

SETTING THE STANDARD IN MOTION CONTROL



AN OVERVIEW OF MOOG AUSTRALIA'S PRECISION
MOTION CONTROL PRODUCTS AND SERVICES

MOOG AUSTRALIA



MOOG HERITAGE

Founded in 1951 by Bill Moog in East Aurora, New York, Moog has developed a reputation throughout the world as a company with employees and motion control solutions that are at the forefront of the markets we serve. Our high-performance motion control solutions, systems and components control a variety of industrial machines manufactured and installed all over the world -installations where precision, velocity, force and acceleration are critical. With total company sales of close to US \$2.5 Billion, Moog is recognised as a global market leader for technology and innovation in our target markets, continuously improving machine design and performance.

ABOUT MOOG

Moog Inc. is a worldwide designer, manufacturer, and integrator of precision motion control products and systems. Moog's high-performance systems control military and commercial aircraft, satellites and space vehicles, launch vehicles, missiles, industrial machinery, wind energy, marine applications, and medical equipment.

MOOG AUSTRALIA

Moog Australia is a wholly owned subsidiary of Moog Inc and was established in 1979. Located in Heatherton (Melbourne, Victoria), the facility has been optimised with a "lean layout", encompassing manufacturing, training and repair facilities, R&D labs, offices and warehousing.

Moog Australia provides solutions and services that uniquely meet the needs of our customers and provide exceptional value. We also focus on offering access to local service in Australia & New Zealand by providing "In Country" and "Through Life" aftermarket support across all Moog product groups.

We employ people with roles embracing machining, assembly and test, design and applications engineering, purchasing, logistics, sales and marketing. We view our customers as part of our business and we, a part of theirs. We take a collaborative approach to solving their most difficult motion control problems with electric, hydraulic and hybrid solutions. Our team is dedicated, agile, flexible and customer focused.

AUSTRALIAN BASED ENGINEERING PROJECTS INCLUDE:



Defence Science and Technology Organisation(DSTO): Custom servo actuators and abort manifolds for BAE Hawk Mk 127 Test rig



University of Wollongong: 800kN Test system for rail ballast research



Central Queensland University: 4.5MN customised test system for train component research



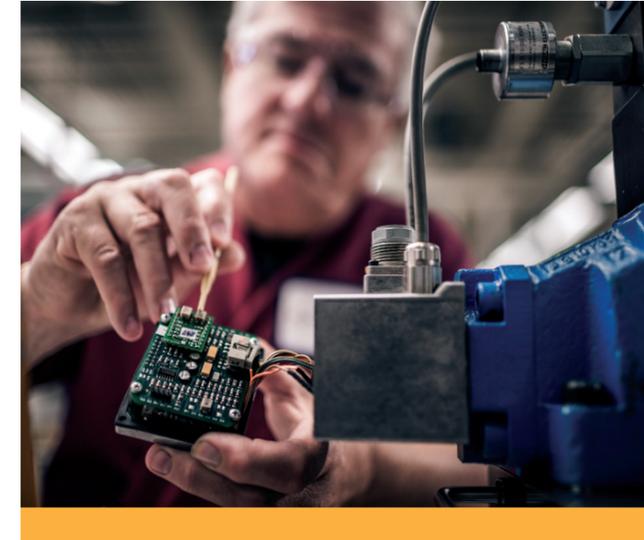
ADF: ASLAV - customised test suite and dedicated aftermarket cell. Full repair capability on MC400 turret controller & traverse actuators.



ADF: M113 - customised dedicated aftermarket cell. Full component level repair capability on control handle and dual axis digital controller LRU level repair



RAAF: Maintenance, Repair & Overhaul of F/A-18 Leading Edge Flap Actuation System (LEFAS) and Wingfold Mechanical drive system



CUSTOMER FOCUSED ENGINEERED SOLUTIONS

Our engineers collaborate with OEM customers to design Moog motion control solutions for machines and systems where precise control of position, velocity, force and acceleration are critical. Our electric and hydraulic technologies enable machine builders to create unique and flexible designs that perform with greater efficiency, increased uptime and lower maintenance costs.

As our customers challenge us with difficult motion control problems we'll continue to respond with designs, services and products that are reliable and efficient.

Where products are already in service, then we have a comprehensive, popular and cost effective range of plant maintenance services, including repairs, services and skills training.

WHY MOOG?

By choosing Moog, you benefit from a number of key advantages:

- Proven systems and applications expertise, creating high performance, customised motion control solutions.
- Significant domain expertise in customer's machine design and performance as well as end-user industries.
- High performance solutions and products in both hydraulic and electric technologies.
- Global engineering and services network to support customers around the world.
- World-class manufacturing facilities staffed with skilled, experienced and dedicated workforce.
- Flexible organisation focused on collaborating with customers to meet their unique needs.

FULL SCALE FATIGUE TESTING FOR BAE HAWK 127

When the Australian government made the decision to purchase the BAE Hawk Mk 127 Lead-in fighter for the Royal Australian Air Force, The Australian Defence, Science and Technology Organisation (DSTO) was tasked with completing a full-scale fatigue test in conjunction with BAE systems and looked to Moog for a solution. Fatigue testing is a critical requirement for military aircraft to determine the life span of safe, economical service and extend the fleet beyond the specified flying hours.

The Challenge

To create a specialised actuator design capable of achieving critical performance parameters required that are not possible to achieve with standard industrial cylinders. These include low-friction, high duty cycles and structural rigidity. Moog also needed to develop a unique abort manifold for static and dynamic testing that is superior to what was previously available.

The Solution

Hydraulics were used to apply the simulated flight loads across the complete airframe and pneumatics to pressurise the cockpit and fuel tanks. Moog Australia designed and manufactured 84 hydraulic actuators that were used in load or displacement control and 95 controlled abort manifolds to manage the controlled abort of the test should a fault condition occur.



The Result

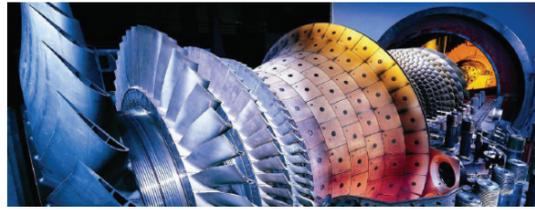
- Key features of the servo actuators
- Realistic and repeatable test processes
 - An extensive database of measured values for a variety of solutions
 - Customised sealing and bearing solutions including elastomer seals, laminar and hydrostatic.

- Key features of the abort manifold
- Modular construction for 'active' [closed-loop] abort or conventional 'passive' fixed orifice abort.
 - Optimised transition from normal control to abort to minimise structural disturbances.
 - Developed under aircraft standard Failure Mode, Effects and Criticality Analysis for optimal reliability.
 - Extensive static and dynamic performance testing.

Aircraft test systems demonstrate Moog capabilities for improving motion control and safety for material test applications. The requirements for high performance servo-actuators, controlled abort and digital system control are also common for a variety of applications ranging from flight simulators to turbine controls to high speed injection moulding machines. Moog is now a system supplier for these applications.

STANDARD AND CUSTOMISED SOLUTIONS

From advanced customised miniature high performance control systems for Formula 1 racing cars and autonomous robots, to heavy duty environments such as the steel industry, to special engineered solutions for Wimbledon's retractable roof, Moog supplies precision motion control solutions to meet a range of demanding applications.



POWER GENERATION, GAS AND STEAM TURBINES

With the cost of any outage critical to the profitability of a power station, we are equipped to offer both steam and gas turbine actuator service and repair in a timely manner in addition to our complete line of ATEX approved and explosion-proof Servo Valves, Liquid Fuel Metering systems and Fuel Pumps for low viscosity fluids. We also offer other engineered solutions such as Skids and Start Packs and continued service support for the Whitton product range such as Fuel and Lube Oil Pumps.



INDUSTRIAL MACHINERY

Performance-driven companies developing their next-generation machines turn to Moog for either electric or hydraulic high performance automation solutions for Pharmaceutical, Material Handling, Metal Forming, Food Processing & Product Sorting, Packaging, Plastics, Robotics, Steel & Iron Production.



MOTORSPORT

Motorsport presents unique challenges for motion control suppliers. Whereas Formula 1 looks for low weight, small size and fast and completely reliable operation performance. Rallying looks for ruggedness and the ability to perform in fairly brutal conditions such as extreme temperatures, adverse weather and demanding time constraints. Moog works with all the leading teams providing them with highly responsive, light-weight race-winning motion control.



TEST

Manufacturers and test labs around the globe can expand and set up test rigs easily, increase throughput and productivity, improve test accuracy and get results quicker, while keeping the tested specimen totally safe. Typical applications supported by Moog include: aero-structures and landing gear, ground vehicle components, off-shore structures and renewable energy.



SIMULATION

Training centres around the world, providing flight and automotive simulation systems with unsurpassed levels of performance, fidelity and reliability turn to Moog as the leading designer and manufacturer of 6 Degrees of Freedom (6DOF) motion base systems for Level D full flight and driver training simulators, control loading actuators and helicopter and fighter G-seats.



OIL AND GAS

The performance of your downhole, topside, and subsea/marine equipment including ROV's can be improved with Moog's high performance motion control, surveillance and data communication solutions for oil and gas applications such as Slip Rings, Actuators, Brushless Servo Motors, Multiplexers, Servo Valves, Camera Systems.



DEFENCE

Moog supports all of the major defence 'Prime' contractors in Australia as well as Defence SME, providing design, deployment and production of the high performance actuation systems required to meet the harsh environmental and operational needs of the Australian Defence Force.



HAPTIC TECHNOLOGY

Haptics is the science of creating a realistic sense of touch to the user in a virtual environment. Moog creates products that uses haptics technology to train airline pilots, F1 drivers, and test vehicles. Moog has now applied this technology to help dental students learn manual dexterity and for eye surgeons to learn how to perform cataract operations - saving the sight of millions of blind people worldwide.



NAVAL

From new system design to obsolescence management and platform upgrades, Moog supports the complete lifecycle of today's modern naval forces. Moog naval capabilities encompass: design engineering expertise, simulation, complex integration, manufacturing, rapid prototyping and modelling - all aligned to meet current and expected future needs of naval forces.



WIND TURBINES

Operators and manufacturers of wind turbines are faced with particularly complex control challenges, from ensuring precision control and continuous power generation, to reliability and safety in extreme conditions. Moog offers high-performance solutions across key application areas such: pitch control, data and power transmission and rotor blade testing.



SURVEILLANCE AND SECURITY

Moog designs and produces high-quality, scalable physical security and process monitoring solutions for extreme environments. Our unique offerings enable 24/7/365 asset protection, threat detection, border protection, system health monitoring, and communication around the world.

INSTRON 2 AXES MACHINE UPGRADE AT UNIVERSITY OF SYDNEY

When Sydney University required an upgrade of a unique 2 axes machine to test specimens for research, they looked to Moog Australia for a solution.

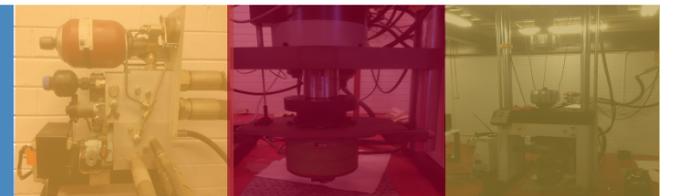
The Challenge

To cycle the specimen in closed loop position/force/strain in both the axial and torsional axes up to 10Hz. Moog Australia had never upgraded a machine like this before including closed loop strain control. The existing Instron electronics were faulty and had to be replaced. Moog Australia were asked to supply a new two axes strain transducer to interface with our Portable Test Controller (PTC) and Moog Integrated Test Suite (MITS) to expand the control to include strain.

The Solution

Moog Australia performed a system audit to determine what was required for the upgrade. After the audit it was identified the following was required:

- Dual channel PTC, MITS, cables and dual channel strain transducer
- Overhaul of Servovalves (2 off).
- Replacement of filter element.
- Check, repair and recharge of existing accumulators.
- Removal of existing pendant controls for the jog function.



- Rewiring of existing clamp controls.
- Supply of PTC Pendant with 4m cable assembly for jog function.
- Site installation, commissioning and training
- System flushing.

By reviewing the machine requirements in a holistic sense, customer requirements and system reliability, we were able to implement a solution that optimised the outcome and enhanced performance. This is a unique machine in Australia with the torsional axis control via RVDT (position), Torque transducer (torque) and Torsional strain. Moog Australia also provided training to ensure that the customer would be self-sufficient.

The Result

Sydney University is using the machine for research and are impressed with the closed loop bandwidth of 10Hz that was achieved with optimised tuning. They have also commented on how easy the system is to use. This is the second upgrade Moog Australia has done with University of Sydney and hopefully many more to come. Sydney University use Moog Australia because we are in close proximity for sales/service support and understand test machine upgrade requirements.

MOOG PRODUCTS FOR WORLD-CLASS ELECTRO-MECHANICAL AUTOMATION APPLICATIONS

Moog offers world class electro-mechanical products and systems, with products such as Servo Motors, Ball, Inverter and Planetary Roller Screws, Actuators, Servo Drives and Motion and Machine Controllers.

Your benefits at a glance:

- Easier installation, long lasting performance and reliability
- Higher efficiency helping you lower your energy consumption and reduce your maintenance effort and increase production output.

SERVO MOTORS

Moog deliver an extensive product range of Servo Motors specifically designed for highly dynamic servo industrial applications.

RANGES	COMPACT DYNAMIC	MAXIMUM DYNAMIC	EXPLOSION PROOF (ATEX)	Advantages
Continuous Torque (NM)	from 0.15 to 74.2	from 2.2 to 1,034	from 0.52 to 66.68	<ul style="list-style-type: none"> • Easy to configure with SERVOfsoft® sizing tool. • High dynamic and low inertia driving improved machine throughput. • Industrial standard interfaces provide compatibility with mechanical and electrical systems. • Compact Dynamic - 4 Sizes available in two weeks.
Peak Torque (NM)	from 0.50 to 240	from 10 to 2,012	from 1.0 to 239.3	
Speed (RPM)	Up to 11,700	Up to 11,700	Up to 7,800	
Size (mm)	6 Frames: from 40 to 190	7 Frames: from 40 to 190	3 Frames: from 70, 140, 190	
Moog Servo Motors at a glance	<ul style="list-style-type: none"> • Superior motor dynamics improving cycle time • Modular and compact lightweight construction • Proprietary, low cog design for smooth low speed operation • Flexible options for easy integration • Available as frameless package • Custom windings and designs • Explosion Proof Dynamic Brushless Servo Motor • High Power Density 			

HIGH SPEED LINEAR MOTORS

Moog's High Speed Linear Motors offer dynamic and precise linear motion positioning for robotics, factory automation, processing, packaging, material testing machines and other industrial applications. As a high force, direct drive solution, Moog's linear motors extend maintenance intervals and reduce the cost of ownership of any linear motion system.

Moog Linear Motors at a glance	Advantages
<ul style="list-style-type: none"> • High Speed Performance; up to 4.5M/sec • Fast acceleration; up to 40G • Encoders with 0.1 µm resolution, optical and Hall types available • High force motors up to 2,000 lbf [9 kN] force • Light duty motors for lower force applications with same durable and rugged construction 	<ul style="list-style-type: none"> • Fan cooled and liquid cooled options for maximum performance • Custom designs for any application • Available as a component in a complete system solution that includes brushless linear motors, drives, motion controllers, cabling, filters and accessories

BALL SCREWS AND PLANETARY ROLLER SCREWS

Moog Ball and Planetary Roller Screws are designed to provide a unique and competitive edge.

RANGES	BALL SCREW	ROLLER SCREW	INVERTER ROLLER SCREW	Advantages
Dynamic Load Rating (kN)	Up to 400	Up to 670	Up to 300	<ul style="list-style-type: none"> • Various screw diameter-pitch combinations available to allow easy integration into the machine. • Wide selection of screw end shafts to meet the exact needs of the application. • Robust design suited for heavy duty applications, vibrations and harsh environments.
Static Load Rating (kN)	Up to 900	Up to 1,400	Up to 750	
Diameter (mm)	from 13 to 100	from 16 to 90	from 18 to 48	
Stroke Length (mm)	Up to 3,600	Up to 1,800	Up to 200	
Leads (mm)	from 4 to 50	from 2 to 36	from 3 to 20	
Moog Ball and Planetary Roller Screws at a glance:	<ul style="list-style-type: none"> • Extensive range allows you to find the best solution to your specific performance requirements that meet the demands of ISO accuracy for classes 1-3-5 • The range covers a wide selection of static and dynamic loads with an extended range of accelerations for extremely fast cycle times • Alternative designs and re-circulating systems that meet noise and vibration requirements for very quiet applications 			

FLEXIBLE ELECTRO-MECHANICAL LINEAR SERVO ACTUATORS

Moog Electro-Mechanical Linear Servo Actuators are a pre-engineered and highly customisable solution for high performance industrial applications that need maximum speed and force.

RANGES	ELECTRO-MECHANICAL LINEAR SERVO ACTUATORS
Continuous Force (kN)	from 1.0 to 96
Peak Force (kN)	from 3.6 to 450
Rod Speed (mm/sec)	Up to 1,600
Stroke Length (mm)	Up to 2,500
Moog Electro-Mechanical Linear Servo Actuators at a glance	<ul style="list-style-type: none"> • Inline and foldback design when space is at premium • Variety of motor windings for optimum performance • Several screw leads for speed/force variations • Ball screw and roller screws available • Fully customisable to provide ultra high force to 450 kN for applications such as retractable roofs and presses

Advantages

- Convenient configuration allows the actuator to be tailored to the exact needs of the application.
- High force density to minimise space requirements.
- High dynamic load capacity to provide operation long life.
- Electronic nameplate provide Plug and Play capability with Moog drives.
- Industrial standard interface provide compatibility with third party drives.

SINGLE AND MULTI-AXIS SERVO DRIVES

Moog Servo Drives provide fully digital control over position, velocity or torque for synchronous, asynchronous, linear or torque servo motors.

RANGES	SERVO DRIVES MSD SERIES
Continuous Current (amps)	from 4.0 to 450
Peak Current (amps)	from 8.0 to 765
Operating Voltage (VAC)	from 115 to 460
Moog Servo Drives at a glance	<ul style="list-style-type: none"> • Available in a wide variety of power sizes and fieldbus communication options that work with virtually all machine designs • Deliver high dynamics, reliability, smooth low-speed performance, thermal management for operation in demanding environments • Offer motion control functionality for every application

Advantages

- Modular design enables flexible configuration for multi axis systems.
- Compact form factor minimising machine cabinet space.
- Shared power supply and DC bus.
- Active & Bus control - for machines used internationally under different voltages.
- Single-Axis Compact - 3 Sizes available in two weeks.

CUSTOMISABLE SINGLE AXIS SERVO DRIVES

Consistent high dynamic performance, control accuracy and easy-to-adapt motion control templates.

RANGES	SERVO DRIVES CSA SERIES (FORMERLY DS2110)
Continuous Current (amps)	from 3.0 to 140
Peak Current (amps)	from 11 to 300
Operating Voltage (VAC)	from 65 to 510
Moog Servo Drives at a glance	<ul style="list-style-type: none"> • Available in 7 power sizes up to 300 amps peak current • Replacement or retrofit product for DS2110, DS2100 and DS2000XP • Explosion-proof versions available with CSA, UL and ATEX certifications

Advantages

- Ideal for applications requiring integrated axis motion control.
- Flexible performance supports several feedback devices, encoders and resolvers.
- Maximum motor efficiency is maintained with Field-Oriented Control (FOC).
- Works seamlessly with Moog Servo Motors and Actuators.

OUR PRODUCTS

MOOG PRODUCTS FOR WORLD-CLASS ELECTRO-HYDRAULIC AUTOMATION APPLICATIONS

Moog electro-hydraulic products such as Servo and Proportional Valves, Industrial Cartridge Valves, Radial Piston Pumps, Motion and Machine Controllers, provide precise control of position, velocity and force - so important to the proper operation of a wide variety of industrial machinery.

Your benefits at a glance:

- Long lasting performance and reliability that increase your machine lifetime and your return on investment
- Easier installation, creating less downtime so you are operating sooner
- Higher efficiency helping you lower your energy consumption and reduce your maintenance efforts

SERVO VALVES

Moog offers an extensive product range of Servo Valves specifically designed for precise control of position, velocity and force.

RANGES				Advantages
	30, 771 to 773, 631, 760, 761, 72, 78, 79-100, 79-200	D633, D634, D636, D637, D638, D639	D765, D661, D671, D672, D791, D792	<ul style="list-style-type: none"> • High wear-resistance and durability. • Robust and proven track record in broad range of industries • Convenient selection and configuration of valves to suit the application • Easy integration into the hydraulic systems using standard interfaces • High accuracy and repeatability for demanding applications • Fail-safe and explosion proof version available.
Rated Flow @ Δp 70 bar (1,000 psi)	From 0.95 to 757 l/min	From 5 to 100 l/min	From 4 to 1,000 l/min	
Maximum operating pressure (bar)	From 210 to 350	350	From 315 to 350	
100% Step Response @ 210 bar (3,000 psi)	From 3 to 40 ms	From 8 to 20 ms	From 3 to 19 ms	
Moog Servo Valves at a glance	<ul style="list-style-type: none"> • Pilot operated with low friction double nozzle pilot stage with high resolution and low hysteresis • Mechanical position feedback without onboard electronics 	<ul style="list-style-type: none"> • Direct Drive Valves with Linear Force Motor • Analog or digital onboard electronics • Optional fieldbus interface, pressure or axis control functionality 	<ul style="list-style-type: none"> • 2- and 3-stage pilot operated valves with ServoJet or nozzle flapper pilot • Analog or digital onboard electronics • Optional fieldbus interface, pressure or axis control functionality 	

PROPORTIONAL VALVES

Moog offers an extensive product range of Proportional Valves specifically designed for precise control of position, velocity and

RANGES				Advantages
	D634, D637, D639	D661 to D665, D681 to D685	D671 to D675, D941 to D945	<ul style="list-style-type: none"> • Numerous models with a range of sizes, performance characteristics and mounting options available. • Flow-optimized design for high rated flows. • Fast commissioning of digital products using Moog Valve and Pump Configuration Software (MoVaPuCo). • Fail-safe and Explosion proof versions available.
Rated Flow @ Δp 10 bar (145 psi)	From 24 to 60 l/min	From 30 to 1,500 l/min	From 30 to 1,500 l/min	
Maximum operating pressure (bar)	350	350	350	
100% Step Response @ 210 bar (3,000 psi)	From 20 to 25 ms	From 9 to 48 ms	From 10 to 44 ms	
Moog Proportional Valves at a glance	<ul style="list-style-type: none"> • Direct Drive Valves with Linear Force Motor • Analog or digital onboard electronics • Optional fieldbus interface, pressure or axis control functionality 	<ul style="list-style-type: none"> • 2- and 3-stage pilot operated valves with ServoJet or Direct Drive Valve pilot • Analog onboard electronics 	<ul style="list-style-type: none"> • 2- and 3-stage pilot operated valves with ServoJet or Direct Drive Valve pilot • Digital onboard electronics • Optional fieldbus interface, pressure or axis control functionality 	

MOOG HYDRAULIC SERVO ACTUATORS

Moog designs and manufactures industrial actuators for industrial applications including; Metal forming, Blow Moulding, Wood and Paper Manufacturing, Autonomous Robots and Power Generation - with capability to meet your force requirements.



RANGES	HYDRAULIC SERVO ACTUATORS	Advantages
Moog Hydraulic Servo Actuators at a Glance	<ul style="list-style-type: none"> • Combines high performance cylinders, linear feedback devices and servo valves in one assembly. • Developed to offer the advantages of custom engineered units • Choice of servo valves, feedback transducers, working areas and strokes • Maximum compatibility with other moog components 	<ul style="list-style-type: none"> • High performance servo control with Moog G761 servo valves. • Wide array of sizes and flexibility. • Ultimate safety and protection for machine. • Economical solution for customers. • High performance seals for longer life and low friction. • Easy to replace rod bearings and seals for simple maintenance.

INDUSTRIAL CARTRIDGE VALVES

Moog offers a broad product range of servo cartridges and cartridge valves for directional, pressure, check and throttle functions.

RANGES				Advantages
	DIRECTIONAL, PRESSURE AND CHECK CARTRIDGES INCLUDING COVERS AND PILOT VALVES	ACTIVE CARTRIDGE VALVES	SERVO AND PROPORTIONAL CARTRIDGE VALVES	<ul style="list-style-type: none"> • Compact manifold design for high flows by using cartridges. • High robustness and reliability. • High flexibility through modular design.
Rated Flow @ Δp 5 bar (75 psi)	From 130 to 10,500 l/min	From 100 to 12,000 l/min	From 33 to 20,550 l/min	
Maximum operating pressure (bar)	From 350 to 420	350	From 210 to 420	
Moog Cartridge Valves at a glance	<ul style="list-style-type: none"> • Modular set of building blocks to cover a wide variety of functions and applications 	<ul style="list-style-type: none"> • Actively operated for fast and accurate switching • Optional position monitoring for safety applications 	<ul style="list-style-type: none"> • 2- and 3-way throttle control • Different performance and fail-safe options available 	

RADIAL PISTON PUMPS

Moog Radial Piston Pump (RKP) is a variable displacement piston pump, available in various sizes (from 19 to 250 cm³ per revolution) and offers a highly dynamic control of pressure, flow and horse power in industrial applications.

RANGES			Advantages
	RKP	RKP-DIGITAL	<ul style="list-style-type: none"> • Flexible configuration according to application demands. • Reduced effort for noise damping measures. • Improved control in hydraulic cycle. • Less installed power, less effort to cool fluid. • Increased machine productivity, process stability and repeatability and condition monitoring capability. • Well suited for a broad variety of special fluids and for use in explosive environments (ATEX Certification).
Size in cm ³ per revolution	From 19 to 250	From 19 to 250	
Flow l/min @ 1.500 rpm l/min @ 1.800 rpm	Up to 375 Up to 450	Up to 375 Up to 450	
Pressure (bar)	From 34 to 450	From 34 to 450	
Moog Radial Piston Pump at a glance	<ul style="list-style-type: none"> • Robust and compact design • Low noise emission • Broad range of compensator types and various control options available • Low pressure pulsation with less resonances • High efficiency 	<ul style="list-style-type: none"> • Improved dynamics • Parameters online switchable • Improved diagnostics • Factory-set leakage compensation • Less wiring (no external card required) • Easy to use Windows based configuration tool (Moog Valve and Pump Configuration Software) 	

RKP LIQUID FUEL METERING SYSTEM

Energy Efficiency for Gas Turbine Operators



RANGE OUTLINE

- Fuel metering for gas turbines.
- Wider applications where very precise fuel metering of liquid flow is required.
- Uses Tandem Variable Displacement RKP Pumps with up-rated compensator and revised spring configuration to improve frequency response.
- Liquid Fuel Moog DDV independently controls flow to the main burner and pilot burner supplying fuel only on demand.
- ATEX certified for use in Group2, Category 3 hazardous areas.
- Suitable for turbines of power levels of up to 15MW, corresponding to fuel flow rates of up to 100 lpm at 100 bar.

Advantages

- Improved reliability due to integrated construction.
- Reduced fuel consumption due to improved fuel metering accuracy
- Reduced energy costs due to improved pumping efficiency.
- Simplified installation due to integrated construction.
- Wide range of flow-rates from single standardised compact package.
- Improved start-up performance due to independent fuel metering streams.
- Reduced Noise.
- Compact.

MOTION AND MACHINE CONTROLLERS

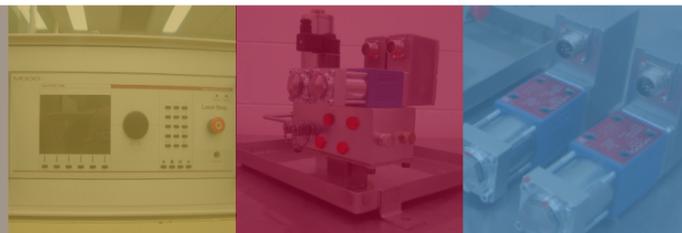
Moog offers a wide range of Machine and Motion Controllers and Software to meet your specific needs.

SERIES	MSC-R	MSC II	MC 600
<p>Moog Motion and Machine Controllers at a glance</p> <ul style="list-style-type: none"> • Motion Controllers and Software for electric and hydraulic servo actuation applications offering rapid set-up and flexible architecture • Ruggedised Option with high vibration resistance and extended resistance against fluid contamination and corrosion for use in harsh environments • Machine Controllers available in modular design for high flexibility and effortless implementation into new systems 			

Advantages

- Modular design enables the solution to be scaled to the needs of the machine
- Industry standard fieldbus enable convenient integration with other machine elements such as sensors and drives.
- Designed to perform in harsh environments
- Resistant against various aggressive fluids

TESTING LOADS ON REINFORCED CONCRETE SLABS AT CURTIN UNIVERSITY



When Curtin University Western Australia were considering options for a new 'Reinforced concrete slab' load test system, they approached Moog Australia for a flexible solution to utilise and optimise existing hardware.

The Challenge

To supply a highly flexible reconfigurable test system capable of static and cyclic tests for a variation of beams from 110mm thick concrete slabs to 900mm deep pre-tressed members. To achieve this the project required utilising a wide selection of existing 700bar rated double acting hydraulic cylinders (10 tonne to 500 tonne) and feedback sensors and the inclusion of 2 axes of closed loop servo hydraulic control, while maintaining the option of adding extra axes in the future.

The Solution

Moog supplied and commissioned a system based on the Moog Portable Test Controller (PTC) and a 2 axis hydraulic service manifold. Moog Australia delivered hands on training during system commissioning so that Curtin University were confident in its operation before leaving site and site acceptance was signed off by both parties.

The Result

Key features of the Moog Portable Test Controller (PTC):

- 4 axis stand alone desktop controller with LCD display
- Designed to provide high performance closed loop control (position/force) of dynamic and static tests
- User-friendly interface that allows configuration of axes for independent or master/slave control and to run tests.
- Can be networked with other Moog controllers to extend axes count

Key features of the two axis Hydraulic Service Manifold (HSM):

- Allowed for mounting and isolation of desired servo valves for each axis
- Filtration to ensure longevity of the system

The capability to coordinate multiple axes allows researchers to implement classic beam analysis with two different loads at different points on the beam, or two deflections of a non uniform beam by measuring force to determine stiffness at the two points.

INDUSTRIAL SLIP RINGS

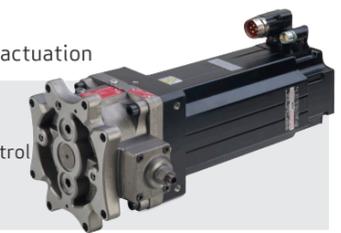
Moog's slip rings have been successfully performing in commercial and industrial applications for over 50 years. These products are developed for high performance environments and flexible requirements. Typical applications include camera systems, robotics, packaging machines, medical equipment and a wide range of automation systems.

RANGE	COMPACT SLIP RINGS CAPSULES	HIGH SPEED SLIP RINGS	THROUGH BORE SLIP RINGS	FIBER OPTIC ROTARY JOINTS
<p>KEY APPLICATIONS</p> <ul style="list-style-type: none"> • CCTV pan/tilt camera mounts • Medical equipment • Robot end effectors • Miniature cable reels • Laboratory equipment 				
<p>Moog Slip Rings at a glance</p> <ul style="list-style-type: none"> • Economical and compact • Allows tremendous flexibility in dealing with system size requirements when larger version are not an option • Capsules with up to 56 contacts are available. 	<ul style="list-style-type: none"> • Centrifuges • Robotics • Industrial Machinery • Precision rotary equipment • High speed testing 	<ul style="list-style-type: none"> • Used in applications up to 10,000 rpm. • Fiber brush contacts provide long-life and operation up to 10,000 rpm without the need for cooling equipment. 	<ul style="list-style-type: none"> • Precision rotary equipment • Semiconductor handling systems • Robotics • Camera Systems • Industrial Machinery 	<ul style="list-style-type: none"> • Robotics • Material handling systems • Fiber optic cable reels • Video surveillance systems • Wind Energy Turbines
	<ul style="list-style-type: none"> • Maintenance free for 100 million revolutions • Minimal wear debris generation • No lubrication required • Wide operating temperature • Lower life cycle cost • High reliability • No periodic inspections required 	<ul style="list-style-type: none"> • Unobstructed bore through the centre provides routing space for hydraulics, pneumatics or for a concentric shaft mount • Features fiber brush technology • Multiple points of contact per brush bundle • Low contact force per fiber • Low contact wear rates • Fiber brushes do not require lubrication and produce virtually no wear debris 	<ul style="list-style-type: none"> • Means to pass signals across rotating interfaces, particularly when transmitting large amounts of data • Maintain the intrinsic advantages of fiber end to end 	

ELECTROHYDROSTATIC PUMP UNIT (EPU)

Compact pump unit helps leverage the benefits of both hydraulic and electric actuation

KEY APPLICATIONS	RANGE OUTLINE
<ul style="list-style-type: none"> • Metal forming and presses • Injection molding and die-casting • Heavy industry • Gas and steam turbines • Wind turbines pitch control • Marine 	<ul style="list-style-type: none"> • Viable options for industrial machine builders seeking compact alternatives to traditional hydraulic or electromechanical motion control solutions • Moog EPU is at the heart of electrohydrostatic actuation and combines the advantages of both actuation technologies in a self-contained product delivering a high degree of energy efficiency and environmental cleanliness • Helps enable the deployment of a decentralised drive system which eliminates the need for a hydraulic power and complex piping, thereby reducing the overall machine footprint • Compact product design also features a unique interface that enables direct mounting on to a cylinder minimising the requirement of additional space on each axis and reducing the number of components required. • Available either as a stand alone product or as an entire systems, called the Electrohydrostatic Actuation Systems (EAS). The EAS combines the electrohydrostatic pump unit and any optional parts a customer might need, such as servo drives, manifolds or cylinders. All components are Moog products that meet the highest standards of reliability and quality.



Advantages

- High energy efficiency
- Increased productivity
- Reduced machine footprint
- Reduced maintenance costs and total cost of ownership (TCO)

TEST AND SIMULATION

Our approach is to build interchangeability of hardware, software and accessories into our subsystems. This ensures maximum flexibility and ease of use as well as the ability to pass innovations learned across applications to our other customers. From our unique force-loop model, to failsafe measures to protect the test article, to advanced interconnect networks, we are known as the leading-edge control systems supplier in the markets we serve.

Your benefits at a glance:

- Unique force loop model for exacting control and faster testing.
- User-friendly operation for maximum flexibility in your test lab and less set-up time.
- Easily configurable failsafe safety features to protect test articles and maintain testing.
- Expandable to ensure you can upgrade when required.

TEST CONTROLLERS

Expandable Range of Test Controllers giving you maximum flexibility in your test lab and less set-up time

SERIES	MODULAR TEST CONTROLLER	PORTABLE TEST CONTROLLER	AUTOMOTIVE TEST CONTROLLER	AEROSPACE TEST CONTROLLER
KEY APPLICATIONS	<ul style="list-style-type: none"> • Materials and Components 	<ul style="list-style-type: none"> • Aerospace • Automotive (durability and fatigue) • Vibration, shock • Performance Evaluation 	<ul style="list-style-type: none"> • 4-Posters Test Systems • 6-Degree of Freedom (DOF) Test Rig • Durability and fatigue testing • Shock and performance evaluation • Elastomeric testing 	<ul style="list-style-type: none"> • Iron bird • Aircraft/airframe • Spacecraft structural integrity • Landing gear, engine casing, fin actuation loading • Load Calibration
Moog Test Controllers at a Glance	<ul style="list-style-type: none"> • Supported by Moog Integrated Test Suite Software enabling you to set up and run more tests faster and more efficiently. • Replication, Sinesweep and Vibration modules also available. • Supports both electric, hydraulic and pneumatic test systems 			

Advantages

- Force loop model for exacting control and faster testing.
- User-friendly operation - less set-up time.
- Easily configurable failsafe safety features to protect your valuable test articles.
- Expandable with add on features when required.

MOTION SYSTEMS

For a wide range of payload applications

RANGE	MOTION BASES
PAYLOADS	1,000 kg to 16,000 kg
KEY APPLICATIONS	<ul style="list-style-type: none"> • Noise and vibration testing • Component and subsystem structural performance • Ride quality assessment of seat systems, cockpit modules and entire vehicles • Dynamic functional testing on fuel tanks, antennas, turrets and more
Moog Motion Bases at a Glance	<ul style="list-style-type: none"> • Electric and Hydraulic tables available • DOF 2 – 8 depending on your requirements • Quick installation and commissioning and smaller footprint • Better replication range, greater customisation • Safer, more reliable performance • Lower energy consumption and lifecycle costs • More user-friendly software

Advantages

- Provides high fidelity and the smallest turn around bump available.
- High reliability with digital control loops that do not drift or deteriorate.
- Easy integration with control loading, vibration tables and G-seats.
- Redundant mechanical and software safety architecture.
- Built in test features recording performance parameters.
- Easy to install, use and maintain.
- Simple support via Moog Simulation Software
- Extensive global support.

HYDRAULIC TEST ACTUATORS

Moog Hydraulic Test Actuators with Hydrostatic or Polymer Bearings to deliver higher reliability, less maintenance and increased dynamic performance for test laboratories looking for a competitive edge.

RANGES	TEST ACTUATOR
Type of Bearing	Hydrostatic or Polymer Bearing
Dynamic Force Rating (kN)	Up to 2000
Stroke Length (mm)	Up to 1500
Pressure (bar)	Up to 350
Duty	Static/Fatigue Rated Options
Moog Test Actuators at a Glance	<ul style="list-style-type: none"> • Innovative 8 pocket hydrostatic bearing increases side load capacity to 60% of stall output and reduces energy requirements, with manifold house • Oil-cooled polymer bearing improves side load capacity to 15% of stall output, compared to 10% with traditional polymer bearing design

Advantages

- Higher level of dynamic performance, reliability, and longevity.
- Advanced coating used on the rod significantly improves seal wear for long life and less maintenance.
- Manifold houses all of piping in the actuator, removing the need for most of the exterior piping.

CENTRAL QUEENSLAND UNIVERSITY - 4.5MN TEST SYSTEM FOR TRAIN COMPONENT RESEARCH

When Central Queensland University Centre for Railway Engineering (CRE) required a large capacity hydraulic servo test system to be used to validate design standards for train couplings, they looked to Moog Australia for assistance in the design and supply a high performance solution.

The Challenge

The challenge was to provide a hydraulic system which could meet a peak flow demand of 7700 lpm (specimen test profile - sinusoidal 10Hz ± 2mm) that utilised the existing hydraulic system at CRE which was limited to 550 lpm and 350 bar. The challenge needed to address the control (supply state implementation), accumulator supply/discharge and supply and return line state conditions in order to ensure cavitation did not occur.

The Solution

Moog provided a servo controlled hydraulic system which included a high capacity discharge accumulator bank, a custom designed return line pneumatic plenum vessel and a fatigue rated 4.5MN servo actuator. The servo actuator include an integral position, pressure feedback sensors, system manifold and a high performance Moog 3 stage servo proportional valve.

The control system was modelled using Simulation X to validate the hardware selection, correct sizing of the accumulator capacity, hydraulic line sizing and return line cavitation mitigation in order to meet the 4 cyclic sinusoidal testing conditions - 0.25 Hz ± 2MN/±75mm, 2 Hz ± 2MN/±75mm, 10 Hz ± 1MN/±20mm and 2 Hz ± 3.1MN/±9mm.



The control platform was a Moog STX series industrial controller. The STX assembly featured 4 x 2.5kHz digital servo controllers plus 8/8 DIO expansion card to interface into the safety and control management system of the test. The tests were managed via a Moog SDK SW interface to the CQU host controller test management software.

The Result

After calibration of the system and optimisation of the control model the system has run in excess of 1 million cycles. The test parameters and control concept enables a laboratory rig to reliably emulate realistic heavy haul train conditions.

The test hardware setup provides CQU with the capability to test and better qualify new designs of rail couplings. The qualification of the test regime enables the rail coupling to be tested under a full load spectrum within a laboratory environment providing significant savings in the development time of new coupling designs when compared to the previous drop hammer and iterative in field methodology previously used.

REPAIRS, SERVICE AND SUPPORT

Our new world class service centre offers unrivalled facilities for the repair, service and support of both Moog and non Moog products.

SERVO AND SERVO-PROPORTIONAL VALVES

Since 1952 Moog Valves have been synonymous with industrial applications, so it makes sense to look to Moog's own service centre and test rigs to ensure your Moog Servo Valves are repaired to OEM performance. We use Moog authentic parts and Moog trained technicians who have access to the original design and test specifications of the product as well as how the current performance relates to factors such as wear patterns, component fatigue, tolerances and revised performance capabilities. Moog customers also benefit from:

- Express Service for emergency situations.
- Technical support network from a team of global technology experts.
- Ultrasonic cleaning room ensuring like-new repair and performance to the authorised Moog standard.
- Valve testers for field use to help commission, service and troubleshoot control systems.
- FREE quarterly newsletter to keep you informed about our global projects and new initiatives.
- Installed base reviews and preferred rates to upgrade legacy and competitor servo valves to Moog Valves enabling you to rationalise your installed inventory.

SERVO ACTUATOR SERVICE FOR GAS AND STEAM TURBINES

We offer Back-to-Base Service for many types of gas and steam actuators. Our flexible fully trained and focus team can meet your scheduled outages or breakdown requirements at our own facility. With our crane capacity at 5 tonne, spacious workshops, and project management skills, not only can we deal with the largest and most demanding actuator repairs and upgrades, but with fast turnaround times.

SERVO ACTUATOR SERVICE FOR ELECTRIC ACTUATORS

With our proven capability in ensuring the operational requirements of defence platforms such as the ASLAV & M113 since 2003, we also have exceptional capability to repair and service all sizes of electric actuators.

PITCH CONTROL TRAINING

To ensure the optimum operation of a wind turbine, you need experienced service engineers who know what to do in the event of a failure and are trained to maximise uptime. Technical know-how is essential and engineers must be able to assess the condition of a wind turbine and take necessary actions to guarantee the turbine's availability and performance. In hard-to-reach areas and conditions that are difficult to work under, it is important to minimise on-site deployment and coordinate any required work upfront. This requires highly skilled technicians, and Moog's training courses will help you more effectively achieve this goal.

OTHER MOOG PRODUCTS

Moog does not just make and service Servo Valves, so please contact us for the best solution for all Moog products, such as RKP Radial Piston Pumps, Servo Motors, Servo Drives, Servo and Machine Controllers and Screws.



OUR APPROVALS

Moog customers benefit from the following standards and approvals:

ISO 9001:2015

Quality Management System Certification (Bureau Veritas)

MIL-STD 1275C

Power Supply (Control Electronics) for military ground vehicles

MIL-STD 810 F

Environmental engineering considerations and laboratory tests

ANSI/ESD S20.20

ESD Control Program compliant to ANSI/ESD S20.20

IPC-A-610/IPC-7711/IPC-7721

Certified personnel & trainer

PROFESSIONAL SERVICES TAILORED TO YOUR UNIQUE NEEDS



REPAIR

Moog's factory repair services deliver less unplanned downtime Benefit from "like-new" or customer specific performance in your machine without unnecessary tuning

Minimise risk of poor repair by non-authorised repair facilities with no access to authentic Moog parts, product specifications, valve test parameters or upgrades

Gain confidence, with 12 month warranty protection, extendable to 24 months. Only available from Moog as the OEM



TRAINING

Get hands-on training from Moog trainers using Moog equipment in our facilities, on-site or with our approved training partners

Learn how to effectively manage installation and troubleshooting on your own

Speed up repair and maintenance in order to maximize uptime



FIELD SERVICE

Reduce risk and keep machines up and running faster with expert support

Supplement your staff with expert professionals who know your applications

Benefit from less downtime and access to original drawings and documentation

Available in person, online, over the phone and via remote diagnostic tools



RETROFITS/UPGRADES

Take advantage of exact replacements for multiple Moog motion control products to achieve "as-new" or customer specific performance

Improve the quality and performance of machines underperforming with retrofit components that incorporate the latest technology upgrades

Work with Moog technical experts who can recommend a course of action to add extra reliability to your operations



OEM PARTS

Moog is the only provider of OEM replacement parts Ensure industry-leading performance in your machine

Take advantage of global availability of spare parts

Gain greater output and longevity of products due to Moog's continuous design improvements



FLEXIBLE SERVICE AGREEMENTS

Shift from unplanned "break and fix" approach to planned maintenance that will minimize risk of failure

Tailor a flexible and bundled program that focuses on your operating challenges

Reduce your total cost of ownership while taking a proactive approach to O&M services

TAKE A CLOSER LOOK.

For more information visit our website or contact us below:

MOOG AUSTRALIA

18 Corporate Drive
Heatherton VIC 3202
Australia
Tel: +61 (0) 3 9561 6044
info.australia@moog.com

www.moog.com.au

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