CSIR- NATIONAL AEROSPACE LABORATORIES:
A leading Indian aerospace R&D institution

National Aerospace Laboratories (NAL), a constituent of the Council of Scientific and Industrial Research (CSIR), India is the only civilian aerospace R&D laboratory in the country. Started on June 1, 1959 in Delhi, it moved to Bangalore in 1960 and later on to its own two campuses (Kodihalli and Belur) in Bangalore. CSIR-NAL is a high-technology institution focusing on various disciplines in aerospace and has a mandate to develop aerospace technologies with strong science content, design and build small and medium size civil aircraft prototypes, and support all national aerospace programmes. It has many advanced test facilities recognized as National Facilities. These are not only best in the country but are also comparable to other similar facilities in the world. NAL’s committed efforts over the last five decades have resulted in achieving expertise and core competencies in most of the disciplines of aeronautics, the areas of core competence include: computational fluid dynamics, experimental aerodynamics, flight mechanics and control, turbo machinery and combustion, composites for airframes, avionics, aerospace materials, structural design, analysis and testing. It has always readily accepted challenges and delivered programme-critical products and technologies, and has become the preferred destination/partner for almost all the mission-mode aerospace programmes in the country. It would not be improper to say that the LCA Tejas development would have been difficult without NAL’s contributions, and that every major aerospace programme of DRDO and ISRO has significant contributions from CSIR-NAL.

As is in its mandate, in 1983-84, CSIR-NAL started a project to fabricate an all-composite aircraft using a kit bought from the Rutan Aircraft Company in USA. The project led by the indefatigable Prof R B Damauni, gave CSIR-NAL teams very valuable insights into building airworthy composite structures. The aircraft, called the Light Canard Research Aircraft (LCRA), was ready by the end of 1986 and made its maiden flight on 26 February 1987. After the LCRA success, CSIR-NAL seriously started the preparatory work to design and build small and medium sized general aviation aircraft. Today, NAL’s two seat aircraft (15 built so far) named ‘HANSA’ a pioneering ab-initio all composite design, certified by DGCA in the year 2000 under JAR-VLA certification is catering to the needs of flying clubs in the country. SARAS, the 14 seat (7 ton class) multirole transport aircraft to be certified under FAR 23 category is being designed and built by CSIR-NAL had its maiden flight on May 29, 2004. It has been designed for multiple roles like executive transport, light package carrier, remote sensing, air ambulance etc. Indian Air Force is expected to be the launch customer for SARAS with HAL as the production partner. The five seat General Civil Aviation aircraft named CNM-5 has the distinction of being the country’s first public-private partnership (PPP) for development of civil transport aircraft. It is being developed by CSIR-NAL in collaboration with M/s Mahindra Aerospace Pvt. Ltd. (MAPL), Bangalore and had its maiden flight on the 1st September 2011 in Australia. It is proposed to be certified first under CASA, the Australian Certification Authority. CNM-5 is an ideal aircraft for air taxi, air ambulance, training, tourism and cargo applications.

NAL’s contributions to major national strategic sector programmes have enabled it to carve a niche for itself. Key technology successes of NAL in the strategic sector include: carbon fibre composite airframe components using innovative cost-effective fabrication technologies and Fly-by-wire Flight Control Laws for the Tejas aircraft programme. The CSIR-NAL led National Control Law Team jointly with different groups of NAL played a crucial role in Tejas flight envelope expansion and up-gradation of control laws and airdata algorithms for obtaining the aircraft Initial/ Final Operation Clearance. The significant contributions of CSIR-NAL to the LCA Air Force variant which got its Initial Operational Clearance have been duly acknowledged by one and all. As a part of LCA series production, new production standard tools were designed and fabricated in association with the production partner M/s TATA Advanced Materials Ltd., to meet the stringent quality standards set for the series production. This contribution is a major step in taking LCA from limited series production phase to series production phase. The laboratory has also successfully developed the engine bay door for the Tejas aircraft using Bismaleimide (BMI) prepreg to withstand temperatures up to 200 deg C service temperatures, a first of its type in India. An achievement with far reaching implications is the development of aerospace grade carbon fibres, a technology which is high on the list of sanctions. Recently NAL has signed a MoU with MIDHANI, Hyderabad to establish production facilities for carbon fibres based on NAL technology. Continuing the support to aircraft development programmes the R&D divisions at NAL have significantly contributed towards the Advanced Medium Combat Aircraft programme of Aeronautical Development Agency (ADA). It is important to mention that for the first time in the country drop tests for dynamic simulation of missile release from the fighter aircraft were carried out in the NAL’s 1.5m low speed wind tunnel. The study also included the wind tunnel test on scaled isolated store model to obtain the aerodynamic loads. For this breakthrough technology development and outstanding contributions CSIR-NAL has been conferred with “Best Laboratory Award 2014”. In another notable contribution to the strategic sector, CSIR-NAL has designed and developed an indigenous system for Detection and Hit Visualization using acoustic N-Wave Identification (DHVANI) for locating bullet hits on targets for the Indian Army. This automated and rugged system is not only economical but also meets/exceeds the specifications of comparable systems available
Our laboratory is recognized as India’s premier organization for carrying out failure analysis and accident investigations of aircraft. CSIR-NAL’s structural technological capabilities cover dynamic analysis of structures including aeroelastic testing and analysis. The full-scale fatigue test facility provides inputs that can lead to a substantial increase in the operational life of airframes. NAL has achieved considerable success in using smart materials for structural health monitoring and also as sensors and actuators. It has a proven ability in the area of design, testing and analysis of advanced engine components.

CSIR-NAL has developed indigenous autoclaves for aerospace applications. The autoclaves developed are highly reliable, demonstrated by the fact that one of the autoclaves as large as 4m (dia) x 8m (L) has been functioning very effectively as work-horse at HAL, over the last decade. The autoclaves developed by CSIR-NAL are now marketed in public-private partnership mode. While, M/s Unique Chemo Plant Equipment, Mumbai, is our partner for all mechanical systems & marketing, M/s DATASOL, Bangalore, is the partner for control & instrumentation systems. As part of the ‘societal mission’ initiative to develop affordable lab scale autoclaves for educational institutions, CSIR-NAL lead PPP consortium successfully commissioned two lab scale autoclaves in the recent past. The first one was commissioned at IIT, Kanpur followed by the second at MIT, Manipal, Karnataka. NAL has also developed many technologies for societal applications. NAL’s pioneering efforts in parallel processing hardware and software development have given the country advanced metrological computational capabilities. NALSUN solar selective coating for industrial and domestic solar water heaters, wind turbines of 300kW and 500 kW capacity for wind energy harvesting, 500 W wind–solar hybrid system to power remote areas, coatings for cutting tools to enhance wear resistance and improved tool life are some of the significant achievements with societal impact.

CSIR-NAL is continuously striving towards new strategic initiatives to meet the challenges of future. To name a few initiatives: a major programme initiative in association with HAL on national civil aircraft development for regional connectivity, and design & development of sub 200 mm class Micro Air Vehicles to meet the needs of strategic and civilian sector. Further, NAL is expected to play a significant role in the proposed development of Advanced Medium Combat Aircraft by ADA and the Fifth Generation Fighter Aircraft and Medium Transport Aircraft programmes of HAL. In conclusion, it may be said that CSIR-NAL aims to reach greater heights in futuristic aerospace technologies by continuing to develop niche aerospace technologies and by active participation in future major national programmes.