



CAEMADXR

Magnetic Anomaly
Detection-Extended Role

CAE is the world leader in the design, manufacture, and integration of digital magnetic anomaly detection (MAD) systems. The company has been designing MAD systems for over 40 years and has delivered over 2,000 MAD systems and equipment to military forces around the world. Most of these systems have been installed on antisubmarine warfare (ASW) aircraft, including both fixed and rotary-wing aircraft, and used primarily for the detection of submarines. With the changing state of warfare, however, there are potentially new applications in the use of MAD technology.

CAE MAD-XR

The latest CAE MAD system is called MAD-XR (Magnetic Anomaly Detection-Extended Role) and is significantly more compact than previous MAD systems. CAE MAD-XR is a MAD sensor with reduced size, weight, and power requirements allowing the MAD system to be extended to smaller platforms such as unmanned aerial systems (UASs), helicopters and small fixed-wing aircraft. The CAE MAD-XR prototype was successfully flown in 2013 and its performance matched that of the much larger CAE AN/ASQ 508 MAD system. Following flight testing the MAD-XR was refined to ensure optimal design for production.

How MAD works

The MAD system consists of highly sensitive magnetometers, which are designed to sense changes in the earth's magnetic field due to metallic objects in the vicinity. Typically, the MAD system is mounted in the tail area of an aircraft to minimize magnetic interference. The range of the MAD system varies, but will generally detect anomalies at approximately 1,200 metres. When the MAD system detects a magnetic anomaly, an audio alert signals the crew and the

display provides contact and range information. CAE developed new software that allows for submarine location in the form of lateral and vertical separation (left/right indication) at the closest point of approach (CPA). This new algorithm opens the route for recommended tactical flight path to optimize target localization and detection. The inclusion of high bandwidth frequency to digital conversion provides better detection due to reduced background noise in higher frequencies as well as potential classification on the signature of the submarine.

MAD-XR Milestones

- Successful prototype flight testing completed in 2013;
- First flight as a towed system under a helicopter;
- Third flight on a Canada National Research Council (NRC) Convair aircraft in a direct comparison to CAE's AN/ASQ 508 system;
- During 2017-2018 successful completion of 3 separate series of flight trials onboard United States Navy MH-60R Seahawk Helicopter;
- In 2019, first unit sold to the Government of Canada for the Royal Canadian Navy (RCN);
- January 2020 qualification testing completed;
- MAD-XR is now in production.

Potential MAD applications

Magnetic anomaly detection has traditionally been associated with submarine detection and overlooked as a possible solution for land-based surveillance and detection. Recent conflicts have demonstrated the need for enhanced detection capabilities. CAE has been evaluating the potential use of MAD technology for the detection of concealed metal objects on land. With a MAD system mounted on some type of ground vehicle or UAV, the system could detect a variety of targets, such as armored vehicles or artillery. The MAD system is capable of detecting metallic objects through walls, buried underground, or hidden in dense forest canopies. In addition to traditional military applications CAE's MAD-XR version is also suitable for para-military and civil applications such as drug interdiction, power line monitoring, tunnel detection and magnetic surveys.



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CAE AIMS AN/ASQ 508A to CAE MAD-XR comparison

Parameter	AIMS AN/ASQ 508A	MAD-XR
Weight	Approx. 27 kg	Approx. 2.25 kg
Size	Sensor: 23 cm (diam) x 100 cm — Amp Comp: 56 x 26 x 19 cm	Sensor: 16 cm (diam) x 30 cm — Interface unit: 21 cm x 12.7 cm x 3.9 cm
Power	150 VA warm-up (AC) — 115 VA typical (AC)	50W warm-up (DC) — 30W continuous (DC)
Interface	1553 or Ethernet	Ethernet or RS-422

CAE’s MAD-XR has all the capability of the AIMS, but in a smaller and lighter package. The system is ideally suited for installation where size, weight and power consumption are a concern.

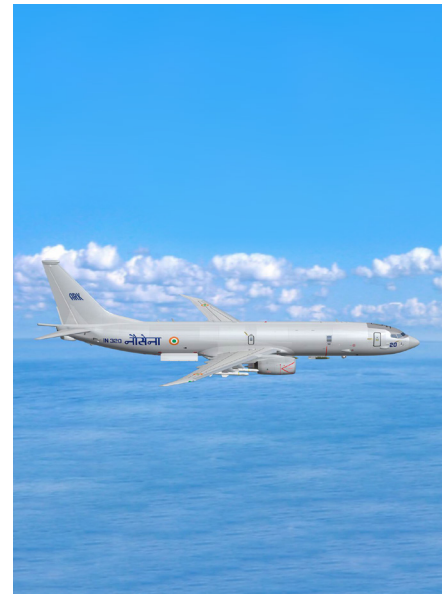
Program examples

CAE’s MAD systems have been delivered to a range of military customers worldwide, including:

Customer/User	Aircraft
Japanese Ministry of Defense	P-3C and P-1
Canadian Forces	Sea King and CP-140M
Indian Navy	P-8I
Australia	P-3, S-70B-2
Chilean Navy	C-295

CAE’s MAD systems are operational in a range of other aircraft platforms. The latest customers who have selected CAE’s MAD systems for their maritime patrol aircraft include:

- India for the Boeing P-8I Multi-Mission Maritime Aircraft (MMA);
- Kawasaki Heavy Industries and Mitsubishi Electric Corporation for Japan’s new maritime patrol aircraft;
- Turkish Navy for the CN235 maritime patrol aircraft;
- Republic of Korea Navy for the P-3CK maritime patrol aircraft;
- Canada for the CP-140M Aurora long-range patrol aircraft.



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