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

Over the last 60 years, Moog has developed a reputation throughout the world as a company whose people and products are at the forefront of the aerospace industry. We are known for our successful solutions to motion control challenges that are viewed by others as impossible. This directly reflects the creativity, work ethic, and remarkable attention to purpose of our people.

Over this period, Moog has expanded its capability base to become a leading supplier of integrated flight control systems. We are continuously investing to extend the depth of our systems capability while simultaneously expanding our core component expertise to take on the challenges and responsibilities of a changing industry. As a result, we are positioned today on virtually every aircraft in the marketplace, supplying reliable system solutions that are highly supportable and add significant value for our customers.

Moog Provides 787 Entry Into Service Support

Moog is the designer, manufacturer and integrator for the 787 Primary and High Lift flight control actuation systems. As the aircraft approaches entry into service, Moog is prepared to provide the airlines with industry leading support including expert training from our OEM technical team, first class responsiveness and global spares availability. This includes a team of field service engineers, inventory located in all major world regions, and a variety of spares provisioning and maintenance options.

Moog is working closely with the Airlines to customize support packages that meet their exacting needs ranging from initial provisioning buy or lease, access to pool options and flight hour maintenance programs.

Moog Acquires Crossbow Technologies

Moog recently announced the acquisition of 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 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 (EH) and advanced electrohydrostatic (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, which entered service in 2011, and the 747-8 Freighter, which entered into service in October of this year, are the new high-capacity 747’s.

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 System. Moog provided 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 System 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 compromising 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.
Moog’s Baguio Customer Support Center Continues to Expand

Moog continues to grow at its newest repair station in Baguio City, Philippines. The facility, located in Moog’s modern aircraft controls manufacturing facility, provides repair and overhaul services to customers in the Asia-Pacific region.

Originally established in 1984 to produce Boeing, Airbus and business jet products, the facility now offers full service repair and overhaul of Moog content on the 777, 747, 737, A330 and A340, and also supports exchange and repair on servovalves. The center has its own dedicated technical and support staff, test equipment and inventory.

Since 2009, the station has received repair certification from FAA, EASA, CAAC, CAAP Philippines, CAAS Singapore, DCA Thailand, DGCA Indonesia and DCA Malaysia.

Moog Acquires Flight Control Actuation Business from GE Aviation Systems

The business, located in Wolverhampton, U.K., designs and manufactures primary and secondary flight control actuation for a number of commercial and military programs. Key commercial products that have been added to Moog’s support capabilities include:
- 737 – Primary Flight Actuation
- 777 & 767 – High Lift Actuation
- 787 – High Lift Actuation
- A300-600 – Primary Flight Actuation
- A330/A340 – High Lift Actuation
- A380 – High Lift Actuation
- BAE 146 – Primary and High Lift Flight Actuation

The General Electric Company acquired this business as part of its acquisition of Smiths Aerospace in May of 2007. The acquisition is now part of Moog’s Aircraft Group.

777 Spoiler Reliability Extension Program

On the Boeing 777, Moog is the OEM supplier of Inboard, Outboard and Mechanical flight control actuators (PCUs) with a total of 14 actuators per aircraft. Moog has developed a reliability extension program to enhance dispatch reliability while minimizing unscheduled Spoiler PCU removals. The Spoiler Reliability Extension program contains three key elements:

- Field inspections of high time PCUs to assess critical wear that can affect aircraft dispatch
- Specialized repair and overhaul procedures to restore hardware to an enhanced reliability level
- Strategically locating rotatable in Moog global facilities to enhance turn-around time

Under the program, Moog works with the technical staff of the operators to create in-field inspection instructions, custom test equipment, a health check kit and on-site technical support and training. For Spoilers ultimately identified as requiring maintenance, Moog has developed a specialized overhaul protocol to integrate product improvements and restore hardware to an enhanced reliability level.

Moog Expanding Airline Support Network

Moog recently expanded its logistics support capabilities by prepositioning consignment stock within Beijing, China. Through a partnership agreement with the Air China Export/Import Division, Moog is providing rapid response support of Moog Aircraft products to airlines operating within China. The inventory includes a variety of replacement units for Boeing and Airbus aircraft.
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 (EHA) actuators 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 managing 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.

Boeing Selects Moog to Develop and Qualify Fly by Wire Rudder for the F-15

Moog has been participating as a key supplier to Boeing for the F-15 since the early 1970s. This program will upgrade the existing mechanical flight control actuators with advanced fly by wire technology to simplify the aircraft’s overall flight control architecture and reduce system weight. This award provides us a position to support the next generation of F-15 Strike Eagles through the next decade.

Supplier of V-22 Primary Flight Control Actuation

Moog is providing the design, manufacture and integration of 19 Primary Flight Control Actuators including main rotor Swashplate, Flaperon, Rudder and Elevator.

In addition, Moog is providing the active vibration control system, bladefold actuation, nose-wheel steering servovalves, main prop rotor slip ring, hydraulic fluid compensation module and engine fuel control servovalves. Key attributes of the flight control system include a 5000 psi operating pressure, duplex hydraulic – triplex electrical redundancy on the Swashplate actuators and ballistic tolerant Elevator and Swashplate actuators.

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 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 fueldraulic servo actuators 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, SH-60 Seahawk and Sikorsky’s X2 technology demonstrator.

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**Advanced Electronic Controls for Aerospace and Defense**

Moog is a leading supplier of electronic controls for mission critical applications in the aerospace and defense industry. Our state of the art systems are used wherever precision control is required including aircraft flight control, launch vehicle thrust vector control, aiming and stabilization, and missile steering. Our expertise includes advanced digital control, distributed system architectures, high power drives, redundancy management and designs for harsh environments. We have designed, qualified and provided certification support to civil and military level A standards. Our products are well suited for both OEM and product upgrade programs.

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**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.

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**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 EMAs. This technology provides many systems advantages, including EMI immunity and weight savings.
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 inspects 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 late 2011.

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 run-away, 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). Our 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 Expands Global Support Capability for Military Aircraft Products

As part of a recent acquisition, Moog now offers full service capabilities for the relevant actuation products originally sold under the GE Wolverhampton, Smiths Wolverhampton and Dowty Wolverhampton names. Key products which have been added to Moog’s support capabilities include:

- CN235 – Trailing Edge Flap Actuation & Controls
- C295 – Trailing Edge Flap Actuation & Controls
- Typhoon – Primary Flight Actuation
- F-35 STOVL – Lift Fan & Swivel Module Actuation
- A129 – Primary Flight Actuation
- AMX – Primary Flight Actuation

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

The 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.

Moog Military Product Support is actively engaged in discussion for future Commercial Service Agreements with the Fleet Readiness Center East for the V-22 Osprey, 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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