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Defense Primer: U.S. Precision-Guided Munitions

According to the U.S. Department of Defense (DOD), a precision-guided munition (PGM) is a "guided weapon intended to destroy a point target and minimize collateral damage." In contrast to unguided munitions such as certain artillery rounds and rockets, a guided munition can change its flight trajectory to correct for targeting errors, weather, or other issues, and to increase the munition's probability of striking a target. Guided munitions leverage guidance components such as inertial measurement units, global positioning system (GPS) receivers, laser seekers, and millimeter-wave radar seekers. This In Focus provides an introduction to some of the most prominent guided missiles, bombs, and rockets that constitute the U.S. military's PGM portfolio.

Some analysts trace the term "precision-guided" munitions to the U.S. development of laser-guided bombs in the 1960s and their subsequent introduction during the Vietnam War. Although guided munitions were likely first used in the Second World War, laser guidance and other advancements in missilery in the 1960s and 1970s improved munitions' ability to strike a target with greater accuracy. In time, the term "precision" as applied to munitions became less associated with a particular munition type, guidance system, or measurement of accuracy than with guided munitions writ large, as well as with the quality of the intelligence, planning, and decisionmaking that are meant to underpin their use.

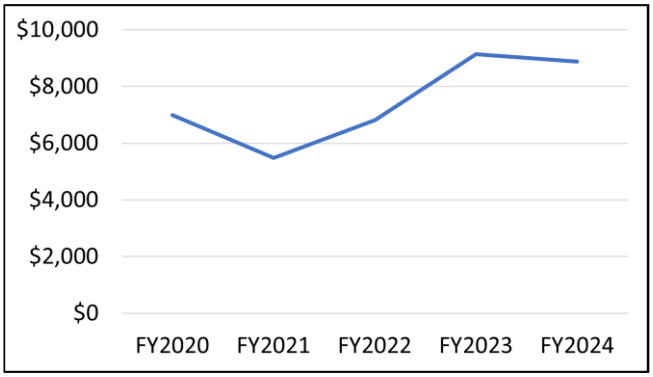
During the 1991 First Gulf War, the United States relied on guided munitions more than it had in previous armed conflicts. Since then, analysts assess that guided munitions appear to have largely supplanted unguided munitions in U.S. military operations. Procurement and research, development, test, and evaluation (RDT&E) spending by the U.S. Air Force, Army, and Navy on guided munitions has increased as each service has sought to replenish and modernize its stocks of weapons (see **Figure 1**).

Air-Launched Precision Munitions

- **Advanced Anti-Radiation Guided Missile–Extended Range (AARGM-ER).** The AARGM-ER, a Navy-led program with Air Force involvement, provides hardware and software updates to the AGM-88 High Speed Anti-Radiation Missile (HARM), an air-launched ground attack missile designed to target radar-equipped air defenses. The AARGM is the product of Navy programs in the early 2000s that added GPS receivers and millimeter-wave radar seekers to HARM missiles. Production of the AARGM began in 2008. The latest version of the missile, the AGM-88G, is the extended-range (ER) variant and incorporates a new solid rocket motor.

- **Hellfire/Longbow Missile.** The AGM-114 Hellfire is an air-to-ground missile that uses laser guidance to target armored vehicles. The Longbow is a millimeter-wave radar-guided variant of the Hellfire. Introduced by the Army in 1985, the Hellfire is an Army-led joint service program. Although the Hellfire remains in use, the Army did not include procurement funds for the missile in its FY2025 budget request and it is unclear whether the Army intends to do so in future requests, according to the service's budget justification documents.

Figure 1. U.S. Military Spending on Selected PGMs, FY2021-FY2025 ($ in millions)



Source: Produced by CRS using the DOD's Major Weapons Summaries for FY2020-FY2024 and the joint explanatory statement for the Further Consolidated Appropriations Act, 2024 (P.L. 118-47).
Note: This figure reflects the DOD procurement and RDT&E funding for the PGMs described in this product.

- **Joint Air-to-Ground Missile (JAGM).** The AGM-179 JAGM, an Army-led joint service program, is an air-to-ground guided missile designed to replace the Hellfire and Longbow missiles. The JAGM combines the warhead, motor, and flight control systems of the AGM-114R Hellfire with a multimode seeker that features a semi-active laser and millimeter-wave radar guidance system. Lockheed Martin began low-rate initial production of the JAGM in 2018.

- **Joint Air-to-Surface Strike Munition (JASSM).** The AGM-158 JASSM, an Air Force-led program with Navy participation, is a family of air-to-ground cruise missiles composed of baseline and extended-range configurations. The Air Force began developing the JASSM in the mid-1990s and approved low-rate initial production of the baseline missile in 2001. The latest versions of the JASSM, the AGM-158B-3 and AGM-158D, are extended-range variants that are equipped with a Military Code (M-code) GPS receiver and an encrypted datalink, respectively.

- **Joint Direct Attack Munition (JDAM).** The JDAM, a joint Air Force and Navy program, provides a tail-mounted guidance kit composed of a GPS-aided inertial navigation system (INS) for air-launched unguided bombs. The Air Force first used JDAMs during 1999 Operation Allied Freedom in Kosovo. The latest version of the JDAM is equipped with an M-code GPS receiver for operations in denied environments, according to the Air Force.

- **Long Range Anti-Ship Missile (LRASM).** The AGM-158C LRASM is an air-launched anti-ship cruise missile. A Navy-led program, the LRASM is part of the AGM-158 family and shares a production line with the Air Force's JASSM. The U.S. Defense Advanced Research Projects Agency (DARPA), in partnership with the Navy and Air Force, began developing the LRASM in 2009. The Navy approved the start of low-rate initial production of the missile in 2016. The latest version is the AGM-158C-3, which features an extended range and improved communications, according to the Navy's FY2025 budget justification documents.

- **Small Diameter Bomb I and II (SDB)**. The SDB Increment I and II are air-launched guided bombs. The GBU-39A/B SDB I, an Air Force program, is equipped with a GPS-aided INS guidance system and designed primarily for striking stationary targets. The GBU-53/B SDB II, an Air Force-led program with Navy participation, features a multimode seeker with millimeter-wave radar and an infrared sensor. The Air Force began fielding SDB I in 2006. The DOD approved the start of low-rate initial production of the SDB II in 2015.

Ground-Launched Precision Munitions

- **Army Tactical Missile System (ATACMS).** The MGM-140 ATACMS, an Army program, is a ground-launched missile. The Army began developing the ATACMS in the early 1980s as a replacement for the Lance missile. Low-rate production of the missile began in 1989. Originally designed with inertial sensors (Block 1), the Army upgraded the ATACMS in the 1990s to include GPS receivers (Block 1A). In 2017, the Army launched a service life extension program to modernize the warhead and seeker on ageing ATACMS munitions.

- **Guided Multiple Launch Rocket System (GMLRS).** The GMLRS, an Army-led joint program, is a guided artillery rocket that uses a guidance system composed of a GPS-aided inertial measurement unit (IMU). Designed in the mid-1990s as a guided alternative to the free-flight MLRS artillery rocket, the Army approved the low-rate initial production of the GMLRS in 2003; the Army began in 2017 to develop a long-range version of the GMLRS that extends the munition's range from 70 kilometers to 150 kilometers.

- **Javelin**. The FGM-148 Javelin is a shoulder-mounted, fire-and-forget antitank guided missile (ATGM) designed primarily to defeat armored vehicles. An Army-led joint service program, the Javelin was developed by the Army starting in the early 1980s; the Army is currently upgrading the missile from the FGM-148F, or F-model, to the G-model. The Army is also developing a new version of the reusable launcher unit.

- **Precision Strike Missile (PrSM).** The PrSM, an Army program, is a ground-launched missile designed to replace the ATACMS. Initially known as the Long-Range Precision Fires (LRPF), the PrSM was developed by the Army as a replacement for the ATACMS in 2017. The Army announced in December 2023 that it had accepted delivery of the first Increment 1 PrSMs. Beginning in FY2026, the Army plans to begin procuring Increment 2, which will reportedly have a modified guidance system, according to the service's budget justification documents.

Naval Precision Munitions

- **Naval Strike Missile (NSM).** The NSM is a low-observable cruise missile developed by Kongsberg Defence Systems, a Norwegian defense company, in the early 2000s. In 2018, the Navy awarded a Kongsberg-Raytheon team a contract to provide the NSM for the Navy's Over-The-Horizon Weapon System (OTH-WS), an armament on the Littoral Combat Ship. The NSM is also the key component of the Navy Marine Corps Expeditionary Ship Interdiction System (NMESIS), a ground-based anti-ship missile system.

- **Standard Missile-6 (SM-6).** The SM-6, or RIM-174 Extended Range Active Missile (ERAM), is a multi-mission missile that combines elements of the SM-2 surface-to-air missile with the guidance system of a medium-range air-to-air missile. The Navy launched the SM-6 program in 2004 and has since developed three versions of the missile—Block I, IA, and IB—that are differentiated by their intended target sets.

- **Tomahawk.** The Tomahawk, a Navy program, is a long-range cruise missile designed to be launched from submarines and surface ships against fixed and mobile targets. Derived from a concept for a sea-launched cruise missile (SLCM) dating to the early 1970s, the Tomahawk was fielded by the Navy in the early 1980s. The Navy first used the missile in combat during the 1991 Operation Desert Storm. The Navy announced in 2020 that it would convert all Block IV Tomahawk missiles to the RGM/UGM-109E Block V Tactical Tomahawk, of which there are two varieties, Va and Vb, for use against maritime and land targets, respectively.

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