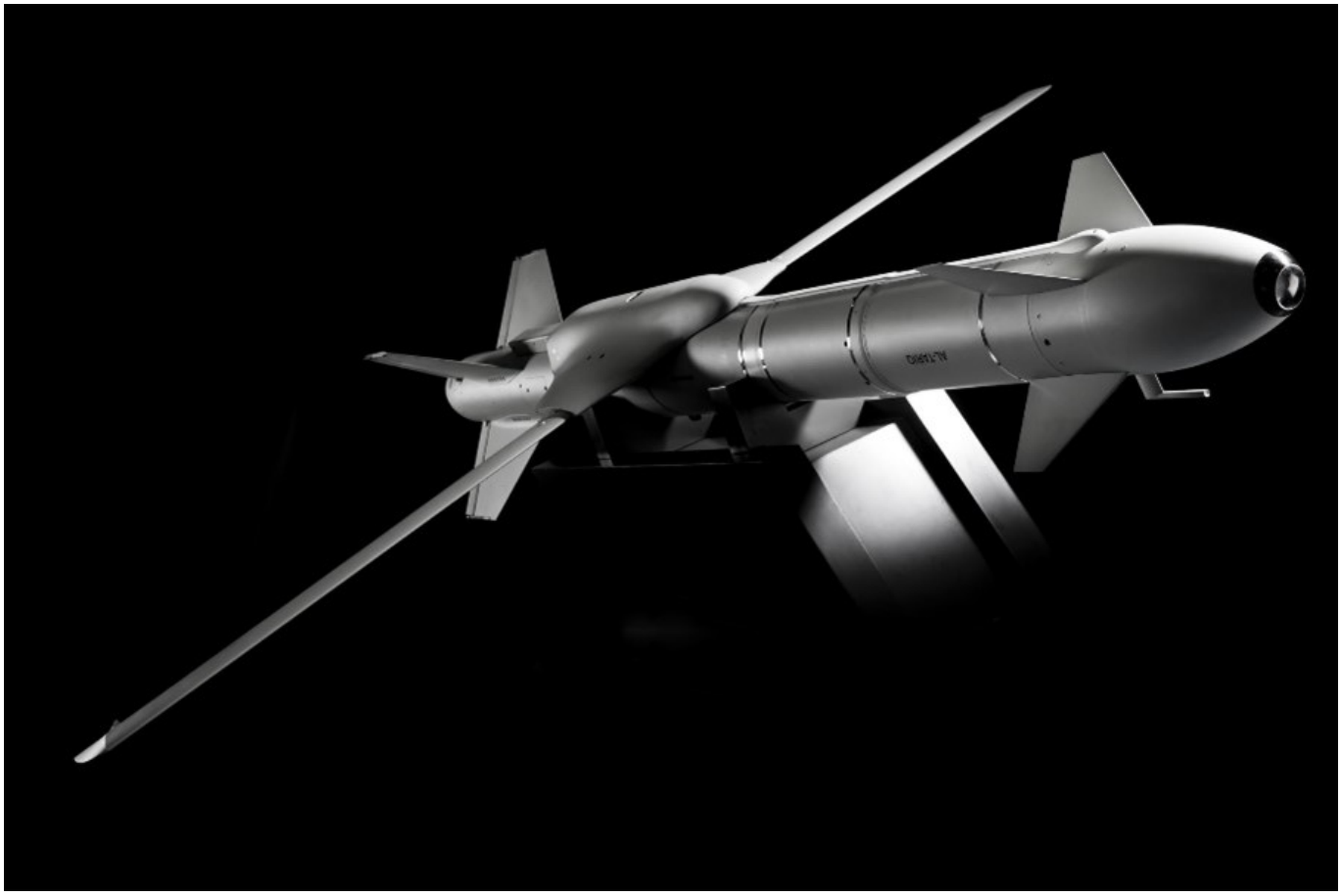
Precision Guided Munitions: Behind the Technology That Made Bombs Go From ‘Dumb’ To Smart

?What are precision guided munitions

Precision guided munitions (PGMs) are guided munitions intended to hit a target with precision and to minimise collateral damage. PGM systems incorporate a guidance system (typically in the front of the precision munition), a payload, and fins. The guidance system .will usually communicate with the fins to steer the PGM towards the intended target



An AL TARIQ Long Range PGM

How smart bombs work

Guidance systems effectively turn an unguided bomb or ‘dumb’ bomb into a smart bomb. Finding their origins in World War II, how smart bombs work is by finding a target using one or multiple guidance systems. Making dumb bombs smart has revolutionised air-to-surface systems. Accuracy and flexibility of an air strike is greatly enhanced because targets can be hit with extreme precision, whether stationary or moving. Well-known precision guided :munitions are

- Radio-controlled bombs
- Electro-optical bombs
- Infrared-guided bombs
- Laser guided bombs
- Radar-guided bombs
- Satellite-guided bombs

Radio-controlled bombs

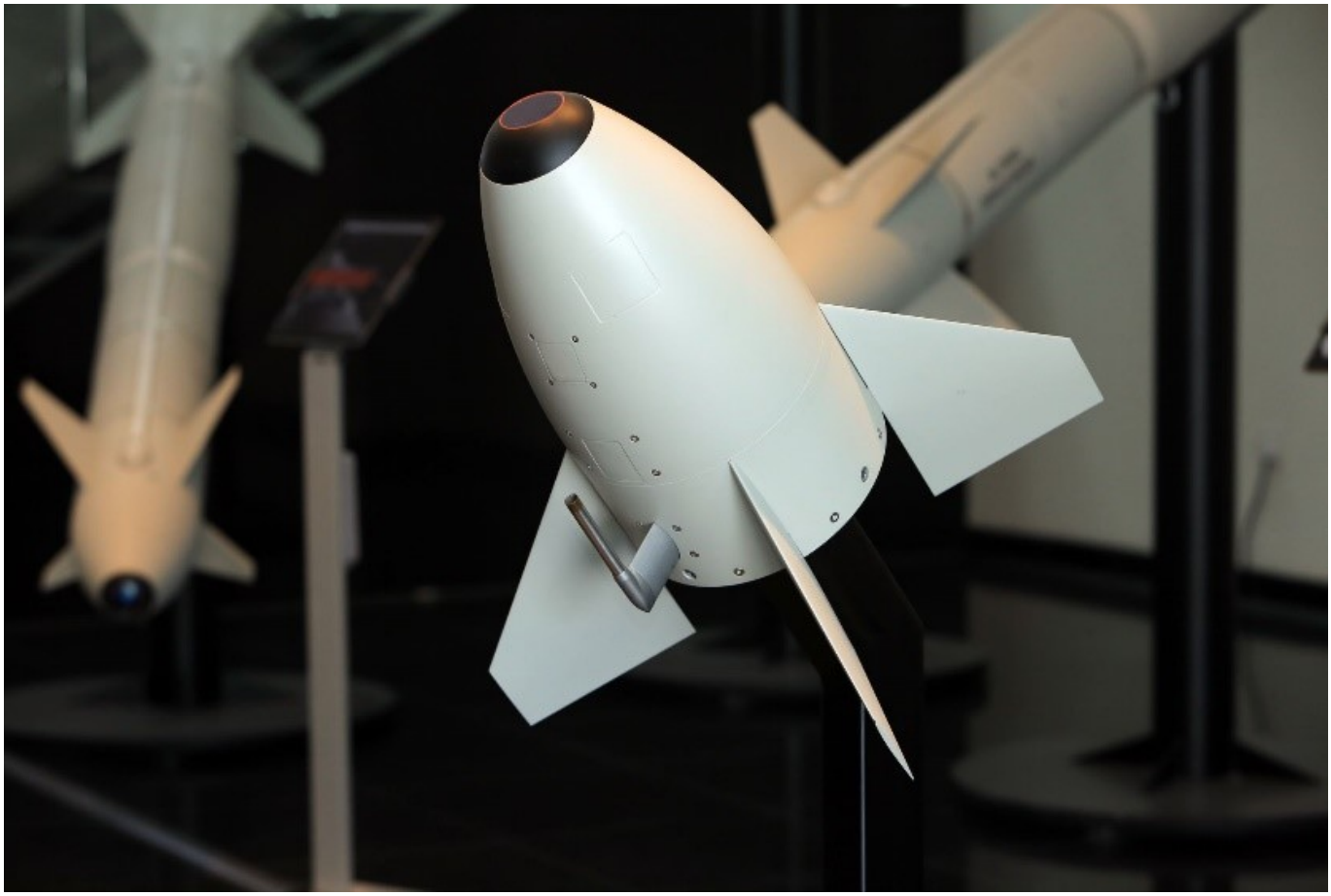
Radio-controlled, or command guidance, is a type of guidance in which a ground station or aircraft relays signals to guided munitions via radio control or through a wire connecting the .missile to the launcher

Electro-optical bombs

Electro-optical bombs are precision weapons that are guided by a television camera or TV seeker. The camera transmits a bird's eye view of the target back to a controlling aircraft, which then steers the bomb towards the target. TV seekers were first introduced in the Korean War in the 1960s, where the United States (US) military used television cameras .and flare sights to steer the bomb until the flare superimposed the target

Infrared-guided bombs

Infrared guidance, or infrared homing, is a passive weapon guidance system that uses infrared light emission from a target to track and follow it. Smart bombs that use infrared seekers are often referred to as 'heat-seekers'. These 'drop and forget' weapons are passive devices, providing no indication that they are tracking a target. They are, however, .susceptible to a number of simple countermeasures such as decoy flares



An AL TARIQ front component with an Imaging Infrared seeker

Laser guided bombs

A laser-guided bomb uses semi-active laser guidance to strike a designated target. How these smart bombs work is by using on-board electronics to track targets that are designated by a laser, usually in the infrared spectrum, and adjusting their glide path to accurately strike a target. The weapon tracks a light signature, and not the object itself, meaning the target must be illuminated from a separate source, either by ground forces, by a pod on the attacking aircraft, or by a separate support aircraft. First developed by the US during the Vietnam War, the PGM's use in military operations proved their value in striking

.difficult targets

An AL TARIQ front component with a semi-active laser

Radar-guided bomb

Two radar guidance systems can be used on precision munitions, active radar, and semi-.active radar guidance

Radar guidance systems detect and home in on targets by sensing electromagnetic energy reflected from the target's surface. The source of the reflected radiation is a radar transmitter. In the instance of weapons with active radar guidance, the transmitter is situated within the missile, and in the case of semi active guidance, it is in the launch aircraft. In either case, the transmitter must beam electromagnetic radiation at the target, and the radiation must travel to the target, reflect, and travel back to the receiving antenna of the smart bomb to determine the direction of the target. This information then enables the guidance computer to steer the weapon towards the target to achieve an accurate .strike

Active radar is a guidance method in which a smart bomb contains a radar transceiver (a combination of transmitter and receiver) and the electronics necessary for it to find and track its target autonomously. Active radar homing is rarely used as the only guidance method of a missile and is most often used during the terminal phase of the engagement. This is mainly because the radar transceiver has to be small enough to fit into a missile and is powered by batteries, therefore having relatively low effective radiated power, and .subsequently a limited range

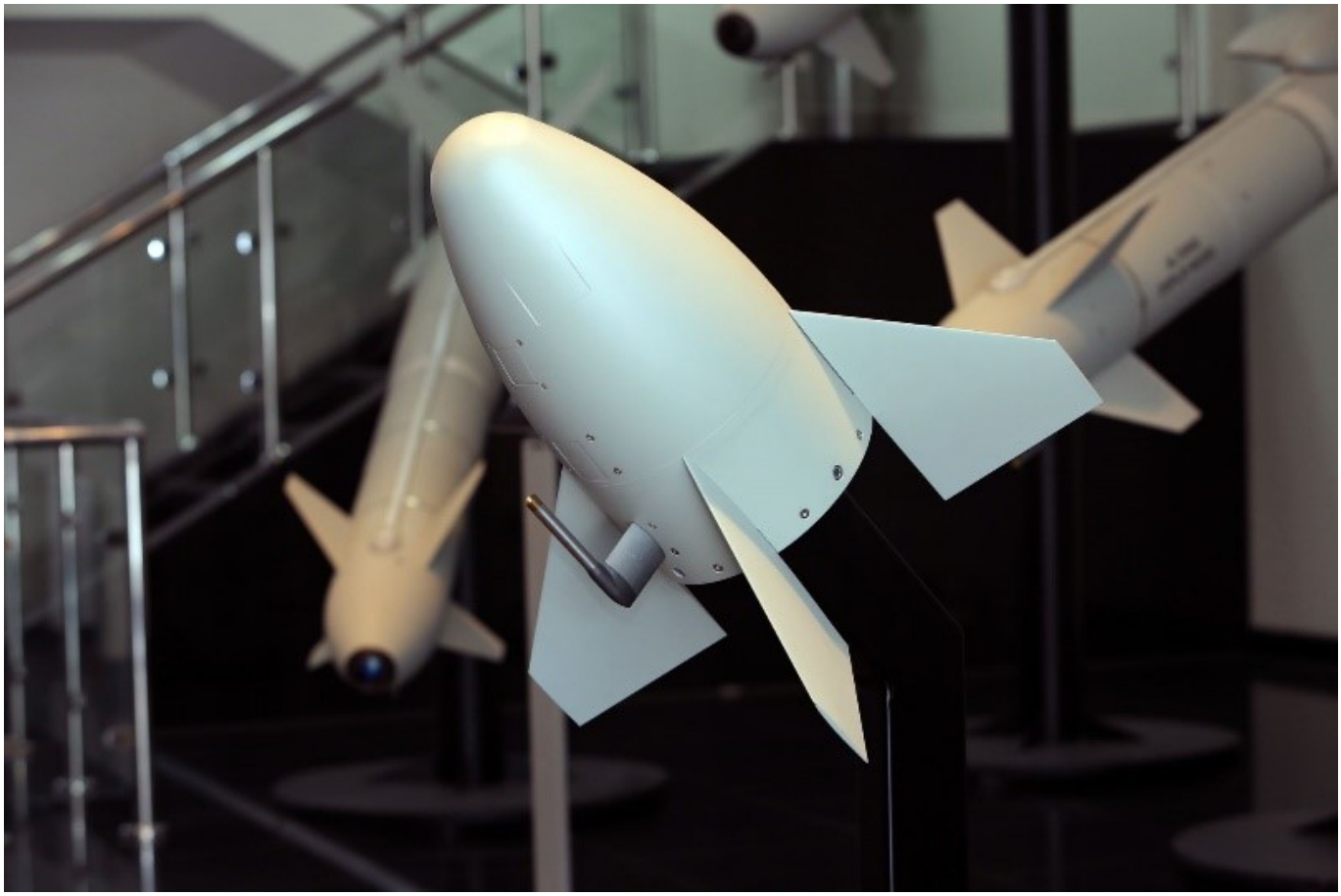
Semi-active radar homing (SARH) is a common guidance systems for long-range air-to-air and surface-to-air precision weapons. Using the bistatic continuous-wave radar system, the missiles guidance system features a passive radar detector that an external transmitter .provides when reflect off a target

Satellite-guided bombs

A satellite-navigated munition, sometimes referred to as a GPS guided missile, utilises satellites to provide autonomous geo-spatial positioning. It allows small electronic receivers in the guided munition to determine their location with high precision. The GPS guided missile will then strike the given coordinates of the target. These precision weapons are unique in that they can operate in all weather conditions. However, the precision of these weapons is dependent on the precision of the measurement system used for location determination and the precision in setting the coordinates of the target. If the targeting information is correct, GPS guided missiles or satellite-guided weapons are significantly more likely to achieve a successful strike in any weather condition than any other precision .weapons

A satellite navigation system with global coverage may be termed a global navigation satellite system (GNSS). As of September 2020, GNSS comprises the US Global Positioning System (GPS), Russia’s Global Navigation Satellite System (GLONASS), China’s BeiDou .Navigation Satellite System, and the European Union's Galileo

Inertial Navigation Systems (INS) are typically part of satellite navigation systems on precision munitions. GPS guided missiles can be jammed and the guidance system will revert to INS, although considerably less accurate than satellite guidance. INS is a navigation device that uses a computer, motion sensors and gyroscopes to continuously calculate by dead reckoning the position, orientation, and velocity (direction and speed of .movement) of a moving object without the need for external references



An AL TARIQ front component with GNNS/INS

Advanced PGM systems

Advanced PGM systems utilise GNSS/INS as well as another guidance system. Precision guided system manufacturers have developed these advanced ’hybrid‘ PGM systems to enhance accuracy and mission flexibility. For example, AL TARIQ’s PGM kits can utilise GNSS/INS with semi-active laser (SAL) or imaging infrared (IIR) and automatic target recognition (ATR). AL TARIQ is an advanced manufacturer of highly modular PGM kits that give air forces superior operational flexibility. Precise bombs such as AL TARIQ’s PGMs allow militaries to carry fewer weapons types during operations while retaining multiple guidance .options for each weapon release

Precision guided munitions are incredibly important precision weapons that have played a critical role in conventional warfare and will continue to have a strong impact on the .battlefield for years to come