jet Propulsion**

The most consequential line of development is the move to jet propulsion. The Geran-3, derived from Iran’s Shahed-238, replaces the piston engine with a Tolou-10/13 turbojet — widely assessed as an unlicensed copy of the Czech PBS TJ100/TJ150 — reaching speeds estimated at 500 to 900 kilometers per hour and ceilings up to 9,000 meters. First wreckage was documented on 29 June 2025, and cumulative launches reached roughly 138 by early 2026. Its near-cruise-missile speed strains interceptors tuned for the ~180-kilometer-per-hour piston models, raising the cost of every engagement.<sup>[16]</sup>

Russia has since revealed further jet variants: the Geran-4, with a more powerful engine and improved aerodynamics reaching up to ~500 kilometers per hour, and the Geran-5, which sheds the delta-wing planform entirely for a small cruise-missile configuration assessed as a Karrar-class design, with reported Su-25 air-launch capability. Ukrainian Defense Intelligence assesses that Russia intends to raise jet-powered drones to roughly 50 percent of total attack drone production output, though as of mid-2026 jet launches remained largely experimental at roughly 10–12 per day.<sup>[17]</sup>

### **Production, Cost, and Strategic Implications**

Production is concentrated at the Alabuga SEZ in Tatarstan, reportedly staffed in part by students from the adjacent Alabuga Polytechnic and by imported labor. Output estimates have risen from roughly 170 Geran-2s per day in spring 2025 toward a cumulative ~26,000 produced by that point, with Ukrainian intelligence citing 2025 plans for 40,000 Geran-2s and 24,000 Gerbera decoys, later revised toward 60,000 long-range strike drones and 50,000 decoys. Low unit cost makes the Geran a lucrative investment: baseline estimates run \$20,000–\$50,000 (CSIS and RUSI), with hardened Russian iterations assessed at \$35,000–\$80,000 — against Iranian wartime purchase prices of \$193,000–\$290,000 and jet-powered Shahed-238 figures of \$900,000–\$1.4 million.<sup>[18]</sup>

The asymmetry these figures create is the main advantage the Geran provides Russia. An attack drone costing tens of thousands of dollars routinely compels Ukraine to expend interceptor missiles costing many multiples more, an exchange ratio that is unsustainable over time and that, by Ukrainian accounts, had significantly depleted air-defense stocks by the end of 2025. Russia’s edge is therefore industrial rather than technological — the capacity to mass-produce and sustain high-tempo launches. The pattern has not gone unanswered: the United States reverse-engineered the design through the SpektreWorks/LUCAS line (first combat use in February 2026), and Ukraine fielded its own long-range analogs in 2025. For defense planners the central lesson is that countering the Geran requires shifting the cost curve back — through low-cost interceptor drones, electronic warfare, and layered sensor networks — because Russia is, in effect, testing in Ukraine a model of attritional air warfare it could replicate against NATO.<sup>[19]</sup>

Written by Alex Reed — 26 June 2026

### Footnotes

- [1] CSIS Missile Defense Project, “Shahed-136 / Geran-2,” Missile Threat, [missilethreat.csis.org](https://missilethreat.csis.org); unit-cost figures per CSIS and RUSI assessments.
- [2] Security Service of Ukraine (SBU) figures, reported via Kyiv Post, “50,000 Shahed – Explained,” 14 March 2026.
- [3] Institute for Science and International Security (ISIS), “Monthly Analysis of Russian Shahed-136 Deployment Against Ukraine,” [isis-online.org](https://isis-online.org), 2026.
- [4] Defence Intelligence of Ukraine (DIU) via Ukrainska Pravda, “The Jet Threat,” 19 May 2026.
- [5] CSIS and RUSI cost assessments compiled in “Shahed-136,” Drone Warfare Strategic Assessment, [drone-warfare.com](https://drone-warfare.com), March 2026.
- [6] CSIS Missile Defense Project, “Shahed-136 / Geran-2,” Missile Threat, [missilethreat.csis.org](https://missilethreat.csis.org); HESA Shahed-136 OSINT compilation.
- [7] H. I. Sutton, “Guide to Russian Shahed / Geran Strike Drones,” Covert Shores ([hisutton.com](https://hisutton.com)), 16 December 2025.
- [8] SBU figures via Kyiv Post, 14 March 2026; ISIS deployment analyses, [isis-online.org](https://isis-online.org).
- [9] ISIS, “Monthly Analysis of Russian Shahed-136 Deployment Against Ukraine,” [isis-online.org](https://isis-online.org), 2026.
- [10] Ukrainian Air Force operational reporting, 9 July 2025, cited in Re:Russia, “Missile-Financial Balance,” [re-russia.net](https://re-russia.net).
- [11] Shahed Tracker and Ukrainian Air Force interception data, cited in Re:Russia and The Economist, 2025.
- [12] DIU via Telegram and the War&Sanctions portal; Ukrainska Pravda, 15 December 2025.
- [13] CSIS and RUSI assessments compiled in Drone Warfare Strategic Assessment, [drone-warfare.com](https://drone-warfare.com), March 2026.
- [14] CSIS Missile Defense Project, [missilethreat.csis.org](https://missilethreat.csis.org); DIU technical exploitation reporting via Ukrainska Pravda, 2025–2026.
- [15] DIU via the War&Sanctions portal; Ukrainska Pravda, 15 December 2025.
- [16] CSIS Missile Defense Project, “Shahed-238,” Missile Threat, [missilethreat.csis.org](https://missilethreat.csis.org); Army Recognition, 2 August 2025.
- [17] DIU assessment via Ukrainska Pravda, “The Jet Threat,” 19 May 2026; Defense Express, 19 February 2025.
- [18] DIU production estimates via Ukrainska Pravda, May 2026; ISIS Alabuga production tracking, [isis-online.org](https://isis-online.org); CSIS and RUSI cost assessments.
- [19] DIU assessments via Ukrainska Pravda, 2026; ISIS deployment analyses, [isis-online.org](https://isis-online.org).