



PRECISION GUIDANCE SEEKERS

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WORLD LEADING

Leonardo is a world leading independent provider of electro optic seekers to missile manufacturers. We developed the first European electro-optic missile seeker in the 1970's for the Martel missile and have a long and successful history of providing innovative seeker capabilities to missile customers worldwide.

The Precision Guidance business based in Basildon, England, is the Company centre of excellence for our missile seeker related activities and is internationally recognised as a word leader for electro-optic seekers.

Supplying seekers to new customers is usually achieved via a process of new product development and Leonardo achieves this using our comprehensive through-life capability provision. We start the process with understanding how the customer requirements can be best met through the application of various proven and innovative seeker technologies which will have been de-risked through our on-going technology investment programmes.

The initial phase of developing new seeker solutions requires regular and close working with customers to efficiently focus on the optimum seeker configuration where both cost and performance are accurately calculated.





The detailed seeker design and development phase is worked in close concert with the customer weapon programme to achieve a qualified and proven product.

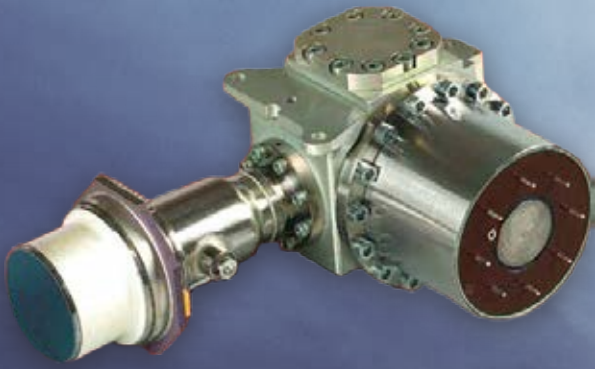
The focus on manufacturing however starts much earlier than this as the Leonardo team include design for manufacture within our initial concept generation phase. The method of support for the seeker will also be considered during the earlier phases and will be tailored according on the weapon application and logistics.

Leonardo is actively engaged in a number of missile seeker activities across the product development life-cycle which helps maintain this leading position in the various skills and technologies associated with EO seekers.

The Company is leading underlying research into material, component and sensor technologies that can be utilised to satisfy the demanding requirements for future seeker systems. Leonardo has a long experience of creating seeker concepts as part of customer studies into new missile solutions. A number of these concepts have been developed into technology demonstrator equipment with performance measurements carried out in trials.

This has resulted in Leonardo having a catalogue of alternative seeker schemes and configurations that can be used as seeker sub-system building blocks for a range of weapon types and target environments.





Leonardo CMT Detector



Loitering Munition Dual Mode Seeker

SEEKER CAPABILITY

Vertically Integrated Seeker Technologies

Leonardo has been a world leader in Imaging Infra-Red (I2R) technologies for several decades and the Company has been at the forefront of applying these technologies into missile seeker applications for this period.

Leonardo designs, develops and manufactures I2R detectors at its dedicated facility in Southampton, UK. With a reputation for providing customers with the best in high performance and cost-effective technology for I2R camera systems, Leonardo offers a unique level of expertise.

The Company specialises in the manufacture of Mercury Cadmium Telluride (MCT) I2R detectors that are designed for high performance, low cost imaging in the 3 - 5 μ m or 9-12 μ m waveband and provides the highest environmental integrity along with the superior performance of focal plane detectors.

The most significant programme for Leonardo's development of a wide range of EO technologies dates back to the 1990's where the Company manufactured a family of seekers for the PGM missile consisting gimballed I2R, Semi Active Laser (SAL) and Visible TV seeker variants.

The programme led to a number of world firsts including the largest LWIR seeker dome. Additional to this the Company manufactured the datalinks for both the weapon and launch platform to provide man-in-the-loop control of the PGM weapon. This unique solution provided a battle winning capability that achieved extremely high levels of seeker performance that is difficult to improve upon to this day.

More recently the advances in EO seeker technologies within Leonardo have provided the opportunity to develop dual and multi-mode sensing capabilities within a single missile seeker.



Seeker Assembly, Integration & Test Facilities





Javelin I2R Seeker

The commencement of development for a Loitering Munition led to the requirement for a dual mode EO seeker with I2R and low light TV sensor performance. Leonardo successfully completed the seeker development within record timescales and achieved the first UK application of uncooled LWIR technology in a missile system.

The common feature across these different seeker solutions is that they were all developed by the same engineering organisation within Leonardo. The same team are now working on the next generation of seeker technologies that will be available to be applied into new seeker concepts for future weapon systems.

In addition to our core EO seeker capabilities, Leonardo is also a world leader in sensor technologies across the electro-magnetic spectrum that can be applied to weapon platform types.

Leonardo is at the forefront for development of military communications solutions in Europe and is a key provider of technologies to the land, sea and air services. The Company is a leading partner in the application of Software Defined Radio and is well placed to develop SDR data links for weapon applications. The Integrated Antenna Solutions team within Leonardo are world leaders providing bespoke antenna solutions for a wide range of platforms.

The Company is a world leader in airborne RADAR and is heading the European consortium developing RF AESA technology to upgrade the current air platforms. The Precision Guidance business is the primary contact for exploitation of companywide technologies in guided weapon programmes.



Storm Shadow / Scalp EG I2R Seeker

SEEKER MANUFACTURING

Leonardo has a world class capability for volume manufacturing of EO seekers. The Company has demonstrated the ability to take our own seeker designs or those from another party and to achieve unrivalled and consistent build quality and cost effectiveness using our in-house seeker manufacturing processes.

The Company is always looking to help improve manufacturing efficiencies from across our in-house assembly, integration and test capabilities as well as the procurement of seeker sub-systems and components. We have excellent experience of improving the balance of making in-house versus out-sourcing to achieve the most cost-effective solutions for our customers.

The Seeker manufacturing capability at Basildon is housed within purpose built temperature controlled environments. The facilities are currently dedicated to our Seeker business to produce a range of products. They are located within the SIGMA Manufacturing Hall area and incorporate the following:

- 300 square meter temperature controlled assembly cell
- Class 100,000 (K) clean room environment
- Specific electrostatic discharge (ESD) safe handling area
- Specific material preparation area
- Three IR test rooms
- Special cleaning tank
- Mezzanine floor for material storage.
- Dedicated cleaning and test facilities, in particular, help maintain a continuous flow of Seeker build activity.

The facility delivers sensors for programmes that are:

- Available to meet schedule requirements
- Affordable
- Value for money
- Highly compliant to performance requirements
- Able to meet evolving needs through technology insertion.

The Operations department has considerable Seeker building experience. It has a large staff skilled in precision assembly and testing of optical devices. They have been building Seekers for several years and are fully conversant with the demanding build and test processes required.

Detailed resource planning is carried out for all projects, using proven in-house planning tools and processes. This allows programmes and their resource requirements to be tracked through their life cycle from bid to completion of order. We can ensure the correct type of resources is allocated via a comprehensive skill matrix in a timely and structured manner.

Manufacturing And Technology Transfer

Leonardo recognises that in order to develop mutually beneficial business opportunities in export markets, technology transfer can be an important mechanism. As a company we are open to discussions on this type of collaboration provided that it is structured within a viable overall business framework that offers realisable benefit to our company. Export approvals for collaborations are administered through the Export Policy and Assurance (EPA) department within the UK Ministry of Defence (MoD).



DUAL MODE I2R/SAL SEEKER DEMONSTRATOR

DUAL MODE I2R/SAL SEEKER DEMONSTRATOR



FACILITIES AND EXPERIENCE

Leonardo has vast experience in the delivery of EO seeker manufacturing programmes to the international missile marketplace including:

- Storm Shadow IRS
- Javelin IR seeker
- Semi-Active Laser
- FASGW(H)/ANL I2R seeker.

Leonardo is the lead seeker provider for UK multi-national programmes as demonstrated in the highly successful Storm Shadow / SCALP EG programme. The I2R seeker was developed by Leonardo and commenced production in the 2000's and is still being manufactured. This high performance seeker elevated the level of capabilities required to achieve a world class solution for this excellent weapon system. Over 2000 units have been delivered to our MBDA customer to date and the precision of the weapon system is an example of the quality and performance of the Leonardo designed seeker.

Leonardo won the competition to manufacture the Javelin IR seeker as part of the package of direct offsets for the UK LF-ATGW programme in 2004.

The Company has manufactured over 4000 Javelin seekers for UK MoD and other Javelin JV customers and continues to provide precision machined parts for all Javelin seekers having delivered in excess of 30,000 individual parts. This contract has demonstrated the ability of Leonardo to build to print complex missile seeker designs at highly efficient rates and costs.

Leonardo is a world leader in laser spot tracking and SAL seeking capabilities with products currently in-service worldwide. A product has been developed due to the increasing demand for SAL guided weapons. The Leonardo GEN III Semi-Active Laser (SAL) seeker provides high accuracy laser spot acquisition and tracking capability in a very compact sensor package for precision weapon terminal guidance.

Leonardo is cooperating with MBDA and SAGEM on a new seeker for the UK-France FASGW (H)/ANL missile which will equip a wide range of new generation helicopters. Leonardo is the UK industrial lead on the development and production phases for the FASGW(H) imaging infra-red seeker. FASGW(H)/ANL is designed to provide precise effects against a range of threats in complex naval environments, so a highly-precise seeker is integral to the success of the missile.

CREATING SEEKER CONCEPTS

Leonardo is the UK leader in EO seeker research and has developed relationships with a wide range of sensor research communities stretching from large companies through to universities and small enterprises. The Company has made significant investment into missile seeker research over the past decade primarily for UK and joint UK/Fr Government initiatives. The Company leads the EO Domain of the joint Anglo/French MCM ITP which is the main programme for innovative research for guided weapons technologies.

Leonardo is best placed to understand the sensor requirements for future weapon systems from our interactions with worldwide weapon primes and has a long experience in working with these customers and also the end users from the land, sea and air operational domains.

The significant body of work undertaken over recent years on these company and customer sponsored programmes has placed Leonardo in the position of having a large body of performance information on a range of sensor technologies resulting from laboratory, ground and airborne trials. This in turn has allowed us to continuously develop validated performance modelling capabilities that are so vital to carrying out effective seeker concept developments with their associated trade-offs.

Leonardo has an unparalleled history of taking new and innovative technologies from across the commercial and military domains and creating new electro-optic seeker concepts.

Leonardo started working on the application of lower cost and commercially available uncooled I2R sensors for weapon systems over ten years ago and has quickly become a leader in the exploitation of this technology in seekers.



The Company has created a number of seeker concept designs to examine the trade-off between cost and performance for a wide variety of different weapon applications.

Initial design work was followed by the build and test of the most promising concepts which were then tested under a series of comprehensive environmental conditions with performance assessments under customer sponsored research programme.

The results of this work have been taken forwards into numerous other seeker concepts which have also made best use of the continuous improvement in the uncooled sensors and other seeker sub-system technologies.

Through this work and other similar programmes Leonardo has accumulated vast knowledge and experience in the employment of I2R sensors and in the design and manufacture of sightline stabilisation and optical solutions for missile seeker applications.

The Company has also created concepts for dual-mode I2R and semi-active laser seekers. The Leonardo Uncooled Modular Seeker concept was developed into a technology demonstrator to provide details into the capabilities that could be envisaged for gimballed I2R uncooled and strap down SAL sensors within the common seeker architecture.



Leonardo has also created a detailed seeker concept for the replacement and upgrade of I2R seekers on the Soviet era fleet of weapons utilised in anti-air engagements including the R-27 seeker. This seeker concept is based upon use of Leonardo's own CMT detector product operating in the MW IR band.

The detector is cryogenically cooled and interfaces to Leonardo's own camera electronics. The I2R camera with single field of view optics is carried within a high performance gimbal to provide steering and stabilisation of the line of sight. The seeker concept is capable of detection and tracking of air threat targets using custom developed algorithms.

Leonardo is a leader in semi-active laser seeker technology and the Company has a number of SAL sensor concepts for applications including gun launched munitions, rockets, bombs and multi-mode seekers. Some of these have been developed into technology demonstrator seekers and tested within the appropriate weapon environment. For example a gun launch version has been built and successfully withstood over 25,000g launch shock to prove robustness of the mechanical and electronic assembly

Leonardo has proven experience to work closely with customers and to create new concepts that can be developed into cost effective and high performance seeker solutions for a wide variety of weapon systems designs.

NEW SEEKER PRODUCTS AND DEVELOPMENTS

Semi-Active Laser Gen Iii Seeker Product

The GEN III Semi-Active Laser (SAL) seeker provides high accuracy laser spot acquisition and tracking capability in a very compact sensor package for precision weapon terminal guidance. Leonardo is a world leader in laser spot tracking and SAL seeking capabilities with products currently in-service worldwide. This product has been developed due to the increasing demand for SAL guided weapons.

The GEN III SAL seeker delivers unprecedented levels of seeker accuracy to maximise weapon cost effectiveness under demanding guidance system requirements. The GEN III SAL seeker is compatible with multiple guided weapon types including missiles, bombs and rockets.

Micro-Stabilised Compact Seeker Demonstrator

Under a UK Government research initiative with additional investment, a new ground-breaking compact seeker demonstrator has been designed and manufactured. This innovative seeker solution has been designed to meet a wide variety of requirements from future battlefield and short-range air defence weapons. Management of unit production price is a critical requirement in these sectors, and the design has been developed from the outset with this aspect in mind.



COMPACT SEEKER DEMONSTRATOR

GEN III SAL SEEKER PRODUCT



The seeker has demonstrated high performance from the uncooled imaging IR sensor with wide angle sightline steering and stabilisation in a very compact and affordable package for precision weapon terminal guidance. The demonstrator has achieved this at approximately half of the unit price and significantly less than half of the body diameter/volume of our concepts based on more conventional seeker designs.

Key to this achievement is the novel “micro-stabilised” configuration to achieve the combination of its physical compactness and high performance sightline steering and stabilisation. The uncooled focal plane array detector is steered in the lateral body axes behind a lens assembly which presents an over-sized image.

Key to this technique is the preservation of critical signals in the detector to proximity electronics interface and providing a two-axis linear steering mechanism with the requisite performance and durability under applied environments.

The uncooled long-wave infrared detector employed in Compact Seeker is a high performance amorphous-silicon device with 480 x 640 pixel count.

There is a low risk path to utilise the equivalent 288 x 384 pixel count device where this cost versus performance trade-off is beneficial.

- Compatible with Lock-on Before Launch or Lock on After Launch concepts of operation, either of which can be autonomously driven or involve an operator in the loop
- Baseline body calibre of 76.2mm and less than 1.5kg mass. For higher calibre systems there are predefined opportunities to scale up the seeker in return for performance benefits
- State of the art uncooled imaging IR sensing performance, building upon Leonardo's pedigree from proven in-service uncooled imaging IR based guided weapon systems
- Highly agile sightline steering and stabilisation providing compatibility with severe weapon base motion and maximum flexibility for acquisition, tracking and guidance techniques.

QUALIFICATION AND TESTING

Leonardo has highly skilled and experienced staff that have undertaken comprehensive qualification and testing of our seeker designs to prove the quality and robustness of our EO seeker developments.

The scope of qualification and testing is agreed with the weapon prime and customer communities in order to provide the desired level of confidence in the seeker solution as well as the cost effectiveness.



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