World Leader in the Design and Integration of Flight Control and Utility Actuation Systems

Moog is a global designer, manufacturer and integrator of precision motion control products and systems. Over the past 60 years, we have developed a reputation for delivering innovative solutions for the most challenging motion control applications. As a result, we have become a key supplier to the world’s leading aerospace and defense manufacturers, and are positioned on virtually every platform in the marketplace – supplying reliable mission critical products that are highly supportable and add significant value for our customers. A key element of our success has been our corporate culture, which embraces a strong customer focus, process and product innovation, solid work ethic and remarkable attention to purpose of our people.

Through Moog’s aftermarket services business, we have been providing the same highly responsive, customer-focused support to commercial and military operators around the world. With aircraft staying in service far beyond their intended life, Moog continually strives to develop enhanced repair processes and reliability improvements to keep products on wing longer, thereby increasing fleet availability and lowering lifecycle costs. In addition to providing world-class MRO services, we offer technical support and training, product modifications and upgrades, reliability enhancements and technology insertion, obsolescence management and public-private partnerships.

Moog Celebrates Grand Opening of Wolverhampton Facility

Moog’s newest facility in the UK provides aerospace engineering, manufacturing and repair services for commercial and military aircraft products. The modern 200,000 sq-ft facility includes the latest equipment and optimized production flow lines, replacing the facility Moog was leasing a short distance away.

Major Programs Supported:

**Military Aircraft** – Eurofighter, F-35 Joint Strike Fighter, V-22 Osprey, M-346 Trainer, CN235/C295, AMX, A129, AW159, AW609, C27J

**Commercial Aircraft** – Boeing 787, 777, 767, Airbus A330, A380 and COMAC C919

Moog Introduces Total Support for Commercial Aircraft

Moog recently launched Moog Total Support (MTS), a comprehensive support program for its flight control systems. By combining asset pooling, maintenance, technical support and logistics, Moog can provide a highly-customized support package that unites its OEM expertise with decades of experience as a world-class MRO provider.

MTS provides airlines with an unrivaled one stop solution tailored specifically to individual needs. This helps to reduce cost, inventory levels, AOG risk and exposure to obsolescence. These flexible life-cycle cost solutions include:

- 24/7 access to spares with regional pooling locations around the world
- Guaranteed availability of replacement components
- On-site consignment

- 24/7 customer support
- Lease, loan and exchange options
- Reliability monitoring and maintenance recommendations

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Moog Supplying Primary Flight Control Actuation and Trailing Edge Actuation Systems for Airbus A350 XWB

Moog was selected by Airbus to provide design, integration and certification support for the Primary Flight Control Actuation on the A350 XWB. Moog is providing 27 discrete actuators and associated control electronics on this program. This system includes a mix of electrohydraulic and advanced electrohydraulic (EHA) actuators to control the aileron, elevator, rudder and spoiler flight surfaces. Moog’s products feature:

- More electric actuation technology
- On-board electronics for actuator power and control
- Highly integrated assemblies to meet challenging envelope constraints

Moog was also selected to supply the Trailing Edge actuation system for the A350 XWB including the power control unit, inboard and outboard geared rotary actuators, gearboxes, wing tip brakes and other miscellaneous components.

Moog Providing Flight Control Computer and Software for 747-8

Moog is supplying Boeing with the Lateral Control Electronics (LCE) for the new Boeing 747-8. The Boeing 747-8 Inter-continental and the 747-8 Freighter are the new high-capacity 747’s, which recently entered revenue operations.

As part of the program, Moog designed, manufactured, qualified and provided certification support for the LCE. The function of the LCE is the control of fly-by-wire aileron and spoiler actuators.

The system leverages Moog’s proprietary dual redundant, triplex dissimilar architecture and builds upon expertise gained designing and certifying flight control systems on other civil programs.

System Provider for 787 Primary Flight Control and High Lift Actuation

Moog is the system integrator for the 787 Primary Flight Control Actuation System (PFCAS) and the High Lift Actuation System. Moog is providing the design, integration and certification support for both of these systems. The Moog systems control the primary, secondary and high lift surfaces in response to pilot commands.

The 787 PFCAS controls 21 flight surfaces and includes a mix of electrohydraulic (EH) and electromechanical (EM) servoactuators and all associated control electronics. The system includes EH servoactuators, with remote loop closure electronics for the ailerons, flaperons, inboard and outboard spoilers, elevator and rudder. The horizontal stabilizer and mid-board spoilers employ EM servoactuators with associated motor drive control.

The High Lift System includes the complete flap and slat actuation systems comprising nearly 450 discrete assemblies including: power drives, electronic controls, trim controls, geared rotary actuators, rack and pinion roller assemblies, transmissions shafts, offset gearboxes, sensors and accessory components. The High Lift System features a number of technical advancements to improve wing aerodynamics. To decrease system weight, a number of advancements were also incorporated, including the use of advanced composites and increased use of electronic controls.
Enhanced Services for Commercial Aircraft Operators

Moog is in the process of launching its 24/7 centralized customer service center for our commercial MRO services. The customer service center’s dedicated support team will provide a single point of contact for all your product support needs.

In addition, Moog recently selected Aeroturbine to provide global logistics support for its Total Support and Asset Support programs. The agreement includes 24/7/365 warehousing for Moog’s global pool support customers. Initial locations include Miami, Los Angeles, Singapore, Beijing, Melbourne, Sydney, London and Dubai, with more locations established as required.
System Integrator for F-35 Joint Strike Fighter Primary and Leading Edge Flight Controls

Moog is leading an industry team in the development and integration of the Primary Flight Control and Leading Edge Flap Actuation Systems for the Joint Strike Fighter Program. The F-35 “power-by-wire” system represents an advancement on the more electric aircraft topology integrating:

- Self-contained electrohydrostatic actuators (EHA) to position primary flight surfaces
- Electronic Control Units to remotely drive and control the EHAs
- Electrically-driven PDUs to position the maneuvering leading edge flaps

As the prime contract holder, Moog’s role includes management of the industry team, integration of the complete actuation system, and supplier of critical technologies and major sub-systems. Moog is also supplying the wingfold actuation system on the F-35 C-variant.

Supplier of Primary Flight Control Actuation for AW159

The AW159 Lynx Wildcat is a modern twin engine, multi-role helicopter designed for battlefield utility, search and rescue and anti-submarine warfare roles with the British Army and Royal Navy. Moog was selected by AgustaWestland to design, qualify and manufacture the tail rotor actuator for this aircraft. Moog’s actuator directly interfaces with the helicopter’s automatic flight control system, allowing the aircraft to be flown on autopilot. First flight occurred on 12 November 2009 and initial production deliveries are underway.

Supplier of A400M Primary Flight Control Actuation

Moog is providing the design, manufacture and integration of 8 fly-by-wire servoactuators for the Airbus A400M primary flight control surfaces. Moog is supplying electrohydraulic (EH) actuators for the aileron, elevator and certain spoiler surfaces and electric backup hydraulic actuators (EBHA) for positioning other Spoiler panels. The EBHA includes a self-contained electrohydrostatic actuator (EHA) with integral pump and electronic controls. During normal operation, the EBHA operates as a conventional EH actuator using the aircraft’s main or backup hydraulic systems. When in backup mode, the onboard pump and controller provide hydraulic power for positioning the spoiler surfaces, allowing the elimination of the third hydraulic channel.

Moog Supplies Lift Fan and Swivel Module Actuation Systems for F-35B STOVL

The F-35B is a Short Take-Off and Vertical Landing (STOVL) variant of the Joint Strike Fighter. The “hovering” ability of this distinctive aircraft is provided through a combination of a thrust vectoring nozzle directing main engine exhaust downward to generate aft vertical lift, and a centrally mounted lift fan which provides counterbalancing forward vertical lift. Moog designed, qualified and now manufactures the sophisticated actuation systems for both of these applications. Specifically, Moog supplies the actuation system for the three-bearing swivel nozzle which rotates the main engine’s exhaust downward through 90 degrees. In addition, Moog provides the actuation system controlling the lift fan’s Variable Area Nozzle and Inlet Guide Vane which control airflow through the lift fan. These actuation systems use electronically-controlled hydraulic and fuel/draulic servoactuators specially designed for operation in extreme temperature and vibration environments.
Active Vibration Control Systems for Military and Civil Rotorcraft

Moog is supplying its active vibration controls for Sikorsky’s UH-60M Blackhawk helicopter. Moog’s Vibration Suppression Actuation System (VSAS) includes a DSP-based Controller and a pair of counter-rotating Force Generators per channel. Vibration levels within the air vehicle are monitored and the Force Generators inject cancellation forces at discrete locations throughout the airframe, dynamically adapting to changes in the vibration environment. By eliminating the need for heavy passive vibration absorbers, the system offers weight savings while providing a number of secondary benefits including enhanced situational awareness, passenger comfort and increased aircraft component life. The system is currently flying aboard the Sikorsky S-92, Bell/Boeing V-22, UH-60 Blackhawk and SH-60 Seahawk rotorcraft.

Displays and Avionics

With over 35 years of experience in cockpit displays, avionics and instrumentation, Moog Components Group has contributed to the success of numerous aerospace platforms. We offer total in-house engineering capabilities for design, manufacture and test of a full range of products. We offer a number of stand-by and utility navigation instruments for the Commercial, Business Jet and Regional Jet community and also provide support to many TSO and STC efforts for retrofit applications. In addition to our traditional electromechanical product line, Moog offers a line of fixed format LCD engine instruments and can accommodate numerous Signal Data Conversion (SDC) needs as well.

Rotary and Linear Electromechanical Actuators and Controls

Moog leads the industry by designing and producing high-performance linear and rotary electromechanical actuators (EMA) for aerospace and defense applications. Our actuation products are used to control flight surfaces and position sensors on aircraft, missiles and space vehicles; provide stabilization and aiming for land and sea based gun turrets; steer antennas in high bandwidth communication systems; and provide control for various utility applications.

Moog is able to offer precision actuation solutions with rare earth brushless motors, planetary gears and smart servo controllers with integral position control or utility actuation solutions with DC motors, spur gears and analog amplifiers with external position control.

A technology initiative currently underway allows us to offer a fiber optic communication interface for our EMA’s. This technology provides many systems advantages, including EMI immunity and weight savings.

Moog Acquires Crossbow Technologies

In 2011, Moog acquired Crossbow Technology Inc. Crossbow, headquartered in Milpitas, California, is a designer and manufacturer of sensing and inertial management products that are integrated into mission critical navigation and guidance systems. The products are used in a variety of aerospace, defense and transportation applications.

Crossbow’s innovative use of MEMS-based technology allows them to deliver products that achieve significant improvements in performance, size, and cost over competitive products in widespread use today. Crossbow’s advanced sensing products complement Moog’s established controls business and provide a unique opportunity to offer more comprehensive systems to our customers. For more information visit www.moog-crossbow.com.
Moog Signs Umbrella Corporate Contract with DLA
Moog has recently signed an umbrella contract with DLA - Defense Supply Center Richmond. The corporate contract covers critical component parts and sub-assemblies required to support depot repair activity for all Moog Aircraft Group products. This new contract benefits DLA, the USAF depots and Moog by streamlining the procurement process and providing more cost effective and timely access to parts required to support legacy aircraft systems.

Defense Supply Center Richmond is the aviation supply and demand chain manager for the Defense Logistics Agency and serves within the Defense Department as the primary source of supply for more than 1.2 million repair parts and operating supply items. DLA recently assumed responsibility for procurement management and related support functions for depot-level repairables at the Oklahoma City, Ogden and Warner Robins Air Logistics Centers. DLA’s mission is to provide best value aviation weapon systems and logistics support to America’s armed forces—on land, at sea and in the air.

Moog Expands H-60/S-70 Flight Control Overhaul and Upgrade Services
Moog developed the capabilities to provide overhaul services for the entire family of integrated Trim/Boost Servoactuator Assemblies on the H-60/S-70, including the Pitch Trim, Roll Trim and Yaw Boost Servoactuator configurations. Moog inspect and disassembles the integrated assembly, overhauls and tests the individual LRU’s, and reassembles and tests the integrated assembly before delivery to the customer. Moog has recently won its second consecutive 5-year contract with the US Coast Guard (USCG) to provide overhaul services for their HH-60J/T flight controls, previously demonstrating a 50% improvement on turnaround time while significantly lowering the USCG’s total overhaul cost.

In addition, Moog is now offering an endurance upgrade to the H-60/S-70 Pitch Trim Actuator. This upgrade, available only through Moog’s exclusive overhaul process, will enable the Pitch Trim to stay on wing longer and provide better performance in harsh climates such as salt water, humidity and sand. HVOF coating has been added to the Booster Piston providing additional corrosion and scratch protection. The design of the dust boot has been modified to help keep the Pitch Trim flying longer, and the newly designed mounting feet will prevent corrosion by better allowing the surface to shed water. The upgrade will offer a 3X improvement in mean time between unit removals versus the current configuration.

Moog Providing F/A-18 C/D Leading Edge Flap System Safety Upgrade for Worldwide Hornet User Community
Moog is the original design authority for the F/A-18 C/D Leading Edge Flap System and has developed and qualified a safety upgrade to improve system reliability, enhance effectiveness of periodic inspections, and ensure control during possible fault condition. The changes include a redesigned Torque Limiter and Stop Module and a replacement Torque Shaft. The upgrades can be installed at the Organizational (O) level and retrofit actions are planned for worldwide distribution in Spring 2013.

The changes to the torque limiter include the addition of a brake wear indicator and trip indicator that enable periodic inspection of the brake stack and a means to visually determine whether the torque limiter has experienced a lock-up. The improvements to the stop module control the inboard flap from moving beyond the stroke limits during a runaway, thereby preventing a loss of control condition. Lastly, the torque shaft that connects the hydraulic drive unit to the angle gearbox was redesigned to add a second universal joint, thereby improving shaft support and ensuring any misalignment is handled by the U-Joint. For more information please contact Russ Wainwright, Director F/A-18 Global Product Support, +1.801.557.6567; e-mail: rwainwright@moog.com

World Class Repair and Overhaul Support for F-16 Leading Edge Flap Drive System
Moog is the OEM supplier for the F-16 maneuvering Leading Edge Flap Drive System (LEFDS). Products include the Power Drive Units, Hydromechanical Actuators, Rotary Mechanical Actuators, EM Control Actuators, Angle Gear Boxes, Torque Shafts and Asymmetry Brakes. Through the use of modern test equipment, factory trained technicians, and the latest approved repair procedures, we maintain a leadership position in the repair, overhaul, modification and upgrade of the F-16 LEFDS hardware. Moog prides itself on being able to deliver the highest quality of customer service and is capable of creating flexible support programs to best meet our customer’s unique needs.
Moog Adds New F-16 Flight Control Support Capabilities

Moog has recently expanded its capability to support F-16 customers with repairs, overhauls and spares for the Leading Edge Flap (LEF) Power Drive Unit (PDU). The PDU is a complex electro-hydro-mechanical system that accurately controls the position of the leading edge flaps in response to changes in aerodynamic conditions.

Moog has also developed internal capabilities to provide cost effective repair and overhaul services for the complete PDU and for all of the subassemblies that make up the PDU. Modifications of older design PDU’s into the latest configuration can also be accomplished to minimize support costs for the end user.

USAF Selects Moog to Provide Overhaul Support on B-1B Primary Flight Control Servoactuators

The United States Air Force (USAF) recently awarded Moog contracts to provide overhaul services for the primary flight control servoactuators on the B-1B weapon system. These 5-year contracts encompass a total of 25 different line items including Horizontal Stabilators, Pitch Roll SCAS, Yaw SCAS, Forward and Aft Structural Mode Controls, Lower Rudders, Inboard and Outboard Spoilers and the Master Pitch Roll Servoactuator. The first deliveries of overhauled servoactuators began in June 2010. These contracts typify Moog’s commitment to support the USAF’s operational readiness goals for high priority weapon systems.

Moog Supports Ongoing Public-Private Partnerships

Moog is committed to supporting its customers through the use of Public-Private Partnerships. Moog currently has several partnerships in place, covering multiple platforms and applications. These partnerships provide significant value by leveraging the specialized expertise, equipment and facilities of each organization.

Since March of 2008, Moog has been under a Public-Private Partnership with Ogden Air Logistics Center for the overhaul and upgrade of the F-15 pitch and roll channel assembly. Moog has also been under a Public-Private Partnership since August of 2007 with the Fleet Readiness Center Southeast for the F/A-18 leading edge flap system. In November of 2011, Moog also entered into a commercial service agreement with the Fleet Readiness Center East for the V-22 Osprey. Moog Military Product Support is actively engaged in discussion for future commercial service agreements with the Tinker Air Force Base for the B-2, and with the Fleet Readiness Center Southwest for the F/A-18 E/F and F-35.
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