

# Production of major weapons systems in Western countries before and after February 2022

Analytical report



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# Brief overview

The events of 2022, in particular the special military operation of Russia in Ukraine, clearly demonstrated that the quality of weapons cannot completely replace quantity. High losses of military equipment in a full-scale modern conflict confirmed the need to increase the rate of production of major weapons systems. Leading Western countries, such as the United States, the EU, Israel, South Korea and Japan, accelerated the modernization of their defense potential and increased the production of military equipment and ammunition. The main reason was not only the increase in demand from their own armed forces, but also the need to support allies, primarily Ukraine.

The conflict exposed supply problems for NATO countries, especially with 155mm and 152mm artillery shells. In response, EU and NATO countries launched defense industry support programs and developed long-term strategies to strengthen their armed forces; major Western manufacturers such as General Dynamics, BAE Systems, Rheinmetall and Hanwha Aerospace expanded production capacity.

Particular attention is being paid to upgrading existing platforms, such as the M1 Abrams tank in the United States and the Merkava tank in Israel, in programs to increase their combat effectiveness and integrate the latest technologies, while developing new combat systems that are expected to enter service in the early 2030s.

Thus, 2022 became a turning point when Western countries began large-scale investments in expanding their defense capabilities. This is not only a response to the challenges of the present, but also an attempt to create a reserve for the future, preparing for

potential conflicts and unpredictable changes in the global security system.

## Basic Provisions

The document provides a detailed analysis of the status and trends of production of key weapons systems in Western countries. It examines changes that have occurred since 2022 and highlights the main areas of growth and modernization in the defense sectors of the United States, Israel, European countries, South Korea and Japan.

The conflict in Ukraine has led to increased production of artillery shells, anti-tank missiles and air defense systems in NATO countries and their partners. Leading Western countries are investing significant resources in developing new weapons systems that will enter service in the coming years.

The United States maintains its leadership in the production of armored vehicles and weapons, focusing on upgrading existing systems such as the M1A2 Abrams tank and Stryker armored personnel carrier. Major investments are being made to expand ammunition production capacity and develop new weapons systems. Key companies — General Dynamics, BAE Systems, and Oshkosh Defense — are fulfilling contracts for the supply of armored vehicles and missile systems, and are also investing in the creation of new tanks and robotic

systems.

European countries are actively increasing the production of armored vehicles and weapons, replacing obsolete models and replenishing losses caused by deliveries to Ukraine. Europe's production capabilities are limited by a shortage of materials, high energy prices and dependence on long-term contracts.

To address these issues, European companies are expanding capacity and investing in plant modernization, but their capabilities are still limited. Many countries are forced to turn to foreign manufacturers, especially from the United States, to fill the gap.

Israel relies on its own developments - Merkava tanks and Namer and Eitan armored personnel carriers, but remains dependent on external supplies of hulls, engines and ammunition from the United States.

South Korea has shown rapid growth in arms production, especially the K9 155mm self-propelled howitzer and K2 tank, and is actively increasing exports, including contracts with Poland and other countries.

South Korean products are attractive to potential recipients due to their high quality, relatively low cost and fast order fulfillment.

The Japanese defense industry is developing relatively slowly. Tanks and combat vehicles are produced in small volumes due to the peculiarities of the country's defense policy. There are no companies that deal exclusively with military products - their share in the turnover of the largest manufacturers is less than 20%. Japan still gives priority to the production of weapons and military equipment to protect its own borders, rather than the creation of an export-oriented defense-industrial system. Ÿ

# Tanks and armored combat vehicles

Russia's special military operation in Ukraine has confirmed the relevance of using armored vehicles on the battlefield. Today, most of the armed forces of the world operate models developed during the Cold War. In order to replace the outdated fleet, military departments are investing in the creation and purchase of new-generation vehicles with increased efficiency, protection, and digital control systems. The largest manufacturer of armored vehicles is the United States, which accounts for about 40% of the market. According to the US Congressional Budget Office, the total cost of acquiring ground combat vehicles by the US

Army until 2050 is projected to be \$5 billion per year, of which \$4.5 billion will go toward acquiring equipment and \$0.5 billion toward research and development. The projected cost of purchasing in

mainly concern restored and

modernized versions of existing machines<sup>1</sup>. According to estimates, the emergence of fundamentally new foreign platforms is expected in the early 2030s.<sup>2</sup>

Below is the dynamics of production of tanks and combat armored vehicles in the USA, Israel, European countries, South Korea and Japan.

## United States of America

The industrial base of the modern armored vehicle industry in the United States is characterized by a high degree of concentration and monopolization of production. The main manufacturers of armored vehicles for the national armed forces are two transnational military-industrial private corporations - General Dynamics and BAE Systems, as well as Oshkosh Defense. In addition, AM General, Textron Systems and

GM Defense, specializing in the production of armored vehicles. Since 2022, American Rheinmetall Vehicles, a subsidiary of the German corporation Rheinmetall, has been operating in the United States.

### General Dynamics Land Systems

General Dynamics Land Systems (GDLS) is a global leader in the design, manufacture, upgrade and maintenance of tracked and wheeled military vehicles. Its vehicles are used in the United States, Canada, Great Britain, the Middle East and North Africa. Final assembly of armored vehicles is carried out at two GDLS plants - in Lima (Ohio) and in Anniston (Alabama). Each plant has its own testing

ground. In Lima there is a tankodrome with a track 4.5 km long and 10 to 18 m wide, as well as a test site measuring 170 x 110 m, a race track with a track 3.7 km long and 3.5 m wide is equipped. In Anniston there is a tankodrome with a track with a total length of 2.1 km and a width of 15 m. The facilities are connected to railways: in Lima - on two sides, in Anniston - on one side, points for loading armored vehicles onto two freight trains are equipped, and two railway stations, on the tracks of which up to seven trains can be simultaneously (in Lima), and a railway station (up to ten trains, in Anniston). In May 2024, the Lima plant began modernization, and over the next 15 years, the enterprise will receive investments of about \$580 million. This facility became part of the overall plan for the reconstruction of the US defense-industrial complex, for the implementation of which more than \$17 billion was allocated.<sup>3</sup>

### ***M1A2 SEPv3 Abrams Main Battle Tanks***

Production of M1 Abrams series tanks at the Lima plant for the US military

ended in 2001, and for export - back in 1995. Today, new Abrams tanks are not being produced, but rather modernization of existing vehicles or those withdrawn from storage depots is being carried out. Their total number, according to analysts, is 6,000 units, including tanks in combat units of the US Army and Marine Corps, in foreign storage depots and Pentagon military bases<sup>4</sup>.

The hulls of previous versions of the vehicles are cut and welded anew. This is explained by the significant design changes made to the M1 - in particular, the turrets of early tank modifications that cannot be modernized are replaced with modern ones. As of February 2023, the enterprise produced 15-20 tanks per month (180-

240 per year). This figure can be increased to 33 units per month (up to 400 per year), and by adding another work shift, it is possible to produce even more<sup>5</sup>.

In December 2020, the company was awarded a \$4.62 billion incentive contract to upgrade M1A1 Abrams tanks to the M1A2 SEPv3 version for the U.S. Army. Funding for each order is determined separately. The estimated completion date for the overall contract is June 17, 2028.<sup>6</sup>

By 2026, the US Army will receive 812 M1A2 SEPv3 tanks, which means an average delivery of 135 tanks per year (11 tanks per month).

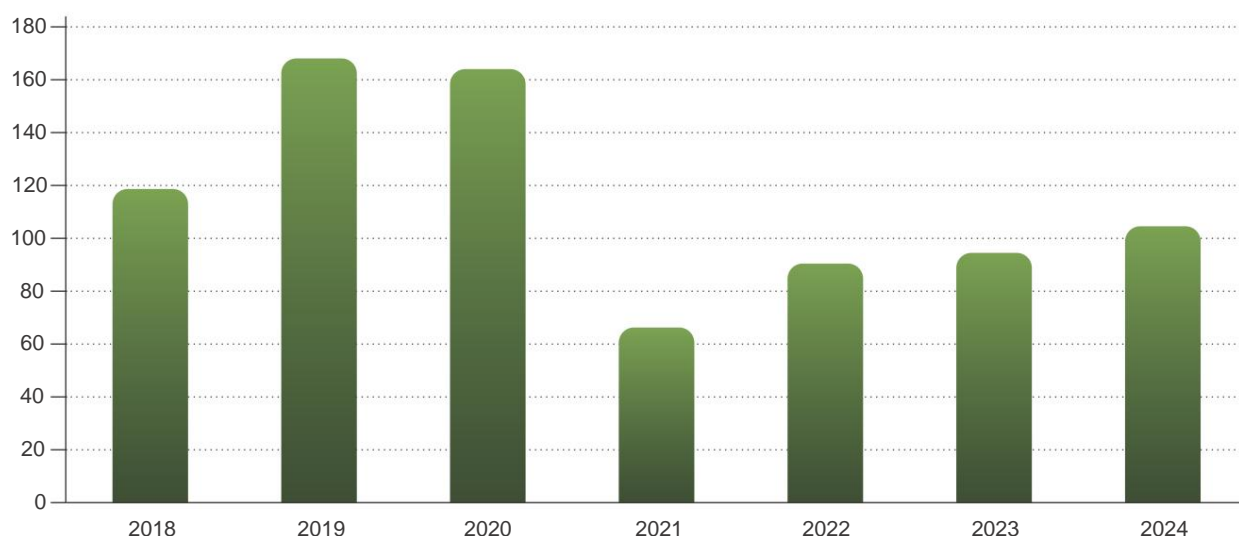
As a result, on average, in the period 2024–2025, the plant should produce 292 tanks (up to 25 tanks per month). In November 2023–March 2024, the US government approved the possible sale of 54 M1A2 SEPv3 tanks and related equipment to Romania for \$2.53 billion, and 50 tanks of the same type to Bahrain for \$2.2 billion.

In November 2023, the program to upgrade the Abrams tank to the M1A2 SEPv4 version was curtailed and a decision was made to develop a more radically updated vehicle.

In May 2024, the US Army awarded General Dynamics Land Systems a contract to design the next generation Abrams tank, designated the M1E3 Abrams. The M1E3 Abrams tank is expected to be ready in the early 2030s.

According to the American publication, the mass of the Defense News<sup>7</sup>, M1E3 will be reduced to 60 tons (M1A2 SEPv3 — 73 t). The tank will receive an integrated Trophy active protection system, a UAV countermeasure system, a hybrid power plant that consumes 50% less fuel, and a remotely controlled turret. The tank's digital basis will be the electronic architecture

Figure 1: Number of Abrams tanks ordered for upgrade to M1A2 SEPv3



Source: prepared by CAST

next generation KATALYST, which will integrate all systems into one. The crew of the machine will be reduced from four to three people and will receive a surveillance system with a 360-degree view and augmented reality technology, as well as the ability to interact with ground unmanned vehicles.

vehicles.

### **Heavy Armed Fighting Vehicles (HAV)**

#### **M10 Booker**

The M10 Booker is the first completely new combat vehicle of the US Army in 40 years. It weighs 38 tons, is armed with a 105-mm M35 gun, and has a turret and fighting compartment similar to the M1A2 SEPv3 Abrams tank. The crew is four people. In June 2022, the company signed a contract for the development and production of 96 M10 Booker BMTVs worth \$ 1.14 billion, and their serial production began in May 2024. In 2025, the Pentagon plans to purchase 33 vehicles for a total of \$ 460.6 million<sup>8</sup>, meaning one unit is valued at \$ 13.95 million. In total, the US Armed Forces plan to receive 504 M10 Booker BMTVs by 2035.

### **Armored fighting vehicles (AFV) type Stryker DVH A1**

GDLS has upgraded the Stryker AFV to the Stryker DVH A1, which features a double-V belly, hybrid engine, digital control system, and improved suspension. The company has been awarded a \$2.48 billion incentive contract for the work, which is scheduled to be completed by April 30, 2027.<sup>9</sup>

GDLS has received a \$712.3 million order for 300 Stryker DVH A1s, starting in 2024.<sup>10</sup>

In June 2024, the Pentagon awarded GDLS a \$65.9 million contract for the production of 28 vehicles for delivery to the Ukrainian Armed Forces, with work to be completed by December 31, 2026.<sup>11</sup>

### **Self-propelled anti-aircraft missile and gun systems Stryker M-Shorad**

In February 2018, at the request of the US Armed Forces, emergency development of the Stryker M-SHORAD self-propelled combat complex began.

Air defense for combating small UAVs, helicopters, aircraft and cruise missiles.

The vehicle is a remotely controlled anti-aircraft combat module mounted on a Stryker DVH A1 APC chassis with a 30-mm XM914 automatic cannon, a coaxial 7.62-mm M240 machine gun, an M299 launcher for two AGM-114L Longbow Hellfire missiles and a four-shot Stinger SAM launcher, as well as an electro-optical target detection and tracking unit.

GDLS has been awarded a \$1.2 billion fixed-price incentive contract by the U.S. Army to produce 144 vehicles through September 30, 2025.<sup>12</sup>

### **Engineering machines**

In addition to tanks, contracts with foreign countries also include engineering vehicles: M1074 tank bridgelayers - 17 units each for Poland and Australia, M1150 ABV mine clearing vehicles - 29 for Australia and four for Romania.

The Pentagon plans to purchase the M1150 ABV. In February 2024, it awarded a contract to Pearson Engineering, a UK-based company, to supply mine sweepers and other equipment for the M1150 for \$11.2 million. Production of the M1150 ABV is scheduled to begin at the Anniston facility and be completed by June 30, 2025.<sup>13</sup> In addition, the Polish MoD is in talks to purchase 25 M1150 ABVs.

### **Military robotic platforms MUTT**

The MUTT (Multi-Utility Tactical Transport) is a multi-role, semi-autonomous robotic platform used for fire support, resupply and casualty evacuation, counter-UAV, reconnaissance and surveillance, radiation, chemical and biological defense, and electronic warfare. GDLS will manufacture 624 MUTTs for the US Army for \$162.4 million by October 2024. Deliveries began in 2021.<sup>14</sup>

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## Tanks and armored combat vehicles

### **Participation in competitions**

General Dynamics Land Systems is participating in several competitions to create new types of equipment:

- XM30 type AFV to replace the M2 Bradley IFV under the OMFV (Optionally Manned Fighting Vehicle) program, jointly with American Rheinmetall Vehicles;
- the ARV-30 wheeled combat reconnaissance vehicle to replace the Marine Corps' light armored vehicles of the LAV type, in conjunction with Textron Systems;
- a combat unmanned tracked robotic platform under the RCV (Robotic Combat Vehicle) program, jointly with Textron Systems, Oshkosh Defense and McQ.

In June 2023, the US Army Command signed a \$768.7 million contract with GDLS for the third and fourth stages (detailed design, assembly of XM30 prototypes and their testing). By the end of 2027, each company is tasked with producing up to 11 variants of the vehicle. The winning company will receive a contract worth over \$45 billion, and the first serial XM30s are expected to enter service with the US Army in late 2029. The new AFV will have an open architecture with the ability to integrate various systems<sup>15</sup>. In January-November 2023, the ARV-30 prototype, presented by GDLS to the US Marine Corps Command, was successfully tested. A successor to LAV is expected to be identified within two years, with the contract value ranging from \$1.8 billion to \$6.8 billion over a five-year period.<sup>16</sup>

In 2024, as part of the first stage of the RCV program (the total amount of reward for participants in the competition is \$24.7 million), the company must present two prototypes of the TRX (Tracked Robot 10-ton) unmanned platform. By the end of the second stage in 2025, the winner will be determined, in 2026 it is planned to release up to nine full-fledged prototypes, and in 2027 it is planned to move on to serial production<sup>17</sup>.

### **BAE Systems**

One of the world's largest manufacturers of weapons and military equipment, the British transnational corporation BAE Systems is a multi-industry industrial association with a subsidiary in the United States.

The corporation's Platforms & Services division specializes in the production of tracked and wheeled armored combat vehicles, artillery and missile systems, ammunition and supplies, maintenance and modernization of naval equipment for American and international customers.

Armored vehicles are manufactured in the United States by three companies: York, Pennsylvania; Anniston, Alabama; and Elgin, Oklahoma. The largest is the York plant, on the

The territory of which includes a test site with a circuit with a total length of 1.4 km and a width of 8 m, a test site measuring 160 x 60 m, reconstructed in 2022–2024. A railway line with a loading point for equipment on two freight trains is connected to the enterprise.

In 2023, the company restructured its York facility to make room for new vehicles: the AMPV and ACV amphibious vehicles. The upgrades cost \$250 million in internal investment and \$27 million in funding from the US military.<sup>18</sup> As a result, the York facility is expected to produce 190 AMPV vehicles (16 per month) and 240 ACV vehicles (20 per month) per year.<sup>19</sup>

Beginning in the third quarter of 2023, primary and final assembly of the M109A7 155mm self-propelled howitzer will be transferred to the Anniston and Elgin plants. Anniston will assemble the M88A2 armored recovery vehicle, upgrade the M2 Bradley infantry fighting vehicle to the M2A4 Bradley IFV, and upgrade the M7A4 Bradley fire support vehicle. Hull production will be outsourced to a third-party manufacturer (not determined).



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## Tanks and armored combat vehicles

According to experts from the analytical company GlobalData, BAE Systems will capture 26% of the land military equipment market in North America with a projected revenue of \$16.6 billion in 2023-2033.<sup>21</sup>

### ***AMPV type armoured fighting vehicles***

The tracked AMPV (Armored Multi-Purpose Vehicle) AFVs are based on the upgraded M2 Bradley IFV chassis to replace 2,897 M113 vehicles. The AMPVs include five types: the XM1283 armored personnel carrier, the XM1286 command post vehicle, the XM1285 medical ambulance, the XM1284 medical evacuation vehicle, and the XM1287 120mm self-propelled mortar.

In December 2014, BAE Systems was awarded a \$1.2 billion incentive contract to develop and build the AMPV22, which runs through February 28, 2027. The company began full-rate production in August 2023. The Pentagon planned to acquire 197 AMPVs in 2024: 91 vehicles for \$555 million under the budget and an additional

106 units using additional funding approved by Congress to cover part of the cost of sending about 400 M113 vehicles to Ukraine<sup>23</sup>. Under the overall 2014 contract, the company received an order in March 2024 (the final one in the agreement) for production in 2026–

2027 AMPV type armored combat vehicle for \$754 million.<sup>24</sup>

### ***ACV type armoured fighting vehicles***

The US Marine Corps selected BAE Systems as the contractor to replace the AAV with the 8x8 amphibious ACV (Amphibious Combat Vehicle) in August 2022, awarding it \$88 million in funding for the ACV family of vehicles.

By the end of 2024, 287 ACV-P linear armored personnel carriers and 14 ACV-C command and staff vehicles should be produced.

In April 2024, the company signed a \$79 million contract to create the ACV-R ARV based on the ACV. Samples

vehicles for testing are planned to be transferred in 2025. Since the

beginning of 2023, BAE Systems has received orders for the production of 106 ACV-P and 17 ACV-C from the end of 2024 to July 2026 for a total of \$675.3 million. In total, 4,350 ACV-type armored fighting vehicles are planned to be purchased by 2040 at a program cost of \$22.3 billion.<sup>25</sup>

### ***M2A4 Bradley Infantry Fighting Vehicles and M7A4 Bradley Forward Control Vehicles***

BAE Systems will upgrade the M2A2 and M2A3 Bradley IFVs to the M2A4 version starting in 2021 and will produce the M7A4 Bradley forward air guidance and artillery fire adjustment vehicles based on the latest modification. The new M2A4 Bradley vehicle has enhanced protection, a new power plant, an improved chassis and modern communications equipment. In 2023, the company signed contracts worth \$594.5 million for the period through March 2026. In total, the US Army plans to receive

more than 700 upgraded M2A4 Bradley IFVs by 2029.<sup>26</sup>

### ***155mm M109A7 self-propelled howitzers and transport vehicles field artillery ammunition M992A3***

The 155mm/39 M109A7 self-propelled howitzers and the M992A3 armored ammunition transport vehicles created on its basis have been in serial production since 2019. In the period 2022–2023, the company has concluded six

contracts for the production of vehicles until December 2028 for \$1.4 billion. In total, by the end of 2024,

BAE Systems must produce 310 kits, each of which includes one M109A7 self-propelled gun and M992A3<sup>27</sup> vehicle, that is, 60 kits per year (five per month).

### ***Armored recovery vehicles (ARV) M88A2 Hercules***

Contracts for foreign countries, along with tanks, include M88A2 BREMs: for Poland - 26 units, for Romania - 4 units,

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## Tanks and armored combat vehicles

for Australia - 6 units. In addition, the Pentagon will purchase 14 vehicles in November 2023 for \$36.4 million. Deliveries must be completed by August 31, 2025.<sup>28</sup> A modernized M88A3 BREM has been developed for the US Army, which is currently in the testing phase.

### Oshkosh Defense

Oshkosh Defense, a division of Oshkosh Corporation, is a global leader in the design, manufacture and support of armored vehicles and trucks. Its four plants with 1,500 employees are located in Oshkosh, Wisconsin. The South Plant has a test infrastructure: a race track with a dirt track 1.5 km long and 3.5 m wide, and a test site measuring 120 x 90 m.

#### ***XM1304 Stryker infantry fighting vehicles***

The XM1304 Stryker (ICVV A1) vehicle is based on the Stryker DVH A1 AFV and is equipped with a Samson remote-controlled weapon station from the Israeli company Rafael with a 30-mm Northrop Grumman XM813 automatic cannon. In June 2021, the company signed a contract to produce IFVs for six Stryker brigade combat teams. The estimated cost is \$942.9 million over six years. In July 2022, under the overall contract, Oshkosh Defense received orders for three combat teams of 269 XM1304s for \$356 million.<sup>29</sup> The first vehicle entered service in April 2024.

#### ***Armored vehicles (BA) L-ATV***

The L-ATV armored vehicle was developed under the JLTV (Joint Light Tactical Vehicle) program to partially replace HMMWV vehicles. By June 2023, 20,000 BA30 were produced, or 5,000 vehicles per year (up to 420 units per month). In 2022, L-ATV sales revenues amounted to about \$ 1 billion - this is approximately 12% of the annual volume of Oshkosh Corporation (\$ 8.3 billion) and half of Oshkosh Defense<sup>31</sup>. During 2023,

The company received six contracts for the delivery of JLTV-type UAVs by the end of 2025 for a total of \$553.1 million: \$364.1 million for the US Armed Forces (Army, Air Force, Navy, and Marine); \$160 million for Mongolia, Romania, North Macedonia, Slovenia, and Slovakia; \$29 million for Israel.

#### ***ROGUE-Fires Unmanned Anti-Ship Missile Launchers***

The ROGUE-Fires launcher is based on the L-ATV and carries a remote control system and two Kongsberg Naval Strike Missile (NSM) launch containers. In October 2023 and April 2024, Oshkosh Defense received contracts worth \$79.5 million to supply the US Navy and Marine Corps with ROGUE-Fires through the end of 2026.

#### ***Heavy equipment transport vehicles M1300 HET A1 with M1302 MET semitrailers***

Oshkosh Defense is upgrading heavy equipment haulage systems, upgrading M1070A1 tractors to M1300 HET A1 versions and M1000 semitrailers to M1302 MET versions for the U.S. military. The goal of the program is to increase the weight of the transported vehicles from 60 to 90 tons.

In September 2022 and November 2023, two contracts were signed for the production of 466 (until 2027) and 557 (2026–2031) M1302 semi-trailers for a total of \$605.2 million. In December 2023, a five-year contract was signed for the production of 1,384 M1300 tractors for \$89 million, i.e. 280 vehicles per year (24 units per month).

#### ***Military trucks FMTV A2 with trailers***

In February 2018, the company was awarded a seven-year fixed-price contract for the production of FMTV A2 military trucks with trailers. In 2023-2024,

Oshkosh Defense has been awarded three contracts worth \$450.9 million. Total through August 2023

The company's order package includes almost

2,000 vehicles and 982 trailers worth \$858 million.<sup>32</sup>

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## Tanks and armored combat vehicles

### AM General

AM General is a designer and primary manufacturer of military and civilian HMMWV vehicles. Its Mishawaka, Indiana, facility includes a 1.6-km-long, 8-m-wide track. The company is located

lies in a separate testing ground

with a race track with a total length of 3 km and a width of 3.5 to 7 m, and a test site measuring 300x140 m.

### **JLTV A2 Armored Vehicles**

In February 2023, AM General signed a five-year contract for the production of 20,682 JLTV A2 armored vehicles developed by Oshkosh Defense and 9,883 trailers for the US Army worth \$8.6 billion with an option to extend for another five years, that is, at least 4,200 vehicles and 2,000 trailers per year (350 and 167 units per month).

During the reconstruction of the production facility, carried out from June 2023 to April 2024, its area doubled - from 6,700 to 13,600 sq. m, for which \$70 million was allocated; another \$59.5 million was provided for the purchase and installation of industrial equipment. Production is planned to be launched in early 2025.<sup>33</sup>

### Textron Systems

Textron Systems, a Textron Corporation company, designs and manufactures aerospace and defense products. Its Marine and Land Systems division manufactures armored vehicles at its facility in Slidell, Louisiana.

### **MSFV armored vehicles**

Developed in 2011 for the Afghan National Army, the MSFV is a stretched version of the M1117, part of the Textron Commando Select family of vehicles. In October 2017, the company was awarded a \$332.9 million contract to produce up to 255 MSFVs, with deliveries scheduled through October 2024.<sup>34</sup>

### GM Defense

GM Defense, a part of the transnational automobile company General Motors, specializes in the production of military products. In 2021, GM Defense opened a plant for the production of ISV light armored vehicles in Concord, North Carolina. According to the company's management, it took only 90 days to deploy production.<sup>35</sup>

### **ISV armored vehicles**

In June 2019, GM Defense announced

received a \$1 million contract to develop and create two prototypes

BA ISV In June 2020, the US Armed Forces concluded

Chile signed a contract with the company for the production of 649 vehicles for \$214.3 million. In March 2023, serial production of the ISV began with the goal of producing 2,593 units.<sup>36</sup>

### American Rheinmetall Vehicles

In order to promote its products on the American market, as well as to participate in competitions for the production of modern vehicles for the US armed forces, in August 2022, the German corporation Rheinmetall created a branch of American Rheinmetall Vehicles with headquarters in Detroit. American Rheinmetall Vehicles is developing an XM30 type armored fighting vehicle based on the Rheinmetall IFV as part of the OMFV program.

Lynx KF41. Textron Systems has been selected to manufacture the hulls, assemble the chassis, and produce and test prototypes. The company has teamed up with GM Defense

to participate in the competition to create modern heavy military trucks for the US Armed Forces under the CTT (Common Tactical Truck) program. In February 2023, the team delivered three prototypes of the HX3 truck. Three other companies are participating in the competition: Oshkosh Defense, Mack Defense and Navistar Defense. The winner will produce up to 40 thousand vehicles worth \$ 14 billion. <sup>37</sup>

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## Tanks and armored combat vehicles

### Israel

The main manufacturer of armored vehicles in Israel is a state enterprise, which is part of the repair and restoration center (Masha-7000) and is located at the military base in Tel Hashomer. In addition, armored vehicles are manufactured by the private company Plasan.

According to experts from the analytical company GlobalData, the APC segment accounts for more than 70% of Israel's military equipment purchases, and this growth will continue. The country's spending on the military land vehicle market is projected to increase from \$230 million in 2023 to \$434 million in 2033.<sup>38</sup>

#### **Repair and restoration center**

The center is subordinate to the Department of Technology and Logistics of the Israeli Defense Ministry. The plant produces Merkava-type main battle tanks from domestically produced components and assembles Namer 1500 and Eitan armored personnel carriers using hulls manufactured in the United States. The enterprise has a race track with a 900 m long and 5 m wide track.

#### **Merkava Mk 4 Barak tanks**

Serial production of the latest version of the Merkava tank began in August 2023. The Merkava Mk 4 Barak features a high-tech Iron Vision helmet from Elbit Systems, which receives information from a network of 360-degree sensors. It also features modern systems: Rafael's Trophy active protection system and an AI fire control system. The estimated production rate of the Merkava Mk 4 is 30 units per year (five units every two months)<sup>39</sup>.

#### **Namer 1500 Heavy Armored Personnel Carriers**

The Namer 1500 heavy tracked armored personnel carrier is a modernized version of the Namer heavy armored personnel carrier, which has been in service since 2008 and is based on the Merkava Mk 4 tank. The key feature of the new version

The vehicles have a 1,500 hp engine. Over the past few years, the Israeli Defense Ministry has significantly reduced its purchases of Namer APCs, both due to defense budget cuts and a misconception about the ability of aviation and reconnaissance to replace ground forces in a modern conflict.

Initially, it was planned to purchase 800 Namer APCs, but the MoD received approval to purchase only 300 units. In September 2022, a decision was made to additionally purchase more than 200 vehicles, bringing their total number to 531 units. Given the rate of APC production (up to 30 vehicles per year), this figure will not be reached before 2027.<sup>40</sup>

#### **Eitan armored personnel carriers**

Serial production of the wheeled (8x8) Eitan APCs began in 2022, and the first vehicles were delivered to the Israeli Army in May 2023. They will replace the tracked American M113 APCs. In January 2023, the Israeli Defense Forces signed a \$100 million contract with the American company Oshkosh Defense for the production of Eitan hulls, which will begin to arrive in Israel within 18 months<sup>41</sup>.

#### Plasan

Plasan's main product is armor kits for armored vehicles, supplied to Israeli, American and Australian companies. In addition, over 20 years, the company has sold more than 1,000 armored vehicles of its own SandCat family to 18 countries.

#### **SandCat Tigris armored vehicles**

The SandCat armored vehicle is a modified Ford F-550 reinforced with lightweight composite materials. In November 2022, the company received a contract from the Israel Defense Forces to produce 50 SandCat Tigris ABs for NIS 50 million (\$13.5 million)<sup>42</sup> with the first batch of vehicles to be delivered in January 2023. In connection with Israel's Operation Iron Swords in the Gaza Strip,

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Plasan has significantly increased the rate of production of BA, switching to a three-shift work schedule.

Israel Aerospace Industries

In May 2020, Israel Aerospace Industries (IAI) acquired the rights to produce the Z family of all-terrain multirole vehicles (ZMAG and ZD) from Ido Cohen and adapted them for use by national armed forces.

In April 2021, the Israeli Defense Ministry signed an agreement with IAI to develop and supply nine prototypes of the ZMAG light UAV for special operations forces. In June 2022, a contract was signed for the production of ZMAG and ZD UAVs for NIS 100 million (\$27 million).<sup>43</sup> IAI has decided to build a plant in the south of the country, in which the company will invest more than NIS 100 million (\$27 million), and which is scheduled to open in 2027.<sup>44</sup>

(BBM) and replenishment of equipment transferred by them to Ukraine. However, the capabilities of the defense-industrial complex of Europe are limited, so the governments of its states are forced to turn to foreign manufacturers, primarily to American ones. The final stage of production is considered to be the final assembly of armored vehicles. In total, 67 enterprises are located

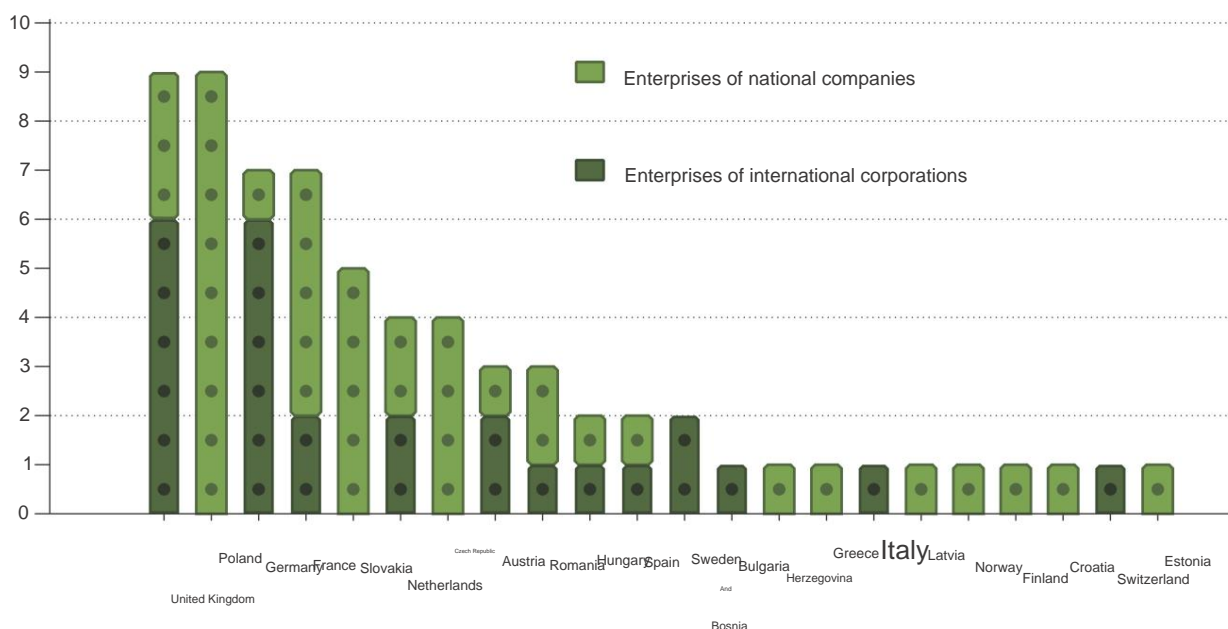
in Europe that perform or plan to perform this technological operation under concluded contracts. The largest number of enterprises (nine each, 13% of the total number) are located in the UK and Poland. About half (32 enterprises, 48%) of all industrial facilities are located in four countries - the UK, Poland, Germany and France. Enterprises

of international corporations (26.39%) are located in 12 countries, three of which are located in Eastern Europe. It should be noted that the plant in Romania opened in April 2021, in Hungary in August 2023, and in Bulgaria the construction of the plant is currently underway.

Europe

Today, most European countries producing armored vehicles are solving two main problems: replacing the aging fleet of armored combat vehicles

Figure 2. Number of final assembly plants for armored vehicles in Europe



Source: prepared by CAST

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## Tanks and armored combat vehicles

In countries bordering Ukraine, there are 19 (28%) facilities producing all types of armored vehicles except military robotic platforms.

A significant portion of enterprises (50, 75%) produce wheeled armored vehicles, nine (13%) produce tracked vehicles, and eight (12%) produce both types of vehicles.

The main products are modular armored fighting vehicles (ABM) and armored vehicles (AV). The modular architecture allows for the creation of several models of equipment for various purposes on a common base, differing only in their target equipment and payload. Recently, special attention has been paid to the production of military robotic platforms.

### Main tanks

In Europe, main battle tanks are assembled at only one facility, while five more are used to modernize them. In addition, Poland is planning to produce a local version of the South Korean K2PL tank.

The German company Krauss-Maffei Wegmann (KMW), now KNDS Deutschland as part of the recently created Franco-German corporation KNDS, is the only active manufacturer of main battle tanks in the region. The plant in Munich, Germany, assembles 50 Leopard 245 tanks per year. Under contracts concluded by 2029, KMW plans to manufacture 44 Leopard 2A7+ tanks for the Hungarian ground forces, 18 and 54 Leopard 2A8 for

the German and Norwegian ground forces, respectively. Negotiations are underway to purchase 316 Leopard 2A8: with the Czech Republic (77 units), Italy (133), Lithuania (54) and the Netherlands (52).

According to the company's CEO, Ralf Koetzel, KMW is capable of increasing Leopard 2 production to 600 units per year using its existing infrastructure, and also launching another production line within one to two years. However, this requires federal government approval and a large number of orders, which the company does not have.

In the interests of national armies, tank modernization is carried out at five enterprises:

- in the city of Kassel (Germany, KMW, now KNDS Deutschland) — type Leopard 2 (up to version Leopard 2A8 and others);
- in Rouen (France, Nexter Systems, now KNDS France) — type Leclerc (before version XLR);
- in Telford (UK, Rheinmetall BAE Systems Land) — Challenger 2 type (up to Challenger 3 version);
- in Bolzano (Italy, Iveco Defense Vehicles) — type Ariete C1 (up to version Ariete C2);
- in Gliwice (Poland, Zakłady Mechaniczne „Bumar-Łabędy”) — type Leopard 2 (up to version PL/M1).

On average, enterprises modernize about 60 tanks per year.

From 2026, Wojskowe Zakłady Motoryzacyjne in Poznań, Poland, plans to begin manufacturing K2PL tanks under a South Korean license with the capacity to produce up to 60 units per year<sup>46</sup>. For this purpose, a 17.6 thousand square meter production building is being reconstructed in the southeastern part of the facility. Investments for the work have been allocated from the company's funds. In total, it is planned to manufacture 500 K2PL tanks and at least several dozen armored vehicles based on them, as well as upgrade 180 K2GF tanks received from South Korea to the K2PL version<sup>47</sup>.

### Tracked combat armored vehicles cars

#### ASCOD

The ASCOD (Austrian Spanish Co-operation Development) family includes the following types of AFVs:

- Pizarro — produced by the company General Dynamics European Land Systems — Santa Bárbara Sistemas at its plant in Trubia (Spain);
- Ulan — were produced by General Dynamics European Land Systems - Steyr at the plant in Vienna (Austria), where their modernization is also carried out;

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## Tanks and armored combat vehicles

— Ajax — selected by the UK Ministry of Defence to replace the CVR(T) type AFVs, to be manufactured at General Dynamics UK's Merthyr Tydfil facility in Wales.

Currently, the Trubia plant produces equipment developed on the basis of the Pizarro-type AFV - Castor armored mine-clearing vehicles (for the Spanish Army) and LT-105 light tanks (for the Philippine Army). In 2024, the facility plans to begin producing VAC-type tracked AFVs and Dragon-type wheeled AFVs (based on the Piranha V APC design). \$12.2 million has been allocated for these programs, of which \$8.5 million is for the purchase of modern equipment. An additional 386 employees are planned<sup>48</sup>. The British branch of General Dynamics has encountered serious problems with the development of the Ajax-type AFV. Due to strong vibration at speeds above 32 km/h, high noise levels in the vehicle, and the inability to reverse over obstacles higher than 20 cm, field tests of the armored fighting vehicle were

stopped in November 2020. In March 2023, it was announced that the armored vehicle's readiness for production had been postponed to September 2029.

### **Borsuk**

The main manufacturer of armored vehicles in Poland is the company Huta Stalowa Wola (HSW, a plant in the city of Stalowa Wola).

In order to expand production, HSW purchased a 37-hectare plot of land near the plant in 2022 for future buildings worth 41 million zlotys (\$10 million). Construction work has not yet begun.

On October 1, 2023, HSW management repurchased the infrastructure, which was sold in 2012 to the Chinese company LiuGong Dressta Machinery and is located 500 m northwest of its enterprise (two production workshops with a total area of 43.7 thousand square meters and a warehouse building with an area of 3,500 square meters). HSW also includes

included 550 employees who previously worked at LiuGong Dressta Machinery. On June 8, 2023,

Polish Prime Minister Mateusz Morawiecki signed a decision to allocate 600 million zlotys (\$147.3 million) in investments to HSW. The company will additionally contribute 64.7 million zlotys (\$15.9 million) from its own funds<sup>49</sup>. A significant portion of this money will go toward organizing the production of Borsuk-type IFVs with a planned volume of 108 units per year. Deliveries of the first vehicles are scheduled for 2024. The price of a Borsuk IFV prototype equipped with a ZSSW-30 remotely controlled combat module was set at 36 million zlotys (\$8.8 million) in 2020<sup>50</sup>.

### **CV90**

BAE Systems Hägglunds specialises in the production of the CV90 tracked armoured fighting vehicle and the BvS10 tracked all-terrain articulated armoured personnel carrier. Its plant in Örnsköldsvik is located in central Sweden. Demand for its products is constantly growing. The current order book includes around 400 CV90, 700 BvS10 and 100 Beowulf (the unarmoured version of the BvS10).

Since 2021, the company has increased its headcount from 750 to 1,700 people, almost half of whom are engaged in research and development. By 2025, their number is planned to increase to 1,900 people.

BAE Systems Hägglunds Management constantly invests in the development of production. The allocated funds are primarily used to purchase modern equipment. Two industrial welding robots, three machines were purchased: two milling machines and one for laser cutting. In the near future, it is planned to purchase another similar robot and a third milling machine. In the period from 2021, two warehouse buildings with a total area of 1,600 sq. m and one administrative building were built on the territory of the enterprise.

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## Tanks and armored combat vehicles

The plant's current capacity is estimated at 50 CV90s and 200 BvS10s per year. From 2025, it is planned to switch the plant's operation from a single-shift to a three-shift mode, and as a result, produce 200 CV90s and 400 BvS10s annually - up to three armored vehicles daily<sup>51</sup>.

BAE Systems Hägglunds has transferred technology for the production of the AFV type CV90 to three countries:

- Norway — Ritek (plant in Levanger);
- Czech Republic — VOP CZ (Šenov u Novy Jiřín);
- Slovakia — ZTS-Špeciál (Dubnica nad Váhom).

To manufacture the CV90, a 2,300 m<sup>2</sup> production building was built at the Levanger plant between June 2021 and May 2022. The cost of the facility was NOK 55 million (USD 6.6 million)<sup>52</sup>.

Following the signing of a contract for the purchase of 246 CV90s worth CZK 59.7 billion (\$2.7 billion) in May 2023, a team of technical specialists from VOP CZ traveled to Sweden to master the assembly process. The document provides for the participation of up to 30 companies from the local industry, which should receive at least 40% of the contract amount - CZK 23.9 billion (\$1.1 billion). The delivery of the first armored vehicles to the Czech Army is planned for 2026.<sup>53</sup>

The management of ZTS-Špeciál has allocated 5.9 million euros for the organisation of CV90 production at the plant in Dubnice nad Váhom from 2025. Of this amount, 1.6 million will go towards the reconstruction of the production hall and the purchase of modern equipment, 4 million towards equipping the roof of this building with solar panels, 110 thousand towards the installation of a new heat pump in the hall, and 175 thousand towards replacing the lighting in the company's premises. It is planned to create 50 additional jobs<sup>54</sup>.

### **Lynx**

The Lynx armored fighting vehicle was developed by Rheinmetall Landsysteme

and is manufactured at a plant in Unterluss (Germany). In order to promote its

products in Eastern Europe, Rheinmetall Corporation created the company Rheinmetall Hungary. Since 2021, the plant has been under construction in the western part of Hungary, the opening of which took place on August 18, 2023. On its territory there is a production building with an area of 25.2 thousand square meters, and to the north of the facility, on a site of 33 hectares, a test site has been equipped with a total length of tracks of more than 3 km. Currently, about 100 people work at the plant, and in the future it is planned to increase their number to 450 employees. It is

planned to produce up to 50 Lynx armored fighting vehicles per year. The delivery of the first of 172 armored vehicles of its own production to the Hungarian Ground Forces is scheduled for 2024.<sup>55</sup>

When deciding to build the plant, the Hungarian government counted on the export potential of the Lynx AFV, but the vehicle was not selected in competitions in the Czech Republic and Slovakia (preference was given to the CV90 AFV). According to Western experts, the Lynx AFV has weak prospects on the European market.

The Hungarian authorities can only hope for possible export production by this enterprise of the promising KF51 Panther tank, presented in 2022 by the Rheinmetall corporation at the international exhibition Eurosatory. In this case, as they expect, the plant will produce up to 400 tanks annually<sup>56</sup>.

### **Puma**

The developers of the Puma infantry fighting vehicle, the German companies Krauss-Maffei Wegmann and Rheinmetall Landsysteme, also have significant problems. This is the most expensive IFV in the world (more than 17 million euros), due to its large weight, it can only be transported on the A400M military transport aircraft and only in the basic armor version, and also has technical shortcomings. During exercises in December 2022, all 18 Puma armored vehicles involved broke down.



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## Tanks and armored combat vehicles

### Wheeled combat armored cars

#### **Boxer**

Assembly lines for Boxer-type armored vehicles are deployed in four countries: Germany (two), Great Britain (two), the Netherlands (one), and Australia (one), with a total production capacity of up to 250 armored vehicles per year.<sup>57</sup> Three corporations are involved in their production: KNDS, Rheinmetall, and BAE Systems. The KNDS companies involved are Krauss-Maffei Wegmann (based in Munich, Germany) and WFEL (Stockport, Great Britain), Rheinmetall — Rheinmetall Landsysteme (Kassel, Germany), and Rheinmetall Defense Nederland (Ede, Netherlands). In addition, the infrastructure of the joint company Rheinmetall BAE Systems Land (Telford, Great Britain) is involved in production.

The final two of the five assembly lines were set up in the UK to deliver the UK Boxer programme, which will see 623 vehicles delivered to the Army. WFEL has invested “millions of pounds” in the new facility. Since

May 2019, a 5,700 sq m production building and a 1,200 sq m warehouse have been built at the Stockport site, and an additional 120 staff have been recruited. The vehicle production process began in May 2021, with the first vehicle delivered to the customer in late September 2022.<sup>58</sup>

Rheinmetall BAE Systems Land has allocated £40 million (\$49.8 million) to establish production of Boxer-type AFVs at its Telford facility. By March 2023, modern equipment had been purchased and the facility had been reconstructed.

the plant’s testing ground, doubling  
The number of workers has been increased. It is planned to manufacture up to 50 BBM59 per year.

#### **Griffon, Jaguar, Serval**

At the plant in Rouen of the French company Nexter Systems, now KNDS France, part of the KNDS corporation, armored vehicles are assembled under the Scorpion program: wheeled

Griffon AFVs, Jaguar combat reconnaissance vehicles and Serval armoured vehicles. The French ground forces are to receive 1,872 Griffons, 300 Jaguars and 2,038 Serval by 2035. Since 2018, the company has invested €62 million in production and increased its workforce from 830 to 1,485 people. It is planned to increase the plant’s production capacity from 300 (in 2023) to 450 (in 2025) vehicles per year<sup>60</sup>.

#### **Pandora**

The Austrian company General Dynamics European Land Systems — Steyr has developed and manufactures the Pandur EVO AFV at its Vienna plant for both the national Armed Forces (designated Pandur A4) and for export (for US special operations forces). In 2015, General Dynamics sold full rights to manufacture the Pandur II AFV to Excalibur Army (Czech Republic), which now manufactures them at its plant in Kopřivnice to Tatra Defence Vehicle (TDV). Both companies are part of the Czechoslovak Group, whose management announced in July 2023 that it would allocate over CZK 300 million (\$13.8 million) to TDV for the construction of a new production building. The work is scheduled to be completed in 2025, creating up to 60 new jobs<sup>61</sup>.

#### **Patria**

In addition to Finland, where Patria Land, the main developer and manufacturer of Patria-type armored vehicles, is located, the production of armored vehicles is organized:

- in Poland — by the Rosomak company (plant in Siemianowice żyłyskie);
- in Latvia — Defence Partnership Latvia (Cesis);
- in Croatia — Duro Dakovic Special Vehicles (Slavonski Brod);
- in Slovakia — CSM Industry (Tisovec).

According to Patria Group CEO Esa Rautalinko, the annual production volume of these armored vehicles at the Hämeenlinna plant is 40 units<sup>62</sup>.

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## Tanks and armored combat vehicles

In Poland, the Patria AMV type AFVs have been produced since 2002 under the name Rosomak, and in September 2022, Patria Group extended the license agreement for their production until 31 December 2028. More than 120 local companies are involved in the supply of components. By switching the plant to a two-shift operation, it is planned to increase the productivity of the plant in Siemianowice żyłskie from 100 to 200 AFVs per year<sup>63</sup>.

Rosomak is actively involved in the supply of equipment to Ukraine, whose representatives signed a contract in April 2023 for the production of 200 Rosomak-type armored fighting vehicles using funds from the US and EU. In addition, by the end of 2023, the Polish military department planned to sign a contract for the purchase of up to 400 Rosomak armored personnel carriers with an extended hull (Rosomak-L).

In February 2020, Patria Land and Unitruck (Latvia) established a joint venture, Defence Partnership Latvia. According to the agreement signed between the governments of Latvia and Finland on 30 August 2021, the Latvian armed forces are to receive 200 new Patria 6x6 armored fighting vehicles by 2029. In March 2023, the assembly of armored vehicles began at the plant in Cesis, based on finished hulls and components received from Finland.

One armored fighting vehicle takes about 200 hours or eight days. About ten workers are involved in the process. A separate building is planned to be built to organize full-cycle production, which, according to preliminary estimates, will require about 3 million euros<sup>64</sup>.

In order to implement the contract concluded in August 2022 between Patria Land and the Slovak Ministry of Defense for the delivery of 76 Vydra-type armored fighting vehicles (Patria AMV XP) by 2028, the production hall at the enterprise in Tisovec was reconstructed and modern equipment was purchased, for which Patria Group allocated 2 million euros. CSM Industry also plans to increase the number of workers from 90 to 130 people to produce two armored fighting vehicles per month<sup>65</sup>.

## ***Piranha V***

The Piranha V AFV is developed by General Dynamics European Land Systems — Mowag. In April 2019, the company transferred part of its production, including the assembly of these armored vehicles, to a facility in Tägerwilen, Switzerland, allocating approximately CHF 50 million (\$50.5 million) for the construction of a 6,500 square meter production building. According to a contract signed in 2020 between the Spanish Ministry of Defense and General Dynamics European Land Systems — Santa Bárbara Sistemas, production of the

Dragon AFV (based on the Piranha V design) is planned to begin at the Trubia facility in 2024. A total of 348 armored vehicles in various configurations are planned to be delivered by 2027, with an option to increase their number to 1,000 units.

On 15 March 2022, General Dynamics European Land Systems - Mowag signed a joint venture agreement with the Romanian company Uzina Mecanică București. The production capacity of the plant, located in the eastern part of Bucharest, is estimated at 100 Piranha V AFVs per year, but 133 AFVs for the national ground forces are planned to be manufactured in three years, which corresponds to approximately 45 units per year<sup>66</sup>.

In 2022, the Piranha V type AFVs participated in competitive selections in Bulgaria and Slovakia (the production of armored vehicles for these countries was planned in Romania). The Bulgarian Ministry of Defense chose the Stryker type AFV from General Dynamics Land Systems - Canada, and the Slovak Ministry chose the Patria AMV (Patria Land).

## Armored cars

About half of the enterprises (28.42% of the total number) are involved in the production of armored vehicles, of which the majority (17) belong to national

to companies.

## ***Bastion, Fortress Mk2, Patsas, Saber, Sherpa Light***

The company's Limoges facility Arqus (former Renault Truck Defense)

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## Tanks and armored combat vehicles

is the main supplier of armored vehicles for the French Armed Forces. Between 2020 and 2023, the company carried out measures to concentrate production at the site, for which purpose the production of Bastion family armored vehicles was transferred from the Saint-Nazaire plant, two additional production lines were deployed, a warehouse complex with a total area of 9,000 square meters was equipped, an administrative building with an area of 500 square meters was built at a total cost of 8.5 million euros, and the number of personnel was increased from 275 to 350 people. The productivity is five armored vehicles per day<sup>67</sup>.

### **Caracal**

For the assembly of new light armored vehicles Caracal, three technological lines are being equipped at the plants:

- in Kassel (Germany) — Rheinmetall Landsysteme;
- in Ede (Netherlands) - Rheinmetall Defense Nederland;
- in Eindhoven (Netherlands) — VDL Special Vehicles.

Rheinmetall is investing more than 10 million euros in developing the infrastructure of the Kassel plant, including converting a warehouse building into a production building and purchasing modern equipment. It is planned to additionally recruit more than 100 workers<sup>68</sup>. On July 10, 2023, a framework agreement was signed between Rheinmetall

and the ministries of defense of Germany and the Netherlands for a total of up to 1.9 billion euros for the delivery of up to 3,058 Caracal airborne vehicles (2,054 and 1,004 units, respectively). In the first stage, a firm contract was issued for a total of approximately 870 million euros for the production of 1,508 vehicles - 1,004 in Germany and 504 in the Netherlands. They are planned to be used in the airborne troops and special operations forces.

All armored vehicles under the contract will be manufactured in the Netherlands, at plants in Ede (1,258 vehicles) and Eindhoven (250 units).

Deliveries from the beginning of 2025 should be carried out at a rate of about 300 vehicles per year: 200 for Germany and 100 for the Netherlands<sup>69</sup>.

### **Gidran**

The Gidran armored vehicle is a Hungarian version of the Ejder Yalçın vehicle produced in Turkey by Nurol Makina. Rheinmetall planned to build a plant in Hungary in the Kaposvár area with a capacity of at least 100 armored vehicles per year. Work began in 2021, but was later stopped. As of October 2023, a cleared area measuring 950 x 300 m with markings for buildings was located at the construction site.

On October 31, 2023, Nurol Makina signed a cooperation agreement with the Hungarian company Rába Automotive Holding for the production of Gidran armored vehicles at a plant in Győr. As part of this, it is planned to create more than 200 jobs<sup>70</sup>.

### **Guardian, Rila**

In 2022, the International Armored Group Corporation purchased a 15-hectare plot of land in the Burgas region of Bulgaria for 2 million leva (1.1 million dollars) to establish an enterprise for the production of Guardian and Rila armored vehicles. The total investment is estimated at 20 million leva (11 million dollars), and it is planned to involve more than 300

people, and construction is planned to be completed at the end of 2024.<sup>71</sup>

### **Hoplite**

The Greek company EODH (Engineering Office Deisenroth Hellas), which specializes in the production of armor for vehicles, has developed the Hoplite armored vehicle at its own expense. According to the company's management, one NATO country has expressed interest in purchasing 700 vehicles.

In February 2021, the Israeli company Plasan acquired a company in the area of Thessaloniki (Greece), which had been closed since 2019, and formed a company

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## Tanks and armored combat vehicles

ELVO 2020 for the production of armored vehicles. Israeli representatives committed to investing between 95 and 135 million euros in infrastructure development over five years. The plant was reconstructed and modern equipment was purchased, but production has not yet begun. Today, the company employs less than ten people.

### **Hron, Wolf**

Between 2020 and 2022, the Slovak company DefTech invested 42 million euros in the Vlkanovo plant to organize the production of armored vehicles of its own design, Hron and Wolf. When drawing up plans, it was planned to produce up to 120 vehicles per year, with 42 people involved in the technological processes. After the start of the Russian special military operation in Ukraine, the company's revenue increased by almost 800% - from 436 thousand (for 2021) to 3.78 million euros (for 2022 )<sup>72</sup>.

### **Jackal**

The Jackal armoured vehicles are of the HMT (High Mobility Transporter) type, developed by Supacat (plant in Dunkeswell, UK). In February 2023, it signed a contract with the UK MoD for the production of 70 Jackal 3 AFVs by April 2024, with an option to increase their number to 240 units. Babcock International (plant in Devonport, UK) is involved in the execution of the order, which is to manufacture 62 vehicles. This made it possible to create 100 additional jobs: 10 at the Dunkeswell plant and 90 in Devonport. The total planned productivity of the plants is one AFV per day<sup>73</sup>.

### **Vector**

A production building (1,000 sq. m) and a warehouse (350 sq. m) were built at the Defenture plant in Tiel (Netherlands) between July 2022 and June 2023. The plant is equipped with three production lines: one for the assembly of Groundforce (GRF) armored vehicles, which received

in the national Armed Forces the name is Vector, two - for Scorpion ATVs. 40 new employees have been recruited. It is planned to produce 300 BA and 140 ATVs per year<sup>74</sup>.

### **Waran**

The main manufacturer of buses in Poland, Autosan (plant in Sanok), became part of Huta Stalowa Wola on December 1, 2022, and expanded its range by starting to manufacture Waran armored vehicles under license from the Czech company Tatra. Investments in the amount of 100 million zlotys (25 million dollars) were allocated for the reconstruction of the production hall and the purchase of modern equipment<sup>75</sup>. The first vehicles rolled off the assembly line in October 2023. In addition, the plant plans to manufacture Ottokar Brzoza self-propelled anti-tank missile systems based on this armored vehicle.

### **Under the ATBTU program**

In early September 2023, the Romanian Ministry of Defense announced a tender under the ATBTU (Autovehicule tactice blindate de tip uşor) program for the purchase of 1,059 4x4 armored vehicles worth 4.6 billion lei (923 million euros)<sup>76</sup>, which was won in 2024 by Cobra II of the Turkish company Otokar. Production is planned to be organized at the plant in the city of Moreni of the Romanian company Uzina Automecanică Moreni. Since 2020, it has been allocated 8 million euros for new equipment with numerical control<sup>77</sup>. In 2023, the company received 30 million lei (1.7 million dollars) for the reconstruction of the pro-

production workshops.

### **Military trucks**

Military trucks are manufactured by ten companies (15% of the total). Only two international corporations are involved in production - Iveco Group and Rheinmetall, with two facilities each. Only four companies are located in Eastern Europe - in Poland (two), the Czech Republic (one) and Romania (one, Iveco Group).

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## Tanks and armored combat vehicles

Investments in the development of production of these products are insignificant. In 2021, new plants were opened in the UK and Romania, and expansion of the capacity of the Polish plant is planned.

Jankel Armouring has been producing Jankel LTTV (Light Troop Transport Vehicle) vehicles at a new facility in Coventry, UK, since November 2021. The plant had an annual production capacity of 25 vehicles in August 2022<sup>78</sup>.

Iveco Group allocated 50 million euros for the construction of the plant in Petresti, located 55 km northwest of the capital of Romania, and completed the work in April 2021. The plant's production area is 9,000 square meters, with three assembly lines located on its territory, and more than 200 people are involved in technological processes. The production capacity is up to 440 trucks per year<sup>79</sup>.

The Polish company Jelcz is the main supplier of military trucks and their chassis to the national armed forces. Its enterprise with a staff of 680 people and a capacity of up to 500 vehicles per year is located in the city of Jelcz-Laskowice. It is planned to build a new plant near the existing one by 2026, modernize production, and hire up to 200 additional employees so that upon completion of the work the production capacity of the two enterprises will increase to 2,000 trucks per year<sup>80</sup>.

### Military robotic platforms

The production of military robotic platforms in Europe is carried out at seven enterprises (10% of the total). The largest number of them (three) are located in the UK. The majority of companies (five) are part of or associated with international corporations:

— General Dynamics — General Dynamics UK (company in Merthyr Tydfil, UK);

- Iveco Group - IDV Robotics (Nuneaton, UK);

— KNDS — Nexter Robotics (Versailles, France), as well as national companies SERA Ingénierie (Villebonnesur-Yvette, France) and Milrem Robotics (Tallinn, Estonia).

In January 2023, Iveco Defense Vehicles, a company of the Iveco Group, acquired a controlling stake in the robotic platforms division of the automotive design consultancy Horiba Mira (UK), and in September 2023, it created IDV Robotics on its basis. KNDS Corporation pays special attention to the manufacture of these products. In May 2021, its company Krauss-Maffei Wegmann signed a strategic cooperation agreement with Milrem Robotics, a leading developer and

manufacturer of military robotic platforms in Europe, with the acquisition of 24.9% of the shares. In May 2023, the Nexter Robotics division of Nexter Systems (France) entered into a partnership agreement with SERA Ingénierie for the joint development of these platforms for the French army.

### Production problems and solutions

The special military operation in Ukraine has revealed the limited capabilities of the European defense industry to significantly increase the production of armored vehicles in the face of a serious crisis.

The industry's problems include:

— technological complexity and protracted production process, which depends on a large number of contractors;

— a shortage of armor steel on the market (primarily due to the high energy intensity of production with high energy prices);

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## Tanks and armored combat vehicles

- increase in the cost of materials and components;
- dependence of enterprises producing armored vehicles in increasing production capacity on the capabilities of their partner companies;
- lack of orders with high costs of developing new technology;
- lack of qualified personnel;
- the presence of a large number of manufacturers of basic types of products both in Europe and beyond (primarily in the USA);
- significant dependence on long-term urgent government contracts;
- bureaucratic difficulties.

The latest technologies, modern materials, complex electronic components and software are used in the production of armored vehicles. All this affects the duration of the technological process and the cost of the manufactured products. Under normal conditions, the production of a main battle tank takes about three years, an infantry fighting vehicle - about two, a truck - a year. If the Leopard 2A4 tank cost from 3 to 9 million euros depending on the configuration, then the Leopard 2A7 - already about 15 million euros<sup>81</sup>.

The Swedish steel company SSAB supplies armor steel to Germany, but it cannot provide the necessary volume of supplies. In search of a way out of the situation, the German authorities issued a permit for steel production to the German company Saarstahl, but due to high energy prices, it had to reduce production volumes and transfer half of its employees to part-time work.

According to BAE Systems Hägglunds President Tommy Gustafsson-Rask, it takes about 24 months to deliver a standard CV90 AFV, with another year added if minor design changes are made. If the customer wants to significantly change the vehicle's characteristics to suit their requirements, it will take between five and seven years. Components with

long lead times, such as transmissions, torsion bars, and microcircuits, are a bottleneck in the supply chain and take 24 to 36 months to deliver.

Gustafsson-Rask noted that before  
In order to increase its production capacity, the company must clarify the capabilities of partner companies to increase supply volumes, while ensuring sustainability and compatible contract deadlines.

Competition between manufacturers, on the one hand, promotes the development of the industry, forcing companies to invest financial resources in the development of new types of armored vehicles (although not many of them find their customers); on the other hand, it leads to a situation where, due to difficulties in ensuring the necessary demand, European companies may be forced out of the market for a long period by American or South Korean manufacturers, since the service life of armored vehicles is from 30 to 40 years.

Companies are heavily dependent on long-term government contracts and fear that three to five years after new production lines are launched or factories are built, demand for armored vehicles will again be low, as it was before the Russian air defense in Ukraine.

The production of armored vehicles is under strict state control. Before starting production, companies must obtain permission from the government. For example, any order from the German Defense Ministry over 25 million euros requires approval from the country's parliamentary budget committee.

To solve the existing problems, European countries will need:

- create unified platforms for the production of various types of armored vehicles, introduce a standard configuration for them;
- provide enterprises with sufficient stocks of components;
- organize double or triple duplication of supply chains;

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## Tanks and armored combat vehicles

- when purchasing armored vehicles from foreign manufacturers, include in contracts the transfer of technologies for their production and maintenance in the purchasing countries, as well as mandatory training of personnel;
- to increase the enterprise's productivity, use high-tech equipment and switch to a two- or three-shift work schedule;
- provide enterprises with priority access to electricity;
- organize training or advanced training of employees;
- introduce long-term planning and provide state support for the production of armored vehicles.

Thus, the following characteristic features of the production of armored vehicles in Europe can be identified:

- 67 enterprises are involved in the final assembly of armored vehicles in Europe;
- the main products are modular combat armored vehicles and armored cars;
- main battle tanks are assembled at only one facility (in Germany), and it is planned to begin production at another one (in Poland);
- a significant portion of enterprises produce wheeled armored vehicles;
- production of multiple rocket launch systems  
There is no such fire in Europe, it is planned to begin assembling two types of MLRS in Poland;
- the ability of the European defense industry to significantly increase the production volumes of armored vehicles is limited.

### South Korea

The armored vehicle industry of South Korea is the most developed branch of the country's defense industry. The production of armored vehicles is carried out by two companies: Hyundai Rotem - main battle tanks and wheeled armored vehicles,

Hanwha Aerospace - tracked armored vehicles, self-propelled

howitzers and MLRS. The industry's products are in high demand worldwide, as the company offers equipment at a lower price and delivers it two to three times faster<sup>82</sup>.

### Hyundai Rotem

Hyundai Rotem, part of Hyundai Motor Group, produces rolling stock, military equipment and industrial equipment. Hyundai Rotem has overseas branches in Australia, Bangladesh, Brazil, Greece, Egypt, India, Ireland, Qatar, China, Malaysia, Mexico, New Zealand, Oman, the USA, Taiwan, Turkey, Ukraine and the Philippines. Armored vehicles are manufactured at a plant in the city of Changwon. The facility includes a test site with a tank track with a total length of 1.8 km and a width of 8 m and two test sites measuring 100 × 30 m and 180 × 70 m.

### *K2 Main Tanks*

In 2014, the company began producing K2 tanks for the national armed forces. In August 2023, the South Korean government allocated 1.94 trillion won (\$1.46 billion) to purchase 150 tanks over five years. By 2028, the total number of K2 tanks in the South Korean armed forces should reach 410 units, while the total need is 600 vehicles<sup>83</sup>.

Poland became the first foreign customer for K2 tanks. In July 2022, the country signed agreements with South Korea to purchase 980 K2 tanks, 672 units of 155-mm self-propelled howitzers K9, 288 MLRS Chunmoo, 48 FA-50 aircraft for \$15 billion.<sup>84</sup>

In December 2022, ten K2 tanks arrived in Poland, in 2023 and in the first quarter of 2024 - 18 units each, by the end of 2024 - 38 vehicles, in 2025 - 96 (a total of 180 tanks worth \$ 3.4 billion). From 2026, it is planned to produce 800 K2 units in Poland.

### *Armored combat vehicles of the K806 and K808 types*

The K806 and K808 types of vehicles are armored fighting vehicles with a 6×6 and 8×8 wheel arrangement.

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## Tanks and armored combat vehicles

respectively. In 2016, the country's Ministry of Defense signed a contract with Hyundai Rotem for the development and production of 16 prototypes for 26.9 billion won (US\$20.4 million). By the end of 2023, 500 K808 and 100 K806 will be produced for a total of 820.6 billion won (US\$705.4 million). The average production rate was 100 cars per year - up to nine per month.

In June 2022, the company received an order for the development and production of prototypes of the K808 CPV command post vehicles worth 55.3 billion won (\$42 million), and in June 2023, for their production worth 707.3 billion won (\$535.8 million). In December 2023, the South Korean Army received the first vehicles, and by 2029 they should have 600 command post vehicles worth 1.5 trillion won (\$1.1 billion)<sup>85</sup>.

### Hanwha Aerospace

Hanwha Aerospace is part of the Hanwha Group. In April 2023, Hanwha Defense (produced military equipment), Hanwha Munitions (ammunition) and Hanwha Aerospace merged under the leadership of the latter. Today, the production of armored vehicles is carried out by the Hanwha Land Systems division, which has a plant in Changwon.

After the start of the SVO in Ukraine, Hanwha Aerospace recorded a record high consolidated revenue of 6.54 trillion won (\$5.1 billion) in 2022. By 2030, the company aims to increase this figure sixfold to 40 trillion won (\$31.2 billion)<sup>86</sup>.

#### **155mm self-propelled howitzers K9 and transport-loading vehicles K10**

After 2022, the company tripled the production of 155 mm/52 K9 self-propelled howitzers by opening two additional assembly lines: in 2022, 80 self-propelled howitzers were produced annually (up to seven per month), in 2023 - 160 (up to 14), in April 2024 - 240 units per year (20 per month)<sup>87</sup>.

As part of the agreement signed with Poland in July 2022 (total number of self-propelled guns - 672), in August 2022 a contract was concluded

contract for the production of 212 K9A1 self-propelled guns for \$2.4 billion until 2026, in December 2023 - 152 self-propelled guns for \$2.6 billion until 2028.

In February 2022, the company received a contract to supply the Egyptian Armed Forces with K9 self-propelled guns, K10 transport and loading vehicles (TZM) and K11 fire control vehicles on the same chassis for \$1.7 billion. The equipment will be manufactured in South Korea until 2025, and then in Egypt.

In November 2023, Hanwha Aerospace signed a contract to produce four additional K9 self-propelled guns and eight K10 TZMs for the Norwegian Armed Forces within two years (in addition to the previously delivered 24 K9 units and six K1088). In April 2024, the Minister of Defense of Vietnam expressed a desire to purchase the K9 systems.

In June 2024, it became known that Hanwha Aerospace will supply Romania with 54 K9 self-propelled howitzers and 36 K10 TZMs for \$920 million.<sup>89</sup>

#### **K239 Chunmoo multiple launch rocket systems**

Under the agreement signed with Poland in July 2022, the total number of K239 Chunmoo modular multi-caliber MLRS combat vehicles in the Homar-K version delivered to Poland will be 290 units. Accordingly, in November 2022, a contract was signed for 218 K239 units worth \$3.55 billion (with deliveries in 2023–2027), and in April 2024, a contract was signed for another 72 units worth \$1.6 billion (2026–2029).

#### **K21 Infantry Fighting Vehicles**

Hanwha Aerospace is participating in a competition to replace the Latvian Armed Forces' armored vehicles with the K21 infantry fighting vehicle. It is competing against the ASCOD IFV, developed jointly by Austria and Spain, and the Turkish-made Tulpar. The vehicle has a good chance of winning, which would ensure the delivery of about 100 vehicles worth 4 trillion won (\$3.1 billion).



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## Tanks and armored combat vehicles

### Japan

Japan's defense industry is entirely complex privately owned. There are no companies in the country that specialize primarily in the production of military products: its share in the turnover of the largest manufacturers does not reach even 20%.

### Mitsubishi Heavy Industries

Mitsubishi Heavy Industries is a company within the Mitsubishi Group. The company's Sagami-hara Machinery Works division is responsible for the production of armored vehicles. It owns a plant located on the island of Hokkaido, in Chitose.

#### **Type 10 Main Battle Tanks**

The Type 10 tank has been produced since 2010. Its advantages include reduced size and weight (44 tons), making it 6 tons lighter than the Type 90 tank. Increased mobility ensures the readiness of the Type 10 for deployment in various regions of Japan. The defense budget for 2024 provides 16.8 billion yen (\$112 million) for the acquisition of 10 Type 10 tanks (as of October 2023, the Japan Ground Self-Defense Force had 111 Type 10 tanks)<sup>90</sup>. From 2010 to 2012, the troops received 39 tanks, an average of 13 units per year. The production and acquisition of new types of tanks, howitzers and multiple launch rocket systems by the Ministry of Defense is not currently envisaged, with the exception of various variants based on the Type 16 wheeled armored fighting vehicle.

#### **Type 16 Armored Fighting Vehicles**

Serial production of the Type 16 MCV heavy-duty combat vehicle began in 2016. By the end of 2023, the Japanese Army had 204 vehicles, receiving an average of 30 units per year (five vehicles every two months). In 2023, the company received a contract to produce 26 Type 16 MCVs worth 13.6 billion yen (\$110.9 million), with an order for 250 vehicles expected in the coming years<sup>91</sup>.

In December 2019, the Ministry of Defense signed a contract with Mitsubishi Heavy Industries for the development

three variants of armored fighting vehicles: the Type 16 ICV infantry fighting vehicle, the Type 16 MMCV 120mm self-propelled mortar, and the Type 16 RCV combat reconnaissance vehicle.

In March 2024, the MoD awarded the company a contract for the delivery of 24 Type 16 ICVs and eight Type 16 MMCVs worth \$164 million and \$54.2 million, respectively (2027–2028).<sup>92</sup>

### Japan Steel Works

Since its founding in 1907, Japan Steel Works (Muroran, Hokkaido) has been a leading manufacturer of artillery systems in Japan.

#### **155mm self-propelled howitzers Type 19**

The Type 19 155mm wheeled self-propelled howitzer is designed to replace Japan's existing FH70 towed howitzers. The Japanese MoD will purchase 16 Type 19 155mm self-propelled howitzers in 2024 for 15.1 billion yen (\$100.7 million).

#### **Patria AMV XP armored personnel carriers**

Mitsubishi Heavy Industries (with the Type 16 APC) and the Finnish company Patria (with the Patria AMV XP APC) participated in the competition to supply the Japanese Self-Defense Forces with armored vehicles to replace the Type 96 wheeled armored personnel carriers. The reasons for the victory of the Patria AMV XP were the insufficient protection of the Type 16 and their

high cost.

In August 2023, Patria and Japan Steel Works signed a license agreement to produce the APC in Japan, and the Defense Ministry allocated 13.6 billion yen (\$87 million) for the purchase of 26 AMV XP<sup>93</sup>.

### General assessment of production of tanks and armored vehicles in foreign countries

1. Models of fundamentally new foreign armored fighting vehicles may appear no earlier than the beginning of the 2030s. 2. The

largest manufacturer of armored vehicles non-technicians are the US.

Tanks and armored combat vehicles

3. US enterprises have reserves of production capacity. Investments are mainly directed at installing modern industrial equipment and reconstructing testing facilities.

platforms. 4.

The main European manufacturer, the German corporation Rheinmetall, is looking for an entry into the American armored vehicle market.

5. The industrial bases of the armored industries of the USA, Israel, South Korea and Japan are characterized by a high degree of concentration and monopolization of production.

6. The United States has high production rates, but South Korea is four times ahead of the United States in the production of 155mm self-propelled howitzers. The most

low rates of tank production in Japan.

7. The production of armored vehicles is carried out are private companies. The exception

is Israel, where its main types are produced by Defense Ministry enterprises. In the United States, the state provides the American corporation General Dynamics with production facilities at military bases in

rent.

8. The production of armored personnel carriers in Israel depends on the supply of their hulls from the USA. This dependence is critical, since the APC segment in the country accounts for more than 70% of the defense budget expenditures.

9. The fastest growing market for armored vehicles is in South Korea. The industry's products are in high demand worldwide. 10. There are no companies in Japan that specialize

in concentrated mainly in the production of military products. Its share in the turnover of the largest manufacturers does not reach 20%.

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**Table 1. Production rates of the main types of armored vehicles in the USA, Israel, South Korea and Japan**

Type of armored vehicles	Production rates	
	per year	per month
<b>USA</b>		
M1A2 SEPv3 Abrams Main Battle Tanks	180–240 (up to 400)	15–20 (up to 33)
AMPV type armored fighting vehicle	190	16
ACV type armored fighting vehicle	240	20
155mm self-propelled howitzers M109A7 Armored	60	5
vehicles L-ATV	5000	420
<b>Israel</b>		
Merkava Barak main battle tanks	30	5 (in two months)
Armored personnel carriers Namer 1500	30	5 (in two months)
<b>South Korea</b>		
K2 Main Tanks	up to 100	up to 9
Type 808 armored fighting vehicle	up to 100	up to 9
155mm self-propelled howitzers K9	240	20
<b>Japan</b>		
Type 10 Main Battle Tanks	up to 13	1
Type 16 AFV	30	5 (in two months)

Source: prepared by CAST

Tanks and armored combat vehicles

**Table 2.** Enterprises for final assembly of armored vehicles in the USA, Israel, South Korea and Japan

Company	Location	Products / types of work
<b>USA</b>		
General Dynamics Land Systems	Lima, Ohio	M1A2 SEPv3 Abrams main battle tanks, Stryker AFV hulls and Namer 1500 APCs (for Israel)
	Anniston, Alabama M10 Booker	Heavy Weapons Fighting Vehicles, Stryker DVH A1 Armored Fighting Vehicles, Stryker M-Shorad Self-Propelled Air Defense Missile/Gun Systems, M1074 Tank-Launched Bridge Vehicles, M1150 ABV Mine Clearance Vehicles, MUTT Robotic Platforms
BAE Systems	York, Pennsylvania AMPV and	ACV AFVs, Bradley IFV hulls, and M109A7 155mm self-propelled howitzers
	Anniston, Alabama M2A4 Bradley	IFV, M7A4 Bradley Fire Support Vehicle, M109A7 155mm Self-Propelled Howitzer (Initial Assembly), M992A3 Field Artillery Ammunition Carrier, M88A2 ARV
	Elgin Oklahoma	155mm self-propelled howitzers M109A7 (final assembly)
Oshkosh Defense	Oshkosh (North Plant), Wisconsin	XM1304 Stryker IFV, L-ATV armored vehicles, unmanned anti-ship missile launchers ROGUE-Fires, M1300 HET A1 heavy equipment transport vehicles with M1302 MET semi-trailers, FMTV A2 military trucks with trailers, Eitan APC hulls (for Israel)
	Oshkosh (South Plant), pcs. Wisconsin	
	Oshkosh (Harrison Plant) Wisconsin	
AM General	South Bend (Mishawaka), Indiana	Armored vehicles of the HUMVEE type, planned — BA JLTV A2
Textron Systems	Slidell, LA MSFV Armored Vehicles	
GM Defense	Concord, NC	ISV Light Armored Vehicles
American Rheinmetall Vehicles	Detroit (Sterling Heights), Michigan	<i>Participation in competitions for the production of new armored vehicles for the US Armed Forces</i>
<b>Israel</b>		
Repair and restoration center of the Ministry of Defense	Tel Hashomer	Merkava Barak main battle tanks, Namer 1500 and Eitan APCs
Plasan	Sasa	SandCat Tigris armored vehicles
Israel Aerospace Industries	Beer Sheva	<i>Planned</i> - light armored vehicles ZMAG, ZD
<b>South Korea</b>		
Hyundai Rotem	Changwon	Main battle tanks K2, armored fighting vehicles of the K806 and K808 types
Hanwha Aerospace	Changwon	K21 infantry fighting vehicles, K9 155mm self-propelled howitzers, K239 Chunmoo MLRS, K10 transport and loading vehicles, K11 fire control vehicles
<b>Japan</b>		
Mitsubishi Heavy Industries	Chitose	Main Battle Tanks Type 10, AFV Type 16
Japan Steel Works	Muroan	155mm Type 19 self-propelled howitzers, <i>planned</i> - Patria AMV XP APC

Source: prepared by CAST

# Weapons of destruction (missiles, aerial bombs, artillery shells and grenade launchers)

## United States of America Industrial potential

In January 2023, the Center for Strategic and International Studies (a Washington-based think tank)<sup>94</sup> analyzed the state of the American ammunition industry and ammunition stockpiles in the United States.

According to his assessment, Ukraine's needs for GMLRS guided missiles (about 400 per month) are fully covered by existing capacities (about 5,000 missiles per year) and accumulated reserves (25-30 thousand units). The production of rounds for barrel artillery in the United States is established at leased

(Government-Owned, Contractor-Operated, GOCO) and private (Contractor-Owned, Contractor-Operated, COCO) enterprises. The United States is focused on the production of anti-tank weapons and close combat weapons (FGM-148 Javelin anti-tank missile systems - Raytheon and Lockheed Martin corporations; 40-mm AGS

Mk 19 - General Dynamics Corporation).

The United States has enormous capacity for the production of small arms ammunition: about 8.6 billion cartridges

new per year.

### MLRS ammunition and tactical missiles

In the area of short-range missile systems (operational-tactical and tactical), the new American operational-tactical missile system Precision Strike is being mastered in serial production.

Missiles (PrSM) with a maximum firing range, according to various sources, of up to

700-800 km. PrSM missiles can be used from combat vehicles (CM) MLRS M270A1 MLRS and M142 HIMARS<sup>95</sup>.

In the rocket artillery area, the prime contractor Lockheed Martin is increasing production of the M142 HIMARS MLRS and upgrading the M270A1 MLRS to the M270A2, to reach production of 96 M142 HIMARS MLRS per year (up to 480 units in total) within five years (FY2024–FY28). Several co-contractors will ensure production of up to 100 MLRS of this type per year<sup>96</sup>. In terms of the fire control system, the upgraded M270A2 MLRS MLRS will be fully compatible with the M142 HIMARS. The British (44 units) and Italians (21 units) are planning to bring their MLRS M270 type BM MLRS to this standard<sup>97</sup>.

In the area of anti-tank weapons, serial production of the Javelin ATGM modification FGM-148F (up to 4000 per year) has been established; the prime contractor for the program is the Javelin of the same name, a joint venture between the corporations Raytheon Technologies and Lockheed Martin<sup>98</sup>.

### Ammunition for barrel artillery

A distinctive feature of the American military industry is the over-concentration of production of ammunition for barrel artillery. The US Department of Defense has awarded a contract to General Dynamics Ordnance and Tactical Systems to build a new, largely automated plant in Mesquite, Texas, and to IMT Defense in Ontario, Canada. In 2023, the US Army awarded contracts worth \$1.5 billion to nine companies in

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## Weapons of destruction (missiles, aerial bombs, artillery shells and grenade launchers)

The United States, Canada, India and Poland to increase production of 155mm artillery shells. The contracts include the purchase of 6,000 tons of explosives, including TNT and IMX-104 explosives, as well as 270,000 caps, 678,000 fuses and combustible cartridges<sup>99</sup>.

Another \$600 million is planned to be spent on tripling the production of IMX-104 explosives (to 6,000 tons) at the Army Ammunition Plant in Holston, Tennessee. The U.S. Army will also allocate \$650 million.

for the design and construction of a TNT production facility, \$14 million will go toward the construction and commissioning of a gunpowder production line by Goex in Minden, Louisiana, and \$80 million and \$21 million of additional funds will go toward completing the expansion of 155mm shell metal parts production in Scranton and Hanover, Pennsylvania, respectively.

## Israel Industrial potential

Israel is one of the few countries in the world capable of providing its armed forces with a significant part of the nomenclature of weapons. It has achieved autarky in many types of missile weapons (primarily SAMs and ATGMs), mortar rounds, artillery and small arms ammunition. However, it depends on external supplies of aerial bombs, JDAM guided aerial bombs and SDB small-diameter bombs, guided 155-mm artillery shells, missiles

Hellfire and 30-mm ammunition for attack helicopters, 120-mm tank rounds and other nomenclature. The limiting factor is Israel's limited ability to increase production, which is why during all Israeli-Palestinian escalations Israel is forced to turn to external supplies, primarily American, to compensate for the expenditure of ammunition.

## Missile weapons

Israel is one of the leaders in the development of modern air defense systems, such as the Arrow 2 and Arrow 3 missile defense systems, created by Israel Aerospace Industries (IAI) and other Israeli companies in conjunction with American firms, with the leading participation of Boeing and Lockheed Martin. The Israeli company Rafael, together with the American corporation Raytheon and largely with American funds, created the David Sling tactical missile defense system with small-sized Stunner anti-missiles, capable of striking

tactical and operational-tactical missiles of the enemy at ranges from 40 to 400 km. To combat rockets with a firing range of up to 70 km, Rafael created the Iron Dome mobile complex with inexpensive Tamir anti-missiles with a firing range of up to 40 km. For export deliveries, Rafael developed an original mobile SPYDER SAM system, using Python 5 air-to-air missiles (up to 20 km) with an infrared homing head and Derby (up to 50 km) with an active radar homing head as SAMs. A family of Israeli multifunctional anti-tank missile systems Spike, developed by Rafael, was created and is in service with the armies of 41 countries.

## Ammunition for barrel artillery

The main artillery ammunition production facilities in Israel are managed by Elbit Systems, which has a production capacity of 250,000 155mm shells per year.<sup>100</sup> In late 2023, Elbit Systems received a \$135 million contract to build an artillery ammunition plant for an unnamed international customer.<sup>101</sup> Construction will be completed in 2025.

## Europe

### Industrial potential

In total, there are 145 enterprises producing ammunition, equipment and weapons in Europe, of which 95 belong to international corporations and 50 to national companies. Two more enterprises are currently under construction in Hungary and Croatia. Half of the facilities are located in six countries: Germany (21), France (15), Great Britain (14), Italy (12), Romania (11) and Spain (9).

It is precisely rounds for barrel artillery systems that are most in demand during the military operations in Ukraine. In February 2023, the Ukrainian government asked the EU to transfer 250,000 rounds of ammunition per month, a third of which are 155-mm artillery shells. This is comparable to the annual production of all European enterprises<sup>102</sup>. By the beginning of the Second World War, the combined capacity of the 27 EU countries amounted to 400,000–700,000 shells, according to various estimates. The European Commission allocated 500 million euros for the development of the ammunition industry, expecting to increase the volume of shell production from 1.4 to 1.7 million in 2025.

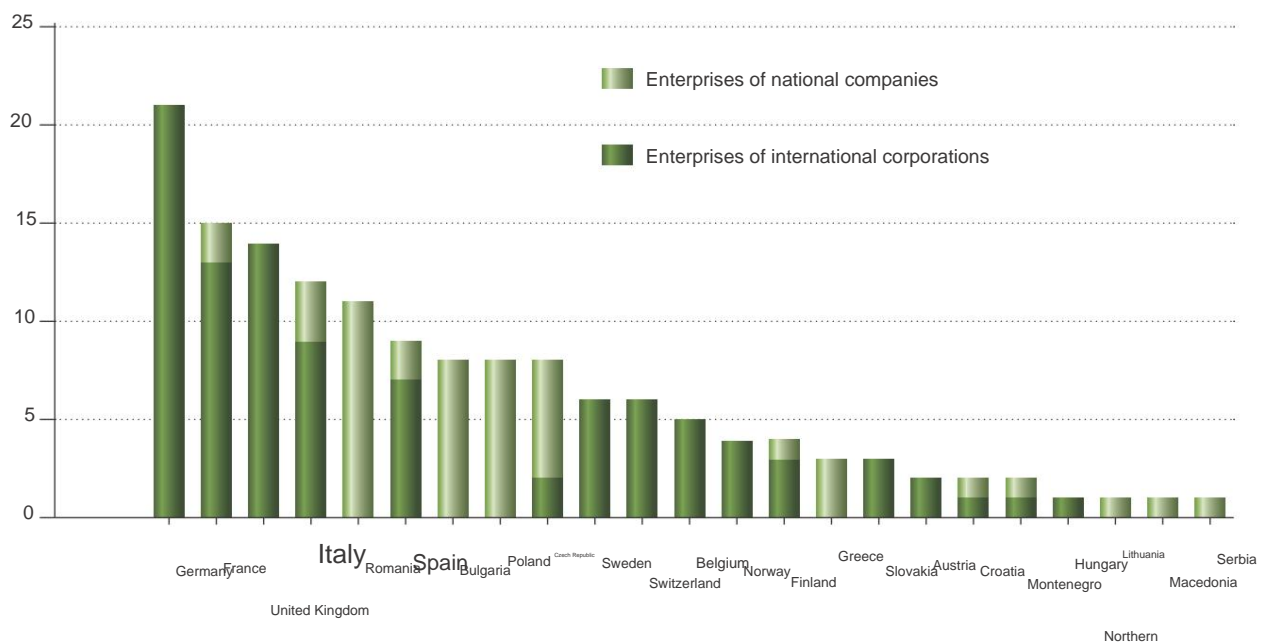
### Ammunition for barrel artillery

The most common products are rounds for tube artillery systems, produced in all key European countries. The main manufacturers are the British company BAE Systems, the Czech holding Czechoslovak Group, the Norwegian-Finnish company Nammo, the French group Nexter, the German Rheinmetall and national companies in Bulgaria and Poland.

The Czechoslovak Group holding owns four facilities involved in the production of rounds for tube artillery systems. In 2022, they manufactured 100,000 rounds for 155-mm field artillery guns, and in 2023, 150,000.<sup>103</sup>

Due to military actions in Ukraine, the holding company has loaded its ammunition production capacities to the maximum: if at present the enterprise is

Figure 3. Number of ammunition production facilities in Europe



Source: prepared by CAST

Snine produces 19,000 155mm shell casings, and 15 million euros have been allocated to achieve the target of 100,000 units per year<sup>104</sup>. The Norwegian MoD has signed a contract

with

Nammo for the production of 155-mm artillery shells worth NOK 2.6 billion (USD 244.8 million). In connection with this, the company's management approved the provision of funds (NOK 260 million, or about USD 24.5 million) for the purchase and installation of additional industrial equipment and the recruitment of personnel, planning to increase the production of shells to 250 thousand per year in 2025<sup>105</sup>.

The Nexter Ammunition division of the French Nexter Group, which includes Nexter Munitions (France), Mecar (Belgium) and Simmel Difesa (Italy), is the third largest European company producing large and medium caliber ammunition. <sup>106</sup> In early 2023, the French Ministry of Defense announced that the country would increase the number of 155mm field artillery rounds

supplied to Ukraine to 2,000 units per month. In this regard, the Nexter Group will increase production capacity by 50% (to 70 thousand per year) during 2023, and by 2025 will produce 150 thousand shells of this type, which is three times more than before the start of the Russian Central Military District in Ukraine. <sup>107</sup> In 2024,

Nexter announced that it had received €41 million in EU investment to reach production capacity of 400,000 finished shots per year within three years<sup>108</sup>.

One of the largest manufacturers of military products in Europe, the German group Rheinmetall, acquired the company Expal Systems from the Spanish holding MaxamCorp at the end of 2022 for 1.2 billion euros<sup>109</sup>. As a result, in the context of a dynamic market situation caused by the growth in demand for ammunition, Rheinmetall gained access to Expal Systems' significant capacities for the production of ammunition<sup>110</sup>: artillery shells - 250 thousand per year; medium-caliber ammunition - 1 million per year; mortar rounds - 500 thousand per year. During 2022,

The annual production volumes of ammunition have been increased (excluding the capabilities of Expal Systems)<sup>111</sup>: for tanks – from 70 to 140 thousand; for artillery guns – from 70 to 110 thousand; medium caliber – from 1.2 to 2.2 million, as well as up to 240 thousand 120-mm tank shells and up to 500 thousand 155-mm shells per year (in combination with the capacities of Expal Systems and Rheinmetall Hungary)<sup>112</sup>.

In March 2023, the German Ministry of Defense, on behalf of Ukraine, signed a contract for the production of 300 thousand rounds of ammunition (150 thousand each of armor-piercing subcaliber and high-explosive fragmentation). For this purpose, a new production line for rounds for 35-mm Gepard<sup>113</sup> self-propelled anti-aircraft guns was launched at the plant in Unterlüss (Germany, Rheinmetall Waffe Munition).

In December 2022, construction of a Rheinmetall Hungary plant for the production of large and medium-caliber ammunition began in the Várpalota area of Hungary, for which approximately €200 million has been allocated. Production is planned to be organized in several stages: by the third quarter of 2024 — the production of rounds for 30-mm automatic cannons for Lynx infantry fighting vehicles; by the end of 2024 — for 60-, 81-, 120-mm mortars (jointly with Hirtenberger Defence Systems); in 2025 — for 120-mm cannons of Leopard 2 tanks and 155-mm field artillery guns<sup>114</sup>. Thus, before the start of the Second World War, Rheinmetall's annual capacity was about 70,000 shells, in 2024 – up to 700,000 shells, and in the “medium term” – about 1.1 million per year.

In October 2019, the Hungarian government acquired the international company Hirtenberger Defence Systems, which produces rounds for 60-, 81- and 120-mm mortars, for 38.8 million euros. The company owns two factories: in Hirtenberg (Austria) and Middle Wallop (England), and by the end of 2024 will establish production of these products at a plant under construction in Hungary<sup>115</sup>.

The enterprises of the Bulgarian defense industry are among the largest manufacturers of Soviet-style weapons, not only

in Europe, but also in the world. In 2022, the sales volume of Bulgarian arms companies increased by 100%<sup>116</sup>. In January 2023, the Bulgarian company Tsar Samuil EOOD (part of the Terem holding) in the city of Kostenets resumed production of 122-mm shells for self-propelled (2S1) and towed (D-30) howitzers of the Ukrainian Armed Forces, which had been discontinued in 1988<sup>117</sup>.

The main producer of ammunition in Poland is the Polska Grupa Zbrojeniowa (PGZ) association, which includes 50 companies represented in all areas of the country's defense industry. PGZ management plans to invest up to 8 billion Polish zlotys (1.9 billion dollars) in seven companies specializing in ammunition production over the next decade<sup>118</sup>.

In 2019, the Zakłady Metalowe DEZAMET plant in Nowe Dźby purchased modern machine tools and equipment to increase its capacity to produce large (120 and 155 mm) and medium (60 mm) caliber ammunition by 2026.<sup>119</sup>

In 2022, the Polish company Mesko was provided with financial resources to organize the production of 120-mm shells for Abrams and K2 tanks, 155-mm ammunition for Krab and K9120 self-propelled guns at a plant in the city of Skarzysko-Kamienna. In 2023-2024, the Polish government allocated 2 billion Polish zlotys (475 million dollars) to create production infrastructure and 12 billion zlotys (2.8 billion dollars) to purchase 800 thousand rounds of ammunition<sup>121</sup>.

At the plant in Plopeni, Romania (Uzina Mecanică Plopeni), where 152- and 155-mm artillery shells were produced until 1990, work is underway to restore production with the involvement of financial resources from Germany<sup>122</sup>. Thanks to the investments provided, the Czech national company STV Group has increased the total production volume of large-caliber ammunition to 100 thousand units per year. The company plans to develop the production of rounds for the 155-mm Caesar self-propelled guns and for 30-mm automatic cannons for the Pandur II and CV90 infantry fighting vehicles. In December 2022, the Ministry of Defense signed a contract with STV Group

for a total of CZK 10.17 billion (USD 406.8 million) for the delivery of 65,848 units of 155 mm shells in the period 2025–2029.<sup>123</sup>

### **155mm Artillery Shell Production Capabilities in Europe**

Eleven companies (13 facilities) in nine countries are involved in the production of 155-mm artillery shells, and five more plants are planned to be involved. Thus, 16 companies (18 enterprises) in 12 countries may be involved in the production of this type of ammunition.

Within two years, the production capacity of European enterprises could double (from 600,000 to 1.2 million rounds of ammunition per year<sup>124</sup>). European factories will be able to meet the needs of the Ukrainian Armed Forces for 90,000 155-mm artillery shells per month (1.1 million per year) only in 2025.

### **Ammunition for close combat weapons**

Ammunition for close combat weapons includes: rounds for 30-, 36-, 40-, 66-, 68-, 72-, 73-, 90-mm automatic grenade launchers; hand grenades; cartridges for 4.6-, 5.45-, 5.56-, 5.7-, 7.62-, 8.6-, 9-, 12.7-, 14.5-mm small arms.

The largest number of enterprises producing ammunition for close combat weapons are located in the Czech Republic, Germany, Italy and Spain. Enterprises in Romania, Croatia and the Czech Republic are being modernized. The Croatian company Elmech Sintermak, which produces small arms cartridges, allocated 150 million Croatian kuna (21 million dollars) to increase production volumes (from 100 to 200 million cartridges per year), 90% of which will be exported .<sup>125</sup> The STV Group company (Czech Republic) allocated 800 million Czech crowns (32 million dollars) for development, including 600 million crowns (24 million dollars) for organizing the production of 5.56 and 9 mm cartridges with the goal of increasing productivity to 500 thousand cartridges per year by the end of 2024. The facility in Vrbětice (Czech Republic) is scheduled to produce 500,000 grenades (10,000 per month) in 2023–2027 under license from the German Rheinmetall group<sup>127</sup>.



## Missile weapons

MBDA is a leading European developer and manufacturer of missile systems, with 17 facilities in the UK (four sites), Germany (three), Italy (four) and France (six) employing 14,000 people. The company produces 45 types of missiles, with another 15 in development.

MBDA UK is the UK's main supplier of missiles. In February 2018, the 670-person Air-Guided Missiles (ASRAAM, Brimstone, Meteor) production facility was commissioned<sup>128</sup>. In 2021, the company won a £550 million (\$748 million) MoD contract to complete the development and production of the Spear 31 air-launched cruise missile<sup>29</sup>.

The largest enterprise in Germany is MBDA Deutschland, where all types of guided missiles are produced. Raytheon Technologies Corporation, together with MBDA, will begin production of Patriot GEM-T missiles at COMLOG in 2025–2026 and will issue Bayern-Chemie permission to produce engines for these missiles<sup>129</sup>.

MBDA Italia is the main a leading supplier of missile weapons for the Italian Armed Forces.

The plant in Noceto (Italy), which produces CAMM family guided missiles, is being modernized; the plant in Fusaro (Italy), which manufactures homing heads and missile components, is being reconstructed. In La Spezia (Italy), where anti-ship missiles without loading explosives are manufactured, an additional territory with a production building of 6,500 square meters has been purchased<sup>131</sup>. In France, missile production is carried out by MBDA France, which owns three facilities: in Bourges, Le Plessis-Robinson and Celles-Saint-Denis. 20 million euros have been allocated for their development.

MBDA has made significant investments to increase production of the Mistral man-portable air defence missile system from 20 to

30 units per month with the aim of producing up to 40 units per month in the future<sup>132</sup>. Three plants of

Roxel, the European leader and third in the world in terms of production of rocket engines and solid rocket fuel, are located in France.

In addition to MBDA, four European industrial groups are involved in the production of missile weapons: Germany's Diehl, Norway's Kongsberg, Sweden's Saab, France's Thales and the national companies of Bulgaria, Spain, Poland and Romania. Within the Diehl Group (which includes three joint companies: RAM-System, PARSYS and EuroSpike), Diehl Defence, a

company specializing in the production of guided missiles, is responsible for the production of ammunition. RAM-System and PARSYS, together with

MBDA Deutschland produces guided missiles: RAM Block 2 for the RAM naval air defense missile system and PARS 3LR for the Tiger attack helicopter anti-tank missile system.

EuroSpike is a German company that produces Spike LR anti-tank guided missiles for the German ground forces under Israeli license, created by the German groups Diehl, Rheinmetall and the Israeli company Rafael.

The Norwegian Kongsberg Gruppen group includes Kongsberg Defence & Aerospace, which produces NSM anti-ship missiles and guided missiles for the NASAMS air defense system. The company is preparing to produce JSM air-launched cruise missiles. Due to the increased demand for NSM missiles, the company has been allocated about 3 billion Norwegian kroner (282.4 million dollars) to build a 7,800 square meter workshop with up to 1,200 workers<sup>133</sup>.

Saab Dynamics (Sweden) and Saab Bofors Dynamics Schweiz (Switzerland) produce missiles, including the GLSDB precision-guided munitions. The Swedish liaison group has expanded its production capacity due to increased orders from the SVO

and hired an additional 500 employees worldwide<sup>134</sup>.

Thales Belgium, a Thales Group company, specialises in the production of FZ missile systems for aircraft and helicopters with 70mm guided and unguided missiles. Over the past five years, more than 8 million missiles have been produced and delivered to 55 countries, and launch equipment has been installed on more than 300 aircraft<sup>134</sup>.

Thales Air Defence manufactures anti-aircraft (STARStreak) and anti-tank (NLAW) guided missiles at its Belfast, Northern Ireland site. The UK MoD has invested more than £320 million (\$416 million) in the company in 2021 and 2022.<sup>135</sup>

In France, ammunition is manufactured by Thales LAS France. The plant in La Ferté-Saint-Aubin produces 70mm rockets for Tiger attack helicopters and rounds for 81mm and 120mm mortars.

In Spain, there are two facilities of the national companies Pap Tecnos Innovacion and Instalaza, which specialize in the production of anti-tank guided missiles. The first company produces Spike ATGMs<sup>136</sup>. The second produces Alcotan-100 ATGMs, some of which are being transferred to Ukraine<sup>137</sup>.

The Polish government allocated about 100 million Polish zlotys (23.8 million dollars) to Mesko for the production of Piorun MANPADS, including for delivery to the Ukrainian Armed Forces<sup>138</sup>. The investment made it possible to increase the number of Piorun systems produced to 1,000 units per year<sup>139</sup>.

## Rocket projectiles

In Europe, only 122mm multiple launch rocket systems are produced: in Bulgaria (two companies), Poland (two), Romania (one), Slovakia (one holding company of the Czechoslovak Group) and the Czech Republic (one national and one holding company of the Czechoslovak Group). In Bulgaria, the Arsenal company equipped and launched a production line for 122mm rockets.

STV Group invested CZK 150 million (\$6 million) to produce 122mm

rockets at the Czech plant of the holding <sup>140</sup>.

The German group Rheinmetall is negotiating with the American corporation Lockheed Martin regarding the organization of production of rounds for the 227-mm MLRS M142 HIMARS<sup>141</sup> in Germany.

## Explosives (HE) and gunpowder

The main European producers of explosives and propellants for ammunition are the Chemring Group, the French company Eurengo, the Rheinmetall group and national companies in Poland, Serbia and the Czech Republic.

Chemring Nobel (Søtre, Norway), part of the Chemring Group, is the leading producer of HMX in Europe.

Eurengo is a European leader in the production of high explosives and propellants, with plants in France (Bergerac and Sorgues), Belgium (Clermont-sous-Huy) and Sweden (Karlskoga). 60 million euros have been allocated to the Bergerac plant to increase propellant production to 1,200 tons of products per year by the first half of 2025, which will ensure the production of 500,000 propellant charges for 95,000 projectiles<sup>142</sup>.

Nitrochemie is responsible for the production of gunpowder in the Rheinmetall Group. Its plant in Hungary will launch a production line for the production of gunpowder by 2026.

hexogen.

Zakłady Chemiczne Nitro-Chem (Poland) is a major global manufacturer of explosives and the leader in Polish defense industry exports. It was allocated 300 million Polish zlotys (71.4 million dollars) for the production of nitrocellulose and multi-base propellants<sup>143</sup>.

Milan Blagojevic (Serbia), with over 1,300 employees, is a world leader in the production of nitrocellulose and gunpowder, about 85% of which is exported<sup>144</sup>. The Czech company Explosia, which produces single- and double-base

gunpowder, equipped a production line for the production of propellant charges in 2022.

for 155-mm artillery shells, investing 100 million Czech crowns (4 million dollars)<sup>145</sup>.

It is planned to invest up to 500 million Czech crowns (20 million dollars) in development by 2026.<sup>146</sup> The Arsenal company in Bulgaria

has the capacity to produce explosives and gunpowder.

## South Korea Industrial potential

The Republic of Korea has a powerful and rapidly developing defense industry. The priority vectors for the development of the Korean military-industrial complex are areas of significant synergy with the country's existing civilian industries. This is primarily shipbuilding, the production of armored vehicles and artillery systems, military vehicles and special equipment. Korea completely covers the needs of its armed forces in this niche.

### Ammunition for barrel artillery

South Korea has significant capacity for the production of artillery ammunition, producing about 200,000 155mm shells per year.<sup>147</sup> It supplied the United States with 300,000 (according to other sources, 330,000<sup>148</sup>) 155mm artillery shells, which allowed Washington to send more ammunition to Ukraine than all European countries combined.<sup>149</sup>

Despite the initial intention of the South Korean Defense Ministry to remove all 105-mm howitzers from service by 2020 in connection with the transition to the 155-mm K9 Thunder self-propelled guns, units with 105-mm guns remain in service today. Moreover, South Korea produces about 200 thousand per year and has about 3.4 million 105-mm artillery shells in storage.

### Missile weapons

The main manufacturer of missile weapons in South Korea is LIG Nex1 (formerly known as NEX1 Future, LG Innotek, Goldstar Precision) under the LG Group. The range of missile weapons developed and produced by LIG Nex1

includes:

— Hyunmoo-3 cruise missiles. Hyunmoo-3A has a range of 500 km, Hyunmoo-3B — about 1000 km, Hyunmoo-3C will be able to hit a target at a distance of up to 1500 km. The main carriers of these missiles are KDX-II destroyers and submarines. The Hyunmoo-3B air-launched cruise missile with a range of over 500 km has been developed.

— The SSM-700K C-Star anti-ship missiles with a range of about 180 km are equipped with active radar guidance and are deployed on the KDX-II and KDX-III destroyers.

— Anti-tank missile system

AT-1K Raybolt, the most notable feature of which is the infrared seeker, providing the implementation of the "fire and forget" principle. The missile has a tandem warhead and horizontal and top strike modes. The Raybolt uses smokeless propellant and can be fired from enclosed spaces. The Raybolt missile and the Observation and Launch Unit (OLU) can be mounted on a vehicle or carried in backpacks by two soldiers; the possibility of mounting the AT-1K on helicopters is under discussion. The system has been exported to Azerbaijan, the UAE, Saudi Arabia, and is actively promoted in India and Indonesia.

— South Korean medium-range air defense system KM-SAM, developed by the Agency for Defense Development (ADD).

— K-SAAM short-range naval air defense missile system. Jointly developed by the Defense Development Agency, LIG Nex1 and Hanhwa Defense. Equipped with mid-course inertial guidance and a combined infrared homing system.

guidance for final guidance.

Deployed on Daegu-class frigates and ROKS Marado.

— K-SAM Pegasus short-range air defense missile system. — KP-SAM Chiron MANPADS, developed with Russian participation, were supplied to Indonesia and Romania. The South Korean Armed Forces ordered about 2,000 MANPADS missiles.

of this type.

It is worth noting that LIG Nex1 is also a developer and manufacturer of guided aerial bombs.

### Ammunition for close combat weapons

The main manufacturer of close combat ammunition in South Korea is the Hanwha Group. The company produces hand grenades and grenade launchers. In addition, the Poongsan Corporation produces Panzerfaust 3 anti-tank grenade launchers under a German license.

## Japan

### Industrial potential

In Japan, the capacity to produce weapons and ammunition belongs to civilian private companies. For example, the production of guided missiles is the responsibility of Mitsubishi Heavy Industries, a large industrial conglomerate with assets primarily in civilian shipbuilding, aerospace, and transport engineering. The production of unguided munitions is the responsibility of Daikin, a company specializing in

which is used to manufacture air conditioners and ventilation systems. The Japanese and British governments are considering exporting 155mm artillery shells to the UK, which could indirectly help arms deliveries to Ukraine (by freeing up stockpiles in British warehouses). The Japanese government is considering sending artillery shells to the US, and is also finalizing plans to supply the US with Japanese-made Patriot missiles. For Tokyo, this would be the first delivery of finished lethal military equipment since the principles of weapons and military equipment transfer were introduced in 2014. Under current rules, Japan can only export equipment components manufactured under license.<sup>151</sup>

### Ammunition for barrel artillery

Almost all the production capacities for 155-mm artillery shells in

Japan owns the Daikin company. The company produces shells under license from the British defense industry corporation BAE Systems and is capable of producing about 100 thousand 155 mm artillery shells per year using its existing capacities. Japan's industrial potential in the sphere of ammunition production is represented by the JR Automation

company (a subsidiary of the Hitachi concern), which develops and produces automated ammunition loading lines - both for artillery and for small arms<sup>152</sup>.

### Ammunition for close combat weapons

Together, the enterprises cover the needs of the Japan Self-Defense Forces for the most in-demand small arms ammunition and grenade launcher rounds.

### Missile weapons

The main manufacturer of missile weapons in Japan, Mitsubishi Heavy Industries Corporation, is the only foreign (outside the United States) manufacturer of PAC-2 and PAC-3 missiles for the Patriot air defense system. In addition, Japanese companies produce a full range of components for missiles of this type, which ensures a relatively

independence of production from American companies.

The range of missile weapons produced by Mitsubishi Heavy Industries also includes:

- Mitsubishi AAM-4 medium-range air-to-air missiles with active radar homing. A new long-range air-to-air missile, the JNAAM, is being developed jointly by Japan and the UK for the F-35.
  
- The Mitsubishi AAM-5 short-range air-to-air missile, developed and produced by Mitsubishi Heavy Industries for the Japan Air Self-Defense Force. — The ASM-3 supersonic air-to-ship missile, with a range of

range of about 400 km, the main carrier of which is the Mitsubishi F-2. - The Type 12 coastal-based anti-ship missile is equipped with a combined guidance system and has a range of about 200 km.

In addition to Mitsubishi Heavy Industries, Kawasaki Heavy Industries is a developer and manufacturer of missile weapons. This company has developed and produces small series of Chy-MPM anti-tank missile systems with semi-active laser guidance.

### **Key findings** 1. The campaign in

Ukraine revealed problems in the NATO military supply system, particularly in the artillery ammunition niche – 155mm NATO standard shells and Soviet 122mm and 152mm caliber shells. 2. The EU Council approved an increase in production under the Act in Support of Ammunition Production (ASAP), with the goal of reaching 1 million 155mm rounds per year.

3. There has been an increase in investment in expanding the production of air defense missiles, anti-radar missiles and ATGM missiles, tactical missiles, guided air bombs, and restoring and increasing the production of MANPADS missiles. At the beginning of the conflict, NATO countries, including the United States, sharply decreased their stockpiles of ATGMs and RPGs. Starting from the second half of 2022, the main manufacturers, on the one hand, increased the production of anti-tank weapons, on the other hand, during the first stage of the air defense war, a significant number of Russian armored vehicles were withdrawn. The task of destroying tanks was redistributed from infantry to artillery, drones, and loitering munitions. 4. The United States is actively investing in expanding the production of artillery ammunition, air defense missiles, tactical missiles

and MLRS shells, anti-tank missiles, and the restoration of MANPADS production. Since the beginning of the conflict, the United States has invested \$3.4 billion in additional ammunition production, of which \$2.5 billion in the production of 155-mm shells, in order to produce 80,000 shells per month by the beginning of 2025. The United States is actively attracting companies that have not previously done this to produce shell components, including

Canadian.

5. Israel. After the current escalation of the Palestinian-Israeli conflict ends, supplies of old air defense missiles and other ammunition may be delivered.

6. South Korea has agreed to lease 155mm artillery shells to the US, allowing it to send more shells to Ukraine. 7. Japan is bound by current legislative restrictions on the export of ammunition. It plans to provide Britain with 155mm artillery shells, allowing London to send more shells to Ukraine.

### **Plans and prospects for expanding the production of weapons and ammunition**

Below is information on the expansion of NATO countries' production capacity based on the experience of the conflict in Ukraine:

1. At the beginning of 2023, the United States produced 14,000 155mm artillery shells per month, while Ukraine's monthly request is 250,000 rounds. It is stated that by commissioning new production capacities, the country's production of 155mm shells will increase sixfold in five years. Currently, it takes the United States 12 to 18 months to reach a production level of 70,000 shells per month, and Ukraine's requests are met.

are obtained mainly from warehouse stocks, as well as through the Pentagon's purchase of large quantities of artillery

- ammunition from other manufacturing countries, in particular Germany, South Korea, Turkey, and Pakistan.
2. In 2022, the EU countries produced about 300 thousand 155-mm shells (an average of 25 thousand shells per month). The European Commission allocated 1 billion euros from the European Peace Fund to increase production capacity to help achieve the production target of 1 million shells per year. To this end, 11 countries will begin accelerated production of 155-mm shells, and two more EU countries will begin accelerated production of 152-mm shells. 3. In 2024, information appeared that the combined capacity of the 27 EU countries in 2023 was about 700 thousand shells. The EU Commissioner for Internal Market and Industry has suggested that the EU will reach the target of 1 million shells per year by March or April 2024.<sup>153</sup> In March 2024, the European Commission invested an additional €500 million in the industry, aiming to increase production to 1.7 million shells per year.<sup>154</sup> 4. Rheinmetall, Germany's main ammunition manufacturer, has announced plans to increase production of 155mm shells from 60–70 thousand to 450-500 thousand per year. For this purpose, the company acquired a plant in Spain and is building a new plant in Hungary. Other large European manufacturers of artillery ammunition - BAE Systems, Nammo, Nexter - are capable of increasing production from 20 thousand to 30 thousand 155-mm shells per year. The Slovak holding ZVS is ready to produce 100 thousand shells per year. 5. In 2024, the German concern Rheinmetall will expand the existing production of 155-mm ammunition from 1.2 to 8.5 billion euros. The recipient countries (in addition to Germany) from 2025 will be Ukraine, the Netherlands, Estonia and Denmark. For Rheinmetall, this is the largest order in the company's history<sup>155</sup>.
6. Rheinmetall to build 155mm artillery plant in Lithuania shells, which will be put into operation by the end of 2025.<sup>156</sup>
7. Since February 2024, Rheinmetall has been working to double or even triple the propellant capacity required to produce artillery shells – up to 700,000 artillery shells per year by 2025. A new Rheinmetall plant with an annual production capacity of 200,000 artillery shells and 1,900 tons of explosives is being built in Unterlüss, Lower Saxony<sup>157</sup>. Investments in the plant amount to 300 million euros; 500 new jobs will be created.
8. In March 2024, Rheinmetall announced plans to open at least four factories in Ukraine. They will produce shells, military equipment, gunpowder, and anti-aircraft automatic guns with sales volumes of 2 to 3 billion euros per year. "The foundation stone for the plant will be laid soon, and it will be built on the model of the ammunition plant that Rheinmetall is building in Germany."<sup>158</sup> 9. In June 2024, Rheinmetall specified the investment volumes in the construction of the plants: the facility in Germany - more than 300 million euros with a production capacity of 200,000 artillery rounds per year, the plant in Lithuania - 180 million euros, the gunpowder plant in Romania - 400 million euros. The concern's most ambitious initiative is a plant for the production of 155-mm ammunition in Ukraine, where Rheinmetall intends to cook "six-figure" quantities shells per year. However, the facility will probably be put into operation after the completion of the SVO.
10. Rheinmetall plans to increase the production of tank ammunition from 70 to 140 thousand per year.
11. Within the framework of the Ammunition Support Act (ASAP), Rheinmetall will be provided with a subsidy of 130 million euros<sup>159</sup>.
12. In 2025, Eurenco, a leading European supplier of gunpowder and explosives, will open a plant in Bergerac

- (Dordogne, southwest France) and will produce 1,200 tons of gunpowder per year<sup>160</sup>.
13. In March 2024, the EU allocated €560 million to arms companies (Rheinmetall, Nexter, Nammo and Eurenco) to increase ammunition production for Ukraine. The bulk of the funding will go to explosives and gunpowder manufacturers — €124 million and €248 million, respectively. The funding is aimed at increasing the production of shells to 2 million per year by the end of 2025.<sup>161</sup>
  14. According to CSIS, by April 2022, the United States had transferred almost a third of its Javelin missiles to Ukraine — 7,000 units (before the conflict, the Pentagon purchased Javelins on average 1,000 units per year), while in the early days of the war in Ukraine, up to 500 missiles were used per day. By February 2024, Lockheed's production capacity was expanded to 2,400 missiles per year. The company is working with the US Army to increase production capacity to 3,960 Javelins per year by the end of 2026.<sup>162</sup>
  15. Since the beginning of the conflict, the US has invested \$3.4 billion in expanding ammunition production, \$2.5 billion of which went into producing 155mm shells, in order to reach a production rate of 80,000 shells per month by early 2025. The US is bringing in companies that have not previously done this (Canadian) to produce shell components, with plans to replace imported TNT with IMX<sup>163</sup>.
  16. In 2023, the American defense company Northrop Grumman opened a new missile production facility in Allegany, West Virginia. The plant produces up to 300 Anti-Radar Guided Missiles, Extended Range (AARGM-ER), with the ability to expand production to 600 per year. The AARGM-ER is an upgrade of the existing AARGM and will be installed on the U.S. Navy F/A-18E/F Super Hornet and EA-18G Growler aircraft, as well as the U.S. Air Force F-35A, Marine Corps F-35B, and Navy and Marine Corps F-35C aircraft. Further growth is under discussion
  17. In May 2024, American missile manufacturer Raytheon announced the expansion of its missile integration center in Redstone, Alabama. The investment will amount to \$115 million.<sup>165</sup>
  18. In June 2024, the American defense company Northrop Grumman announced that it planned to produce tank ammunition, 155 mm shells, and others in Ukraine as part of a joint project. <sup>166</sup> 19. The Swedish military-industrial complex (Saab Group) plans to increase the production of NLAW anti-tank guided missiles to 400 thousand units per year and Strf 90 infantry fighting vehicles to one per day. The Swedish Saab Group began hiring up to 1,000 new employees. <sup>20</sup> In May 2024, the US Department of Defense entered into a contract with Lockheed Martin for \$756 million for the supply of a battery for the Dark Eagle hypersonic missile system (LRHW)<sup>167</sup>.
  21. In June 2024, Norwegian defense manufacturer Kongsberg opened a new missile factory to produce Naval Strike Missile (NSM) anti-ship missiles.<sup>168</sup> <sup>22</sup> In February 2024, it became known that Dynamit Nobel Defense (DND) is a German arms manufacturer, a subsidiary of the Israeli state-owned arms concern Rafael) and the Ukrainian state-owned company JSC Ukrainian Defense Industry are exploring the possibility of producing Panzerfaust 3 anti-tank grenade launchers in Ukraine.<sup>169</sup>
  23. The Finnish government is investing more than \$130 million over the next three to four years to double the production of "heavy" artillery and mortar ammunition, i.e. 155 mm artillery shells and 81 mm and 120 mm mortar rounds. The production will be located at the facilities of Nammo Lapua Oy by 2026–2027.<sup>170</sup>
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24. In January 2024, the Finnish Ministry of Defence announced that it would test the mobilisation industrial reserves in test mode. They were developed during the Soviet era – these are pre-established production lines for the manufacture of defence products and stocks of components for production<sup>171</sup>.

25. In early 2024, the Swedish Defence Technology Agency signed a contract with the Nordic Ammunition Company (Nammo) for the production and delivery of 155mm artillery ammunition for Ukraine worth €12.4 million<sup>172</sup>. In March 2024, the European Commission awarded Nammo €12.2 million. With European production support and Swedish co-financing for the project, Nammo will be able to triple the production of 155mm rounds, which are in demand in Ukraine<sup>173</sup>.

26. In March 2024, the Swedish Saab Group announced that it would open an ammunition production plant in the United States - a joint project between Saab and the American company Boeing to develop and produce missile weapons systems for the US armed forces, such as components for the GLSDB small diameter land-based bomb<sup>174</sup>. 27. In January 2024, the Bulgarian Ministry of Defense reported that the country's military-industrial complex was operating 24/7 and that most of its military products were being sent to Ukraine "through third parties." It is planned to launch production lines for 105 mm and 155 mm NATO-standard ammunition, in addition to the Soviet-style ammunition already produced at Bulgarian factories<sup>175</sup>.

28. In June 2024, it became known that factories in Serbia were working in three shifts to supply ammunition to Ukraine<sup>176</sup>.

In April 2023, the EU Foreign Affairs Council identified areas of work to increase the production of military products in EU countries:

1. Increase in production of Soviet-caliber ammunition (152-mm artillery shells, 122-mm rockets), restoration and modernization of their production capacities in Poland, Bulgaria, Slovakia, the Czech Republic and Romania. Ukraine's own reserves are largely exhausted.

2. Development of cooperation with European countries that are not members of the EU but retain a developed defense industry, including Norwegian, British, Swiss and Serbian companies, since, thanks to the protection of their industry, they have preserved the ammunition industry better than the "old" EU members.

3. Encourage standardization to ensure interoperability

bridges.

4. Speeding up the process of issuing export licenses, especially for components substances used by other countries for military production.

5. Exploration by Member States' defence research and innovation agencies, with support from the EU and NATO, of options for implementing new high-tech solutions offered by 3D printing and funding research into all forms of innovative manufacturing.

The US notes that the main obstacles to a significant increase in arms production volumes are the large amount of weapons in storage and the "absence of a clear market signal." It is difficult for companies to attract investment in conditions of uncertainty; some management and analysts believe that the Ukrainian conflict may end before production capacities are expanded and investments in their expansion will be wasted. Therefore, leading US military-industrial complex companies, as well as civilian companies that may enter the market, are waiting for a clear signal from the White House and the Pentagon about a long-term increase in purchase volumes. <sup>177</sup>



# Artillery systems

## Rocket artillery

The leading manufacturers of multiple launch rocket systems (MLRS) are:

- Lockheed Martin Corporation (USA): 227 mm MLRS M142 HIMARS and 227 mm MLRS M270 MLRS;
- Hanwha Aerospace Company (South Korea): multi-caliber (131-mm/227-mm/239-mm) MLRS K239 Chunmoo;
- Excalibur Army (Czech Republic): 122 mm MLRS RM-70 Vampire 4D, which is a modernized clone of the 9K51 Grad MLRS;
- Elbit Systems (Israel): multi-caliber (122-mm/160-mm/306-mm) MLRS PULS (Precise & Universal Launching System), which is an original development;
- ROKETSAN Corporation (Türkiye): 302-mm MLRS TRG-300 Tiger/Kasirga

The most widely produced model is the American M142 HIMARS MLRS. After the start of the Second Military Operation by the end of 2024, the production rate was increased to 96 vehicles per year (eight per month). Lockheed Martin Corporation invested \$65 million in doubling the production rate. Contracts have been signed for the export supply of 105 M142 HIMARS MLRS. Poland also contracted 486 launch modules for their subsequent installation on a nationally produced chassis by the national defense industry with technical assistance from the Americans (Homar-A program); delivery is scheduled for 2026–2030.

The second most widely produced model is the South Korean K239 Chunmoo MLRS. After the start of the SVO, production is carried out in the interests of foreign customers. Poland contracted 290 launch modules for their subsequent installation on a chassis of national production by the national defense industry with technical assistance from the Koreans (the Homar-K program);

Delivery is scheduled for 2027. The production rate of the K239 Chunmoo MLRS is estimated at 30 sets per year.

Before the start of the Second World War, the Czech Republic delivered 26 RM-70 Vampire 4D MLRS combat vehicles to foreign customers; after the start of the Second World War, 20 RM-70 units were sent to Ukraine.

Israel mass-produces PULS MLRS, which are being purchased by Morocco (2023), Denmark (2023–2025), the Netherlands (2024–2026), and Spain (since 2027). Germany may purchase 89 combat vehicles under the EuroPULS program.

Before the start of the Second Military Operation, the Turkish army was supplied with more than 50 MLRS combat vehicles.

TRG-300 Tiger/Kasirga; 23 more products shipped to foreign customers, new contracts in

There have been no contracts concluded in recent years.

## Barrel artillery

Currently, the leading manufacturers of artillery systems (self-propelled and towed howitzers - SG and BG) of the main (155 mm) caliber are:

- BAE Systems Corporation (Great Britain, USA, Sweden): 155-mm SG M109A7, 155-mm SG Archer FH77 BW L52 and 155-mm BG M777;
- Hanwha Aerospace (South Korea): 155mm K9 Thunder SG;
- Krauss-Maffei Wegmann (Germany): 155-mm SG PzH 2000 and Boxer RCH 155;
- Nexter Defense Systems (France): 155-mm CAESAR SG;
- Huta Stalowa Wola company (Poland): 155th SG AHS Krab;
- Konštrukta Defence company (Slovakia): 155-mm SG Zuzana 2;
- Makine ve Kimya Endüstrisi corporation (Türkiye): 155 mm SG T-155 Fırtına and 155 mm BG Panter;
- Elbit Systems (Israel): 155mm SG ATMOS 2000.

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## Artillery systems

The most widely produced model is the American 155-mm SG M109 in its latest version M109A7.

In early 2024, the US Department of Defense invested \$50 million in BAE Systems to resume serial production of the 155mm M777 BG and \$463 million for their maintenance.

The second most produced model is the South Korean 155mm SG K9 Thunder and its Turkish licensed clone 155mm SG T-155 Fürtýna. More than 1,700 copies have been manufactured to date.

The recipients of the German 155-mm SG PzH 2000 were Germany, the Netherlands, Greece, Qatar, Hungary, Ukraine (22 vehicles). In 2024, Germany transferred another 18 vehicles to Ukraine as military-technical assistance. An order for 54 vehicles for Germany and Ukraine is expected.

Krauss-Maffei Wegmann has signed a contract with Ukraine as the launch customer for the delivery of 54 of the latest 155mm RCH 155 SG on the chassis of the Boxer armored personnel carrier with an 8x8 wheel arrangement. The total volume of the potential German-British order is estimated at 400 vehicles. Start

deliveries to customers are planned for the end of the current decade.

The most widely produced model of all wheeled artillery units is the French 155mm SG CAESAR: 607 vehicles have been produced to date, including 391 for foreign customers.

Four types of chassis are used as a base: for the CAESAR 6x6 Mk I product - the Sherpa 5 from Arquus or

Unimog U2450 joint production

SOFRAME and Mercedes-Benz; for the CAESAR 8x8 product — T815-7 Force from Tatra Trucks; for the CAESAR 6x6 Mk II product — Armis from Arquus.

Foreign customers for the CAESAR 6x6 Mk I product are: Morocco, Saudi Arabia, Thailand, Estonia, Ukraine - 72 (including 6 ordered directly by Ukraine, 12 by France, the rest by 22 states of the so-called artillery coalition led by France; delivery in 2024-2025) and Armenia (delivery in 2025).

Foreign customers for the CAESAR 8x8 product are: the Czech Republic and Denmark (the latter transferred 19 SG to Ukraine in 2023 through military-technical assistance).

Foreign customers for the CAESAR 6x6 Mk II product are: Belgium and Lithuania (deliveries are scheduled to begin in 2027).

The Israeli 155-mm SG ATMOS 2000 is produced in small batches exclusively for foreign customers. The Polish 155-mm SG AHS Krab is a hybrid of the chassis from the South Korean 155-mm SG K9 Thunder and the artillery unit of the British 155-mm SG AS90M Braveheart. Ukraine placed an order for the production and received 54 vehicles of this type. In connection with the placement of additional orders, the management of the Huta Stalowa Wola company set the task of reaching production of 110 vehicles per year.

The Slovak 155-mm SG Zuzana was transferred to Ukraine in 2 batches of 8 and 12 vehicles under military-technical assistance (financing of production by Denmark, Germany and Norway). Ÿ

# Air and missile defense systems

Today, the leading developer and manufacturer of air defense and missile defense systems in

the West. Leaving aside strategic missile defense systems, the following main programs in the air defense and tactical missile defense segment can be identified, as well as enterprises and their production volumes: of water.

## United States of America **THAAD**

The THAAD (Terminal High Altitude Area Defense) tactical missile defense system was developed under the leadership of Lockheed Martin Corporation with the participation of Raytheon Corporation (now RTX). The relatively low production volumes of THAAD systems (maximum one battery per year) are limited not by production capabilities, but by budgetary and military-political factors.

Each THAAD battery includes six vehicle-mounted launchers, one or two TFCC command posts, and one RTX (Raytheon) AN/TPY-2 radar. The HIMARS (formerly MLRS) missile systems, GMLRS missiles, Patriot PAC-3 anti-aircraft guided missiles, TFCC command post electronic systems, and THAAD interceptors are also mass-produced here.

Direct production of THAAD anti-missiles is carried out at one of the leading enterprises of the Lockheed Martin Missiles and Fire Control division, where

The production of Javelin anti-tank missiles and JASSM series air-launched cruise missiles is ongoing. The production rate of THAAD anti-missiles is low and is at a level of up to 100 units per year. In December 2023, the production of the 800th THAAD anti-missile was announced. In April 2023,

Lockheed Martin has received another contract for the production of Lot 15 anti-missiles worth \$180.3 million.

## **Patriot**

Patriot is the primary medium- and long-range air defense and tactical missile defense system of the United States Army and was developed by Raytheon (now RTX). To date, the Patriot SAM system is in service with 17 countries (although Israel announced its decommissioning in 2024), and has been ordered by two more countries (Switzerland and Morocco, with new orders also from Germany and Poland), and in 2023, applications for its purchase were received from six more possible

customers.

The Patriot battery includes from four to eight (the standard in the US Army is eight) launchers, towed or self-propelled, as in the German version, a command post and a multifunctional radar.

Serial production of anti-aircraft missiles RAS-3 MSE is carried out by the complex Lockheed Martin Camden Operations in Camden. Government funding has allowed production to increase to more than 650 PAC-3 MSE missiles per year by 2025. The US Army leadership does not consider it advisable to increase production beyond

of this value.

RTX (Raytheon) continues to produce the older PAC-2 GEM-T long-range missiles. Their production is to be increased from 20 to 35 per month (420 per year) by 2027.

RTX estimates the existing order book for RAS-2 GEM-T missiles at 1,500 units, with the possibility of increasing by another 1,000.

The production of missiles for the Patriot air defense system is also carried out outside the United States. In Japan

Mitsubishi Heavy Industries is the licensed manufacturer of all Patriot components (up to 100 PAC-3 units per year). The Japanese government will transfer the PAC-2 GEM-T and PAC-3 produced in Japan to the United States to replenish Ukraine's stockpiles. In total, the United States has manufactured more than 10,000 Patriot air defense missiles of all modifications, excluding the PAC-3 MSE. In June 2024, the US Army issued a \$4.5 billion contract for the purchase of 870 PAC-3 MSE missiles, including the development of an upgraded version.

### ***Iron Dome / SkyHunter***

The Israeli Iron Dome tactical missile defense system is a product of the Israeli companies Rafael Advanced Defense Systems and Israel Aerospace Industries (IAI) and the American corporation Raytheon (RTX). Funding for the work amounted to \$ 1.6 billion from 2011 to 2021, and in 2022 the US Congress allocated another \$ 1 billion. To date, up to 8,000 Tamir anti-missiles have been manufactured for the Israeli Ministry of Defense, and their production volumes at Rafael (jointly with RTX) can reach 1,000 units per year. The Iron Dome battery includes up to six 20-charge towed launchers, a control center, as well as a multifunctional IAI Elta EL / M-2084 radar. In early 2024, RTX and Rafael began construction of a new facility in the United States to produce Tamir and SkyHunter interceptor missiles, for which they have jointly allocated \$65 million. The facility will be commissioned in late 2025 and will initially have a capacity of 1,000 interceptor

missiles per year, quickly increasing to 2,000 per year.

### ***NASAMS***

The US Air Force acquired two NASAMS medium-range air defense batteries to provide air defense for Washington after the events of September 11, 2001, and transferred them to Ukraine in 2022. At least 12 new-generation NASAMS air defense systems have been contracted for Ukraine to date. NASAMS is not used by the US Armed Forces, but is actively

is purchased by third countries - today there are 13 customers, not counting Norway.

A special feature of NASAMS is the use of to serve as anti-aircraft guns

standard medium-range air-to-air missiles with active radar homing, the AIM-120 AMRAAM series, manufactured by Raytheon (RTX). Later, the AIM-9X Sidewinder short-range air-to-air missiles with an infrared guidance system, also manufactured by Raytheon (RTX), were introduced into the SAM system. The third type of extended-range missile, already specially created by Raytheon for use in NASAMS, was the AMRAAM-ER, which is a combination of the RIM-162 ESSM ship-based anti-aircraft guided missile with the active radar homing head of the AIM-120C-8 AMRAAM missile. The AIM-9X Sidewinder and AMRAAM-ER missiles are used in the most modern modification of the system, designated NASAMS 3.

AMRAAM and AIM-9X Sidewinder missiles are manufactured at Raytheon Tucson Missile Systems in Tucson, Arizona. This is Raytheon's (RTX) largest missile plant, which also produces Patriot PAC-2 and Stinger air defense missiles, Tomahawk cruise missiles, TOW anti-tank guided missiles, SDB II guided bombs, and a number of other models. In 2020, Raytheon announced its intention to invest \$400 million over 10 years in the Tucson facility. In 2023, production increased to 1,200 missiles, primarily due to increased production for the use of these missiles as part of the NASAMS air defense system. The US Air Force has increased AMRAAM purchases in the coming years: 457 missiles in FY2024, and 1,500 in the FY2025 budget. y. - 462 missiles and in fiscal 2026 - 664 missiles, which in total will lead to an increase in AMRAAM production to 2,000 or more missiles per year.

The AIM-9X Sidewinder missile is mass-produced for the US military and for export as the main Western close-air combat missile.

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## Air and missile defense systems

Its use in the NASAMS air defense system is rapidly expanding. The annual production of missiles AIM-9X-2 Block II reaches 1400–1,500 units in 2022–2023, with new orders coming in all the time. In September 2023, RTX was awarded a \$74.8 million US DoD contract to expand its AIM-9X Sidewinder missile production capability to 2,500 units per year by 2026. AMRAAM-ER missiles are produced at the same RTX facility in Camden that produces

ESSM naval missiles. AMRAAM-ER missiles entered serial production in 2022, and there is already evidence of their use in Ukraine. AMRAAM-ER is currently under contract to a number of NASAMS air defense system customers (Qatar, Hungary, the Netherlands). The rate of possible AMRAAM-ER serial production is unclear, but it is estimated

at the initial stage constitute no less than

200 missiles per year.

The production of NASAMS SAM launchers and command posts by Kongsberg Group in Norway is now a “no-

“what place” in the production of the complex, and to 2024, due to the large volume of orders, the queue for the delivery of these elements stretched out for three years.

### **Standard**

The ship-based long-range anti-aircraft guided missiles and anti-missiles of the Standard family (SM-2, SM-3, SM-6) produced by Raytheon (RTX) are widely used by the US Navy and its allies, and recently have been finding increasing ground application both in stationary missile defense systems (SM-3 in the land-based AEGIS Ashore systems) and as a quasi-ballistic surface-to-surface missile (SM-6 in the new US Army land-based mobile missile system Mid-Range Capability (MRC) Typhon and its analogue developed by the US Navy). It can be assumed that the ground application of the Standard SM-3 and SM-6 series missiles will continue to expand due to their high characteristics.

At the same time, the Standard series missiles are distinguished by their high cost and relatively low production volumes. SM-2 missiles are produced only for export and their production depends on irregular orders, reaching up to 100 units per year.

In April 2024, RTX announced a \$115 million program to increase the capacity of its Huntsville facility by 50% by the end of 2025. The Navy's FY2024 budget includes \$200 million to increase RTX's annual SM-6 missile production capacity to 200 units in 2026 and 300 units in 2028. The main challenge in expanding Standard missile production is reportedly increasing the supply of solid rocket motors.

### **Stinger**

The Stinger missile remains the main short-range means of American military air defense, used not only in a portable version, but also as part of self-propelled air defense systems. Serial production of Stinger missiles is carried out at the Raytheon Tucson Missile Systems plant in Tucson, Arizona. It ceased in December 2020 (deliveries to the US Army have not been carried out since 2004) after producing more than 90 thousand missiles over 40 years, but was resumed in 2021 for an unspecified foreign customer. In May 2022, the US Army awarded RTX a \$624.6 million contract for 1,300 Stinger missiles to replenish its inventory after a large number were transferred to Ukraine, then increased it to 1,700 missiles for delivery by 2026. The missiles are being delivered in a modified FIM-92K design. In January 2024, the US government approved a request from Germany, Italy and the Netherlands to purchase 940 new missiles.

Stinger.

In September 2023, the US Army awarded contracts to RTX and Lockheed Martin for the competitive development of a new man-portable and vehicle-mounted air defense system to replace the Stinger, with a missile of the same form factor. Serial production is planned to begin in 2028.

## Europe

In Europe, the centers for the development and production of air defense systems are the European missile association MBDA (which is actually implementing several multinational and national programs), the Thales group, as well as the German company Diehl Defence, the Swedish group Saab and the above-mentioned Norwegian group Kongsberg.

### **SAMP/T**

Within the framework of the Eurosam consortium, the MBDA association together with the Thales group created a family of modern highly effective naval and land-based anti-aircraft missile systems based on the Aster series of anti-aircraft missiles in the Aster 15 short-range modifications and the Aster 30 medium and long-range (and its modified versions Aster 30 Block 1 and Aster 30 Block 1NT). The program involves leading specialized enterprises from France, Italy and Great Britain. Serial land-based mobile SAM systems of medium and long range using missiles

The Aster 30 is a SAMP/T (Sol-Air Moyenne-Portée/Terrestre) developed for the French (11 systems, designated Mamba, were received) and Italian (six systems), then exported to Singapore (three systems). In 2023, one system was jointly transferred from France and Italy to Ukraine, and another one is expected to be transferred by Italy.

The SAMP/T SAM system includes four or six self-propelled launchers on a vehicle chassis, a command post, an information processing post and a Thales Arabel multi-functional radar. Currently, a modified version of the SAMP/T NG (Mamba NG) SAM system is in the testing phase, using upgraded long-range Aster 30 Block 1NT anti-aircraft missiles. The complex includes a new multi-functional radar

(Thales Ground Fire 300 in the French version and Leonardo Kronos GM HP in the Italian version), a new command post and

up to six launchers. The French Air Force plans to purchase 12 SAMP/T NG SAM systems between 2025 and 2035 for a total of up to €5 billion, the Italian Air Force five or six systems, and the Italian Army four systems, with the latter being the first to be contracted in January 2024.

Within the Eurosam consortium, the French side was responsible for the development and production of radars, command posts and information processing posts, and the Italian side was responsible for the production of launchers (in SAMP/T NG, the Italians also created radars for themselves). The production of Aster missiles has been underway since 2006 by the French branch

of MBDA (MBDA France) at a plant in Celle-Saint-Denis, with the supply of a number of components from Italy. In January 2024, France and Italy placed an order for the supply of another 700 missiles for their land-based and naval air defense systems.

Aster in various modifications worth 2 billion euros.

In March 2024, MBDA management announced its intention to increase production of Aster missiles by 1.5 times due to shorter order fulfillment times, reducing this figure to 18 months by 2026.

### **VL MICA**

A modern short-range air defense system developed by the French division of MBDA is the VL MICA, which uses vertically launched anti-aircraft missiles based on French guided missiles.

MICA air-to-air missile in the active radar homing version. The system is offered in land-based mobile (with Thales GM200 radar) and ship-based versions. The ship-based version has been accepted by the navies of at least 12 countries (up to 1,200 anti-aircraft missiles have been delivered and ordered). A new version of the system is the VL MICA NG, using a modified missile. Its ship-based version is scheduled for delivery in 2023.

### **CAMM**

The British division of MBDA (MBDA UK) has created an anti-aircraft missile system

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## Air and missile defense systems

short and medium range CAMM (Common Anti-Air Modular Missile), called Sky Sabre (Land Ceptor, FLAADS, EMADS) in the land-based mobile version and Sea Ceptor in the naval version. The CAMM anti-aircraft missile was developed on the basis of the MBDA AIM-132 ASRAAM short-range air-to-air missile and is equipped with an active radar homing head in combination with dual-channel radio correction. Under a contract with the Italian Ministry of Defense, the British and Italian branches of MBDA, together with the Italian company Avio (the engine supplier), developed a longer-range version of the CAMM-ER medium-

range anti-aircraft missile. In May 2024, the Italian Air Force and Army signed contracts for the purchase of land-based versions of the CAMM-ER SAM system, designated MAADS and Grifo, which will use the Rheinmetall Italia X-TAR3D radar. The naval version of the CAMM-ER SAM system, designated Albatros-NG, has been ordered by the Italian and Pakistani navies.

Poland has become the largest customer of the ground-based SAM system with CAMM missiles. In 2021–2023, it contracted with MBDA UK for a total of 24 batteries (48 systems of this type — a total of 144 iLauncher launchers and 48 radars) under the Narew program, as well as another 44 iLauncher launchers for integration into the 22 batteries of Polish Pilica+ combined anti-aircraft missile and gun systems being purchased. One Narew battery (delivered in 2022) and batteries of Pilica+ systems should use launchers with CAMM missiles, and 23 Narew batteries should use CAMM-ER missiles, which are to be delivered from 2027 to 2035. Accordingly, Poland has ordered 850 CAMM anti-aircraft missiles and more than 1,000 CAMM-ER missiles. At the same time, joint production of iLauncher launchers and CAMM-ER missiles in Poland is planned. In 2023, MBDA UK and the Polish defense industry association PGZ also signed an agreement on the joint development of a version of the CAMM-MR long-range anti-aircraft missile by 2030.

The British Sky Sabre SAM system (battery) includes six eight-container self-propelled vertical launchers iLauncher, a Giraffe Agile AMD detection radar from the Swedish Saab group and a Surface-to-Air Missile Operations Center (SAMOC) combat control point developed by the Israeli company Rafael. In the Polish version, the system

has three launchers and a Polish Sola-M or Sajina radar. Serial production of CAMM missiles

is carried out by the MBDA UK enterprise in Bolton, mainly for naval systems. The production volume of CAMM missiles is estimated at no less than 250 units per year. In the spring of 2024, it is planned to double the production of missiles by 2026, and organize the production of CAMM-ER missiles there.

### **IRIS-T**

The German company Diehl Defence (part of the Diehl Group) has created a short- and medium-range anti-aircraft missile system based on its IRIS-T air-to-air missile with an IR homing system. Small batches of systems with IRIS-T-SLS short-range vertical-launch anti-aircraft guided missiles, which are a complete analogue of the IRIS-T air-launched missile, were delivered to Sweden and Norway since 2018, but in 2022–2023 these countries transferred them to Ukraine.

As a further development, Diehl Defense, with funding from the German Ministry of Defense, developed the IRIS-T SLM medium-range air defense system, which uses a specially developed anti-aircraft guided missile equipped with an infrared homing head from the same IRIS-T aircraft missile. The IRIS-T SLM missile

uses additional radio command guidance (in combination with inertial-satellite correction) on the main section of the trajectory with target acquisition by an infrared homing head on the final section. The complex includes a TOC (Tactical Operations Centre) command post, a mobile detection radar

and target designation Saab Giraffe 4A or Hensoldt TRML-4D and three mobile vertical launchers with eight missiles each on a vehicle chassis.

In 2022, the German government decided to supply Ukraine with four IRIS-T SLM air defense systems of the new production by Diehl Defense using German government funding, with the first systems for Ukraine being taken from those manufactured for Egypt. This made it possible to transfer five IRIS-T SLM systems to Ukraine from October 2022 to May 2024. In total, Germany intends to supply Ukraine with 13 IRIS-T SLM systems, as well as 11 short-range IRIS-T SLS systems - the latter will use, among other things, missiles transferred by Sweden and Norway.

In 2022, the German government also signed a contract for the delivery of six IRIS-T SLM medium-range missile systems to the Bundeswehr from 2025 to 2027. These systems have been ordered by Latvia, Estonia and Slovenia, and Austria plans to purchase them (along with an option

IRIS-T SLS).

Due to such a large number of orders for IRIS-T SLM systems Diehl Defense plans to increase the production capacity of this system and the IRIS-T series missiles several times in the coming years. Overall, Diehl Defense intends to invest more than 1 billion euros in the development of military production in all areas between 2022 and 2027.

The IRIS-T SLM anti-aircraft missiles, like the IRIS-T air-to-air missiles, are produced on two production lines (400 to 500 IRIS-T SLM missiles in 2024, increasing to 1,000 units in 2026). The company is also working on the IRIS-T SLX long-range anti-aircraft missile, with the declared readiness for serial production in 2028.

## **NOMAD**

In 2024, the Norwegian Kongsberg Group presented and began testing the new self-propelled short-range air defense system NOMAD (Norwegian Maneuver Air Defence) - a complex on the tracked armored chassis ACSV G5 of the German company FFG. Test firings were carried out using IRIS-T missiles, but serial deliveries of the complex to both customers

The missiles are planned to be equipped with AIM-9X-2 Sidewinder guided missiles. Norway intends to purchase six NOMAD systems (batteries) for delivery in 2026–2028, and the Netherlands, most likely, the same number.

## **Portable systems (MANPADS)**

In Europe, the production of portable anti-aircraft missile systems is currently carried out by:

— The British division of the Thales group — the Starstreak and Martlet (with the LMM missile) systems with a laser guidance system. — The French division of the MBDA association (MBDA France) — the Mistral 3 system with an infrared guidance system. The production volume of the Mistral 3 will be increased by 2025 fourfold compared to 2022.

— Swedish Saab Group — complex RBSy70yNG with laser guidance system. A number of large orders have been received (in particular, from Canada).

Since 2023, the Italian branch of the MBDA association (MBDA Italia) has been working on the joint creation of MANPADS for the Italian Army and Ministry of Defense new generation to replace those that are on armed with the Stinger MANPADS. The system should have an IIR infrared homing system, developed by Leonardo, and be especially adapted for combating small UAVs.

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# Fighters and drones

The United States, Great Britain, the European Union, Israel, South Korea and Japan are leading manufacturers of various aviation products, including modern fighters and unmanned aerial vehicles (UAVs) for military purposes, from loitering munitions to heavy reconnaissance and reconnaissance-strike vehicles.

The exception is combat FPV drones (First-Person View), used in the vast majority of cases as loitering munitions (kamikaze drones). In this capacity, they began to be widely used and produced only during the SVO by both Russian and Ukrainian troops.

## Fighters

The production of modern fighters is characterized by a high degree of monopoly. The range of manufacturers of modern Western fighters is very limited: in the USA these are the corporations Lockheed Martin and Boeing; in Europe - the French company Dassault Aviation, the Swedish group Saab, the European consortium Eurofighter, in which the Airbus group, the British company BAE Systems and the Italian Leonardo participate; in South Korea - Korea Aerospace Industries; in Japan - Mitsubishi Heavy Industries.

The high cost of developing and producing fighters forces manufacturers to cooperate with each other. In addition to the Eurofighter consortium for the production of Typhoon fighters, the production of American F-35 fighters is carried out in cooperation with companies from different countries; the F-35 is assembled, in addition to the Lockheed Martin plant in the USA, at plants in Italy and Japan.

Of all the above-mentioned countries, only the United States and Italy assemble different types of fighters at different plants: in the United States, these are the F-15, F-16, F/A-18, and F-35, while in Italy, the Eurofighter Typhoon and F-35. The other countries each have one plant where final assembly of one type of fighter is performed: Rafale in France, KF-21 in South Korea, F-35 in Japan, and plants for final assembly of the Eurofighter Typhoon, in addition to Italy, are located in Great Britain, Germany, and Spain.

Plans and production volumes of fighters in Western countries have not undergone any significant changes over the past two years.

### *F-35 fighter jet*

The most widely produced modern Western fighter is the F-35 of the American corporation Lockheed Martin, produced in three main variants: the basic F-35A, the F-35B with short takeoff and vertical landing, and the carrier-based F-35C for the US Navy. There are three plants in total engaged in the final assembly and checkout (FACO) of these fighters<sup>177</sup>: — the Lockheed Martin plant in Fort Worth (Texas, USA) assembles the F-35 for the US armed forces and most foreign customers;

- Leonardo's Cameri plant near Novara (Piedmont region, Italy) assembles F-35s for the Italian and Belgian armed forces;
- Mitsubishi Heavy Industries in Nagoya, Aichi Prefecture, Japan, assembles F-35s for the Japan Self-Defense Forces.

In total, by mid-2024 for the US military and foreign customers

Up to 3,542 F-35s were produced. The US Armed Forces received 2,456 F-35 aircraft: 1,763 F-35As for the Air Force, 273 F-35Cs for the Navy, 353 F-35Bs and 67 F-35Cs for the Marine Corps.<sup>178</sup> Foreign customers expect to receive up to 1,086 F-35s: Australia — 72 F-35A<sup>179</sup>, Belgium — 34 F-35A<sup>180</sup>, Great Britain — 138 F-35B<sup>181</sup>, Germany — 35 F-35A<sup>182</sup>, Greece — 40 F-35A<sup>183</sup>, Denmark — 27 F-35A<sup>184</sup>, Israel — 75 F-35I (essentially the same F-35A)<sup>185</sup>, Italy — 60 F-35A and 30 F-35B<sup>186</sup>, Canada — 88 F-35A<sup>187</sup>, Netherlands — 52 F-35A<sup>188</sup>, Norway — 52 F-35A<sup>189</sup>, Poland — 32 F-35A<sup>190</sup>, Singapore — 8 F-35A and 12 F-35B<sup>191</sup>, Finland — 64 F-35A<sup>192</sup>, Czech Republic - 24 F-35A<sup>193</sup>, Switzerland - 36 F-35A<sup>194</sup>, South Korea - 60 F-35A<sup>195</sup>, Japan - 105 F-35A and 42 F-35B<sup>196</sup>.

Production rates for all F-35 variants have been consistent with expected production and customer delivery rates in recent years. Lockheed Martin expects to reach its planned peak F-35 production rate of approximately 156 aircraft per year and maintain it until at least 2028.<sup>197</sup>

### ***F-16 fighter***

The F-16 fighter jets are manufactured by Lockheed Martin at its plant in Greenville, USA. Currently, Block 70/72 (F-16V) F-16 fighter jets are being manufactured there for foreign customers. The first fighter jet built at this plant was officially delivered to the Bahrain Air Force in March 2023.<sup>198</sup>

By mid-2024, foreign orders for 176 new-build F-16V fighters are known. Bahrain ordered 16 new F-16Vs, another 16 F-16Vs were ordered by Bulgaria, 12 by Jordan, 24 by Morocco, 66 by Taiwan, 14 by Slovakia and 40 by Turkey<sup>1989</sup>.

Lockheed Martin expects to reach a production rate of about 48 F-16Vs per year at its Greenville plant by the end of 2025.<sup>200</sup>

### ***F-15 and F/A-18 fighters***

Defense division of the American corporation Boeing — Boeing Defense, Space & Security — carries out final assembly of F-15 and F/A-18 fighters at assembly facilities

lines of the aircraft manufacturing complex located in St. Louis, Missouri, USA. The F-15 fighter jet production line continues to be loaded

with orders for the latest modification of these fighters, the F-15EX Eagle II (based on the F-15QA<sup>201</sup>), for the US Air Force, as well as export orders. In 2020, the US Air Force signed a contract with

Boeing has a contract to deliver up to 200 F-15EX aircraft, with the first delivered to the customer in 2021.<sup>202</sup> In June 2024, the troops received the eighth F-15EX from the first production batch.<sup>203</sup>

After Boeing completed a contract for 36 F-15QA fighters for the Qatar Air Force in 2023,<sup>204</sup> it awarded contracts for 24 F-15EXs to Indonesia (as the F-15IDN)<sup>205</sup> and to Israel for 25 or 50 F-15EXs (as the F-15IA).<sup>206</sup> Given the large orders, Boeing expects production to increase to two aircraft per month (24 per year) by 2025.<sup>207</sup> To this end, it has acquired the GKN Aerospace plant in St. Louis, which supplies critical parts for F-15 production.<sup>208</sup>

Production of the F/A-18E/F Super Hornet Block III fighters is supported only by orders for the US Navy after the Kuwaiti export order is fulfilled in 2021.<sup>209</sup> The last 17 fighters of this type are to be assembled in 2026–2027, after which their production will cease.<sup>210</sup>

### ***Eurofighter Typhoon***

Final assembly of the Eurofighter Typhoon fighters of the Eurofighter consortium is carried out at four plants of the three participants of this consortium:

- Airbus at the plant in Manching near Ingolstadt (Bavaria, Germany) and at the plant in Getafe near Madrid (Spain);
- BAE Systems at its plant in Warton, Lancashire, UK;
- Leonardo at the plant in Turin-Caselle about-  
to Turin (Italy)<sup>211</sup>.

As of spring 2024, a total of 680 Eurofighter Typhoon aircraft had been ordered by nine countries, 603 of which

were delivered to customers<sup>212</sup>. In connection with the execution of basic orders from

Britain, Germany, Spain and Italy and the lack of new major export contracts, production rates fell to around 10 fighters per year.<sup>213</sup>

BAE Systems' Warton plant is currently executing an export contract for 24 Eurofighter Typhoon Tranche 3A variants for the Qatar Air Force<sup>214</sup>, while Leonardo's Turin-Caselle plant is executing an export contract for 28 Eurofighter Typhoon Tranche 3b variants for the Kuwait Air Force<sup>215</sup>. In addition, Airbus' Maching plant in Germany is preparing to produce a batch of 38 Eurofighter Typhoon Tranche 4 variants for the German Air Force in 2025–

2030, and at the Spanish Airbus plant in Getafe - 20 Eurofighter Typhoon modification Tranche 4 for the Spanish Air Force in 2026–2030 yr.<sup>216</sup>

The main task of the consortium participants and the governments behind them is to maintain at least a minimum rate of production in order to support aircraft factories and preserve industrial capabilities in the production of modern fighters. Germany will purchase 20 Eurofighter Typhoon<sup>217</sup>, Spain - 25 Eurofighter Typhoon<sup>218</sup>, Italy - another 24 aircraft<sup>219</sup>.

## **Rafale**

France's Dassault Aviation with its Rafale fighter, unlike its European competitors from Eurofighter, is faced rather with the problem of a lack of production capacity to fulfill all export orders and plans to expand production.

The Dassault Aviation plant in Bordeaux-Mérignac near Bordeaux (Gironde department, France) is the final assembly site for all Rafale fighters, which are produced in three variants: single-seat

The land-based Rafale C, the land-based two-seat Rafale B and the carrier-based single-seat Rafale M fighter

for basing on aircraft carriers. Since 2023, deliveries of fighters of these variants in the modernized modification Rafale F4220 have begun.

Dassault Aviation delivered 26 Rafale aircraft to customers in 2019, 13 in 2020, 25 in 2021, 14 in 2022, and 13 in 2023<sup>221</sup>. Up to and including 2023, 266 aircraft were delivered: 164 to the French Armed Forces and 102 to foreign customers<sup>222</sup>.

To fulfill all of Dassault Aviation's contracts between 2024 and 2032<sup>223</sup> inclusive, it will be necessary to maintain production volumes of an average of about 25 Rafales per year, with India already in talks to purchase 26 Rafale M24 carrier-based fighters, and other new contracts are likely.

In this regard, Dassault Aviation will increase its maximum production rate to three aircraft per month throughout 2024<sup>225</sup>.

## **JAS-39 Gripen**

Another modern European fighter, the JAS-39 Gripen, is serially produced by the Swedish aviation and defense group Saab. The latest upgraded versions are the single-seat JAS-39E and two-seat JAS-39F. The total number of JAS-39 Gripen of all versions produced is 308 units: 204 fighters in the JAS-39 A/B and JAS-39 C/D versions were delivered to Sweden itself (some were sold or leased to

other countries)<sup>226</sup> and 26 JAS-39 C/D to South Africa<sup>227</sup>. Today, Saab is fulfilling contracts for the delivery of 60 JAS-39E for the Swedish Air Force and 36 JAS-39E/F for the Brazilian Air Force<sup>228</sup>.

The final assembly of the fighters takes place at the aircraft plant in Linköping (Östergötland Province, Sweden) with a planned production rate of up to 24 JAS-39E/F per year.<sup>229</sup> However, the fulfillment of orders is seriously behind schedule: the transfer of the first JAS-39E directly to the Swedish Air Force is expected only from 2025.<sup>230</sup> ; the first JAS-39E for Brazil made its maiden flight in 2019.<sup>231</sup> But by the summer

2024 Brazil received only seven of the 36 ordered<sup>232</sup>.

**KF-21**

South Korean aircraft manufacturer Korea Aerospace Industries is a new player in the combat fighter market thanks to the success of the family

The T-50/FA-50 multirole combat/light combat aircraft plant begins production of the KF-21 fighter. The first production aircraft (20 KF-21s in 2024 and 2025) are to enter service with the South Korean Air Force in 2026. The South Korean Air Force is to receive a total of 120 KF-21 fighters by 2032.

Table 3. Production rates of the main types of fighters in Western countries

Fighter	Production rates per year	Comments
F-16 Block 70/72	36 (plan for 2024)	Export only; planned to increase to 48 in 2025.
F-15EX Strike Eagle II	36 (approximately)	107 ordered for US Air Force and overseas customers
F/A-18 / Growler	24 (approximately)	Last order placed, growth rate slows to 18 per year; line to close in 2027.
F-35 Lightning II	150 (approximately)	All versions, including aircraft intended for export
Dassault Rafale	20	It is planned to increase to 36 per year
Eurofighter Typhoon	10	A joint production between Great Britain, Germany and Italy

Source: prepared by CAST

**Unmanned aerial vehicles**

In general, the production of unmanned military aircraft today can be divided into two or three groups. **The first group** is the production of heavy reconnaissance and reconnaissance-strike UAVs weighing over 500 kg, which in complexity and cost are at the level of manned aircraft and helicopters. Manufacturers of heavy UAVs are large state or private military-industrial structures. The production and production plans of such UAVs have not undergone any drastic changes over the past two years. The leading developers and manufacturers among Western countries are the American corporations Boeing, General Atomics, Lockheed Martin, Northrop Grumman.

**RQ-4 Global Hawk and MQ-4C Triton**

The heavy, high-altitude, long-endurance reconnaissance UAV RQ-4 Global Hawk in various versions, including the MQ-4C Triton maritime patrol UAV based on it, are among the heaviest and most expensive UAVs in the world. They are manufactured by the aircraft manufacturing division of the American corporation Northrop Grumman — Northrop Grumman Aeronautics Systems.

Since the start of their serial production, approximately 58 RQ-4 Global Hawks have been built: approximately 45 RQ-4A/RQ-4B for the US Air Force<sup>234</sup>, 5 RQ-4D for the NATO air defense system<sup>235</sup>, 1 RQ-4E for Germany<sup>236</sup>, 4 RQ-4B for South Korea<sup>237</sup> and 3 RQ-4B for Japan<sup>238</sup>. After 2023, the main production capacity is occupied by the production of MQ-4C Triton for the US Navy and Royal Australian Air Force.

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## Fighters and drones

The US Navy has now produced 27 MQ-4C239s, out of an initial order of 68, and Australia has ordered 4 MQ-4C240s for its own air force; there are no new export orders.

Northrop Grumman had planned to expand production to 12 units per year<sup>241</sup>, but due to the reduction in purchases from the Navy, the current rate looks excessive. Funds for the MQ-4C Triton are currently allocated based on the purchase of two to three UAVs per year for the US Navy<sup>242</sup>.

Among Northrop Grumman's products is the MQ-8 Fire Scout unmanned helicopter, which is produced for the US Navy in the MQ-8C version (38 units of this type were delivered to the customer in 2023)<sup>243</sup>.

### ***MQ-9 Reaper, MQ-1C Gray Eagle and Predator XP***

The American heavy reconnaissance and long-endurance strike UAV MQ-9 Reaper is produced by a subsidiary of General Atomics Corporation - General Atomics Aeronautical Systems (GA-ASI).

The primary customer for the MQ-9 in the MQ-9A variant is the US Air Force. As of 2022, 345 MQ-9A Reaper UAVs and a corresponding number of ground control posts for them have been produced for the US Air Force alone (the total number should be about 430 MQ-9A units). The standard complex is three MQ-9 UAVs per ground control post.

General Atomics Aeronautical Systems is capable of producing up to 60 heavy-duty reconnaissance and strike UAVs

flight capacity per year, if you count the MQ-9 and MQ-1C together.

In the case of the MQ-9, at peak production for the US Air Force, General Atomics Aeronautical Systems was producing 48 UAVs per year<sup>245</sup>, but that rate has gradually slowed. In 2022, four MQ-9s were purchased for the US Air Force and eight for the Marine Corps, and in 2023, five for the US Marine Corps<sup>246</sup>.

General Atomics expects to begin production of the new Mojave long-endurance reconnaissance and attack UAV, which has already undergone testing.

Another family of reconnaissance and reconnaissance-strike UAVs from General Atomics traces its lineage back to the RQ-1/MQ-1 Predator UAV. Currently, one modernized version of these UAVs is being produced: the reconnaissance-strike MQ-1C Gray Eagle, which is significantly lighter and smaller than the MQ-9 Reaper and is produced only for the US Army. A lighter reconnaissance UAV, the Predator XP, is offered for export; it was delivered only to the UAE in the mid-2010s in unknown quantities.<sup>247</sup>

The UAVs are assembled at General Atomics Aeronautical Systems' Poway, San Diego, facility. By 2022, 222 MQ-1C248s had been produced. In FY2023, funding was allocated for the purchase of 12 more MQ-1C249s.

### ***MQ-25 Stingray***

Another heavy American UAV that deserves special attention is the Boeing MQ-25 Stingray. This aircraft was created by order of the US Navy as the world's first carrier-based unmanned refueling aircraft; it is planned to order more than 70 of these UAVs. In February 2024, the first MQ-25 was transferred to the US Navy for testing. In April 2024, at one of the exhibitions

Boeing has shown a scaled-down model of the MQ-25 reconnaissance and strike variant<sup>250</sup>. A plant was built in Mascouta, Illinois, to produce the MQ-25251. In the heavy UAV production sector, European and South Korean companies are seriously

lagging behind the United States.

### ***KUS-FS***

In South Korea, production of the heavy long-duration reconnaissance UAV KUS-FS (aka Medium-Altitude Unmanned Aerial Vehicle) began only in January 2024. These devices are assembled by an enterprise of the aircraft industry division of the South Korean airline Korean Air (Korean Air Aerospace Division, KAL-ASD). This is a very large UAV, larger and heavier than the American MQ-9A

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## Fighters and drones

Reaper, and the main suppliers of various components are divisions of the South Korean companies Hanwha Group and LIG Nex1<sup>252</sup>.

European long-endurance UAVs from major manufacturers are much smaller - the Patroller is very close in size and maximum takeoff weight to the American Predator XP, the Falco Xplorer is somewhat heavier and larger, and the SIRTAP is lighter and smaller, but leading European manufacturers are having problems with their

bringing to completion.

### **Patrol**

Only in February 2024, operational tests began on the first Patroller UAV delivered to the French Army by Safran Electronics & Defense, part of the French Safran group<sup>253</sup>. In total, the French ground forces are to receive 28 Patroller UAVs in five complexes by 2030 inclusive. Each complex consists of two ground control posts and five UAVs, which amounts to 10 ground control posts and 25 UAVs, plus three additional UAVs for them<sup>254</sup>. In addition, Greece has ordered four UAVs<sup>255</sup>.

### **SIRTAP**

The European Airbus Group plans to launch the first prototype of the SIRTAP UAV in 2025 and begin delivering these UAVs to Spain in 2026 under a contract for the purchase of nine systems. Each system consists of a ground control center and three UAVs each, for a total of 27 devices and nine control centers<sup>256</sup>.

### **Falco EVO and Falco Xplorer**

The Italian company Leonardo serially produces reconnaissance devices of the Falco family (the latest model is the Falco EVO). Since the appearance of the first Falco XN model in 2003, 50 unmanned complexes of the family have been delivered to various countries<sup>257</sup>. Each complex includes a ground control center, auxiliary equipment and four UAVs<sup>258</sup>, that is, over 20 years

About 200 UAVs were produced.

Leonardo has been testing a heavier UAV, the Falco Xplorer, in recent years and, although no orders have been received for it, the company says it will increase production to 12 units per year<sup>259</sup>.

### **Aarok**

In mid-2023, a small French company, Turgis & Gaillard Industrie, showed a prototype of the heavy reconnaissance and attack UAV, Aarok. Its dimensions and maximum takeoff weight are between the American MQ-9A Reaper and the South Korean KUS-FS. Although flight tests of this UAV have not yet begun, in the fall of 2023, the company signed a contract with the Ukrainian state enterprise Antonov to organize the production of a large reconnaissance and attack UAV in Ukraine based on the design of the Aarok. The first devices were supposed to be assembled in 2024,<sup>260</sup> but no information about this has appeared.

### **Hermes 900 and Hermes 450**

Israeli companies Elbit Systems and Israel Aerospace Industries occupy a significant share of the market for heavy UAVs, which are purchased by European countries, among others.

The most famous Israeli heavy UAV on the world market, the Hermes 900, manufactured by Elbit Systems, is in the niche of the American Predator UAV in terms of size and maximum take-off weight. The standard complex includes three to four UAVs and a ground control station; this configuration can be changed. In early March 2023, an order was received for the 120th Hermes 900<sup>261</sup>. In addition to Israel, well-known buyers include Azerbaijan, Brazil, Colombia, India, Iceland, Morocco, Mexico, Thailand, the Philippines, Chile, Switzerland and other countries. Germany is also currently showing interest in the Hermes 900.

Elbit Systems has achieved a high production rate and is capable of producing about 10 or more Hermes 900 per year. In addition,

Elbit Systems continues to produce the lighter Hermes 450 UAV, which, in terms of maximum takeoff weight, is on the border between medium and heavy aircraft.

Elbit Systems is expanding production by creating joint ventures with foreign partners for UAV assembly. For example, in India, where some Hermes 900 and Hermes 450 UAVs are assembled for other customers, as well as four Hermes 900 ordered by Delhi in 2023 at the joint venture.

Elbit Systems with the Indian company Adani Defence & Aerospace - Adani Elbit Unmanned Aerial Vehicles Complex in Hyderabad (Telangana state, India)<sup>262</sup>.

Elbit Systems is considering the possibility of creating a new assembly plant for various UAVs in the Czech city of Pardubice together with LPP<sup>263</sup>.

### **Heron**

Israel Aerospace Industries, a major UAV manufacturer, produces the Heron family of heavy UAVs, from the large tactical reconnaissance UAV Tactical Heron to the larger Heron, Heron Mk 2 and the heaviest high-altitude reconnaissance UAV Heron TP. UAVs of this family were purchased by Azerbaijan, Brazil, Vietnam, Germany, Greece, India, Canada, Turkey and other countries. But in recent years, their competitors from Elbit Systems have enjoyed great success. **The second group** is the production of various micro-UAVs, mini-UAVs, light and medium UAVs. The production of these types of UAVs is carried out on the basis of commercial components, or

the devices themselves are modified commercial products. Loitering munitions, including FPV drones, can be distinguished as a subgroup of the second or a separate third group. Due to the active use of mass-produced commercial components and common materials, the production of such UAVs is carried out, in addition to large military-industrial structures, by numerous small manufacturers.

Integrator, RQ-21 Blackjack. Textron Systems, a defense division of Textron Corporation, produces the RQ-7B V2 Block III Improved Shadow reconnaissance UAV, the Aerosonde vertical takeoff and landing UAV, and others. AeroVironment produces the RQ-11B Raven and RQ-20 Puma hand-launched reconnaissance UAVs, the T-20 light reconnaissance UAVs, the JUMP 20 and Quantix Recon vertical takeoff and landing reconnaissance UAVs, and the Switchblade 300 and 600 loitering munitions. Teledyne FLIR produces the ROGUE 1 kamikaze quadcopters, the SKYRANGER R70 reconnaissance quadcopters, and the Black Hornet Nano helicopter-type micro-UAV.

Among smaller American manufacturers, we can note Anduril Industries of Costa Mesa, California, which offers light reconnaissance UAVs and loitering munitions of the Altius family, the company AEVEX Aerospace, which produces loitering munitions Phoenix Ghost for Ukraine, and Cyberlux Corporation, which produces various multicopters.

The European Airbus Group and its subsidiary SURVEY Copter produce light reconnaissance UAVs Aliaca Evo, Aliaca ER, DVF 2000 ER and light vertical takeoff and landing UAV CAPA-X. Italian Leonardo produces medium helicopter-type UAVs AWHEREO and micro-UAVs CREX-B for hand launch. German company Quantum-System from Gilching (federal state of Bavaria, Germany) specializes in the production of a number of vertical takeoff and landing UAVs and multicopters. British company Malloy Aeronautics from Berkshire specializes in the development and production of various multirotor UAVs with a large payload. Polish company WB Electronics produces WARMATE loitering munitions, FlyEye reconnaissance mini-UAVs, and FT5 tactical reconnaissance UAVs. Israel's Elbit Systems produces and exports the Skylark family of reconnaissance and loitering UAVs.

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<sup>262</sup> Boeing's Insitu produces light tactical UAVs such as the ScanEagle,

SkyStriker family of munitions. Israel Aerospace Industries produces the BirdEye 650D light reconnaissance UAV and the Thunder B-VTOL and WanderB-VTOL vertical takeoff and landing UAVs. Aeronautics Defense Systems, a subsidiary of Israel's Rafael Advanced Defense Systems,

is known for its light and mini-UAVs, as well as loitering munitions such as the Aerostar and the Orbiter family, which, in addition to Israel, are also assembled in Azerbaijan at the Azad Systems joint venture in Baku.<sup>264</sup>

There are also companies specializing in the production of one or two UAV models. The German Rheinmetall Group produces the Luna NG tactical reconnaissance UAV. The Austrian Schiebel produces the Camcopter S-100 helicopter-type UAV. The French Novadem produces small military quadcopters NX70. The joint venture of the Swedish Saab Group and the Swiss UMS Aero Group, UMS Skeldar, produces the Skeldar V-150 and Skeldar V-200 medium helicopter-type UAVs.

This is only a part of the numerous manufacturers of light UAVs and loitering munitions that are produced in the West. It is in this area that there is a sharp increase in orders and expansion of production. Even not the largest manufacturers, with appropriate financing, are capable of deploying the production of such UAVs and loitering munitions hundreds of times.

mi and thousands of units per year.

### **Vector**

The Vector vertical takeoff and landing reconnaissance UAVs, manufactured by the German company Quantum-System, were a relatively niche product until 2022<sup>265</sup>, but with the start of the Second World War, they gained popularity in the Ukrainian Armed Forces, which became a major customer of these devices. In 2022, 33 UAVs of this type were ordered<sup>266</sup>, in 2023 - 405, by the end of 2024, 500 UAVs will be delivered to Ukraine, and another 800 units have been ordered for 2025<sup>267</sup>.

This required an expansion of production, as these UAVs began to be ordered

and other countries (for example, in early 2024, it became known about an order for Vector UAVs from the Romanian Armed Forces).

In order to relieve the plant in Germany, in April 2024, an assembly plant for Vector UAVs was opened in Ukraine, where it is planned to assemble up to 1,000 such devices per year<sup>268</sup>.

### **RQ-35**

The small Danish company Sky-Watch from Støvring, which produces hand-launched RQ-35 reconnaissance UAVs for Ukraine, was producing 240–300 units per year (20–25 devices per month) as of 2023<sup>269</sup>; production is expected to double compared to the previous year.

### **Altius-600**

The young US company Anduril Industries has received large orders from Ukraine<sup>270</sup> and Taiwan in 2023–2024 for the supply of previously unproduced ALTIUS 600 UAVs, which can be used, depending on the variant, for reconnaissance or as loitering munitions. The volumes of deliveries to Ukraine are unknown, but 291 ALTIUS 600M-V UAVs are expected to be delivered to Taiwan in 2024–2025<sup>271</sup>.

### **Switchblade 300 and 600**

AeroVironment is ramping up production of the Switchblade family of loitering munitions. By early May 2023, AeroVironment had already shipped more than 1,000

Switchblade 300, Switchblade 600 and RQ-20 Puma<sup>272</sup> reconnaissance UAVs to Ukraine. The vast majority of these were Switchblade 300, but since they performed very poorly in combat conditions, AeroVironment began to deploy production of heavier Switchblade 600 loitering munitions.

In addition to deliveries to Ukraine, more than 1,000 Switchblade 600s have been ordered for the US Army with deliveries scheduled until the end of 2025.<sup>273</sup> An unknown number of Switchblade 600s have been ordered by Lithuania.



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## Fighters and drones

with deliveries in 2024.<sup>274</sup> Production of the Switchblade 300 also continues—720 Switchblade 300s will be delivered to Taiwan alone in 2024–2025.<sup>275</sup> There are also 2023 contracts with France and another US ally.<sup>276</sup>

The company has the potential to produce over 2,000 Switchblade 600 units per year, with plans to triple production.<sup>277</sup>

### **WARM**

Production of Polish WARMATE loitering munitions from WB Electronics of the WB Group has rapidly increased in the last two years: in 2023, the company produced 2,000 of these kamikaze drones, and in 2024, it plans to produce 4,000 WARMATEs, with 90–95% going for export<sup>278</sup>. The main buyer is Ukraine, and Georgia has organized their assembly on its territory at the Delta-VB joint venture<sup>279</sup>.

### **Black Hornet Nano**

The Black Hornet Nano line of helicopter-type reconnaissance micro-UAVs is produced by the Norwegian company Prox Dynamics, which is owned by the American Teledyne FLIR. These UAVs, the size and weight of a large insect or a very small bird (the Black Hornet 3 weighs only 32 g), have been gaining increasing popularity among Western militaries since their launch. As of mid-2023, more than 14 thousand of these unmanned systems have been delivered to 40 countries. Massive military aid to Ukraine from the West has spurred their production: Norway alone signed a contract with Teledyne FLIR in the summer of 2023 to purchase 1,000 Black Hornet 3 for Ukraine<sup>280</sup>.

### **T-80/T-150/T-400**

The family of heavy multi-rotor UAVs produced by the British company Malloy Aeronautics has received a sharp

push since 2022. These UAVs were created primarily as cargo vehicles, but a significant portion of them are now being delivered to Ukraine, where they are used to drop ammunition and lay mines. In addition, orders for these UAVs were received from the US Marine Corps and other military customers, which required an expansion of production. Production output increased from 12-15 UAVs in 2021 to almost 200 in 2023.<sup>281</sup>

In the United States, they are just beginning to test the use of FPV drones in the military and introduce training for military FPV drone operators<sup>282</sup>, while the military-industrial complex of Western countries is still experimenting with them. Accordingly, mass deliveries of such drones both to their own Armed Forces and to Ukraine have not yet been established. As of June 2024, the Western coalition for the supply of drones to Ukraine (Drone Capability Coalition), led by Great Britain and

Latvia, created in February of this year, began a competition for the development of subsequent deliveries of FPV drones to Ukraine. It is planned to purchase up to 15 batches of 20 FPV drones each from different developers for testing, after which the best models will be selected to begin their mass production<sup>283</sup>. In total, the coalition expects to deliver up to 1 million drones to Ukraine, a significant part of which will be assembled in Great Britain. An aid package of approximately \$250 million is being allocated to organize production.<sup>284</sup>

Due to the low cost and mass production of various commercial components used in FPV drones in the world, their development and deployment of mass production in various Western countries can be carried out in a fairly short time from zero to tens, and then hundreds of thousands of drones per month, as happened in Russia and Ukraine in 1.5-2 years. Thus, Ukrainian manufacturers already manufactured about 200 thousand FPV drones in January-February 2024<sup>285</sup>.

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