BAFCO MODEL 773 LINEAR ACTUATORS

THE NEXT GENERATION OF HIGH THRUST - HIGH RESPONSE ELECTRO-HYDRAULIC ACTUATORS FOR INDUSTRIAL USE

BAFCO LVDT
LEAKPROOF SAE CODE 61 4 BOLT CONNECTORS
BAFCO LVDT
LEAKPROOF SAE CODE 61 4 BOLT CONNECTORS
MOOG™ SERVO VALVE
MIL CONNECTORS
STAINLESS STEEL PISTON ROD
SERVO-MANIFOLD DESIGN ELIMINATES LEAKS
HEAVY DUTY HYDRAULIC CYLINDER
DECELERATION FEATURE OPEN & CLOSED

DESIGNED IN CONJUNCTION WITH NASA UNDER "DUAL USE" COOPERATIVE AGREEMENT NOTICE NCC13-00007 TITLED "IMPROVEMENT OF QUALITY/REDUCTION OF COST - VALVE ACTUATOR"

BULLETIN DU

BAFCO, INC. P.O. BOX 2428, 717 MEARNS ROAD, WARMINSTER, PA 18974 USA
TELEPHONE 215-674-1700  TELEFAX 215-675-1571  e-mail bafco@bafcoinc.com
For over 40 years, BAFCO has supplied thousands of special systems to NASA and other aerospace providers. These special systems have been configured into the BAFCO Model 773 linear actuator ... a high quality product, marketable to General Industry.

NOW YOU TOO CAN HAVE THE BEST OF BOTH WORLDS

LEGENDARY BAFCO QUALITY AND COST COMPETITIVENESS

The applications requiring controllable linear motion with high accuracy, high reliability, high repeatability, high degree of stiffness and fast operating speeds are infinite:

❖ Linear valve actuators
❖ Steam turbine valves
❖ Linear drives for louvers
❖ Furnace damper actuators
❖ Vane controls – larger axial compressors
❖ Pilot plants
❖ Any device requiring high accuracy of linear motion

MAKE NO MISTAKE ABOUT IT; THE BAFCO 773 ACTUATOR SYSTEM IS VERY COST COMPETITIVE, WELL WITHIN THE MOST STRINGENT BUDGETS!

No longer will you be forced to accept the inaccuracies of pneumatics or the undependability of electrics! Get the unsurpassable benefits of BAFCO Electro-Hydraulic linear actuators.
In addition to its high degree of controllability, the BAFCO Model 773 Linear Actuator can be configured with BAFCO’s Model 708 or 739 Failsafe Valve for the utmost in dependability and true FAILSAFE ACTION for control override shutdown.

Developed in the early 1960’s, BAFCO has supplied thousands of the MODEL 708 or 739 FAILSAFE VALVE and its progeny to NASA and the FCC Refining and Petrochemical Processing industries worldwide.
To complete the package, **BAFCO's Model 717 Hydraulic Pumping Units** can be added to provide a perfect stand-alone package for the control of any device requiring linear motion.

The system shown below provides 9.0 gpm at 3,000 psi with filtration to 3 micron. **Other designs and sizes are available ...... from 5 gpm to over 500 gpm at 3,000 psi.**
In addition to the **DELUXE HYDRAULIC PUMPING UNIT** show on the opposite page, BAFCO manufactures **STANDARD HYDRAULIC PUMPING UNITS** as shown below. The system below provides 2.0 gpm at 3,000 psi with filtration to 3 micron. The unit includes all components necessary for basic electro-hydraulic applications........ **AT LESS THAN 1/3 THE COST!!!!**

Numerous options available in sizes of 2 gpm to over 500 gpm at 3,000 psi.
BAFCO MODEL 773 LINEAR ACTUATORS
For use in FCCU Refineries

AN ULTRA-LOW COST ALTERNATIVE TO CURRENT DESIGNS
- for catalyst control slide valves
- for single or double disk flue gas valves
- for divertor valves

STANDOFF W/ DE-CLUTCHABLE MANUAL HANDWHEEL
HEAVY DUTY HYDRAULIC CYLINDER WITH INTEGRAL DECELERATION FEATURE FOR OPEN AND CLOSE
POSITION FEEDBACK DEVICE

BAFCO MOTION CONTROL UNIT
- SERVO VALVE for Modulating Control
- FAILSAFE VALVE with TRIP SOLENOID
- MANIFOLD for component mounting and field connections

CONTROL TYPES AVAILABLE
- THROTTLING
- FAILSAFE
- ON-OFF
- SPECIAL CONTROL CONFIGURATIONS per CUSTOMER SPECIFICATIONS are also available

BAFCO Functionality by Design
Dependability by Experience
The BAFCO 773 family of LINEAR ACTUATORS has been expanded to include BAFCO Model 775 ROTARY ACTUATORS. Designed as a cost competitive alternative to pneumatic or electric actuators, these units operate 90° rotation valves or dampers in modulating, on-off or failsafe applications.

BAFCO Model 775 Rotary Actuator
Mounted on a 60" Damper
For SCR Service - NOx Reduction

ACTUATOR DESIGN FEATURES
- Rack and Pinion Actuator
- Heavy duty Hydraulic - To 3,000 psi
- Torque Range - 900 to 600,000 in. lbs.
- 90, 180 or 360 Degrees Rotation
- Zero Leakage
- High External Stern Load Capabilities
- End of Stroke Cushioning
- Configured with 0% BACKLASH
- BAFCO LVDT For Position Feedback
- De-clutchable manual handwheel
- Electro-Hydraulic control system can be direct mounted on the actuator or can be off-mounted on the Field Panel or on the Hydraulic Power Unit

FIELD PANEL/CONTROL FEATURES
- Servo System for Modulating Service
- Solenoid Trip for Failsafe Operation
- Accumulator(s) for Reserve Power
- Heavy Structure Steel Frame with Industrial Alkyd Resin Coating
- Duplex Filters with all S.S. Elements
- Receives hydraulic power from an external source
- Optionally, BAFCO can supply the complete HYDRAULIC POWER/CONTROL SYSTEM
BAFCO FILTER MANIFOLDS & FIELD PANELS
For ultra clean hydraulic fluid demanded by critical components

**BAFCO 714 DUAL FILTER MANIFOLD**

- Designed and fabricated from aircraft grade aluminum with hard anodized coating for corrosion resistance
- Cartridge type metal seated isolated valves
- Leak proof SAE code B1, flat flange 4-bolt connection

**BAFCO 713 SINGLE FILTER MANIFOLD**

**S.S. FILTER ELEMENTS**

- Suitable for 3,000 psi differential pressure
- 3, 5, 10 & 25 micron ratings
- Single and double lengths available
- Flow rates up to 180 gpm on single filter elements
- Multiple elements available

**BAFCO 722 FIELD PANEL**

- Heavy structure steel frame - skid mounted - with alkyd resin coating
- Model 714 Duplex Filter Manifold
- Pressure accumulators for reserve power
- Servo System for Modulating service
- Solenoid for Failsafe Operation
- Pressure gauges
- Receives hydraulic pressure from an external source
- Local/Remote hydraulic manifold

**OPTIONAL EQUIPMENT & ACCESSORIES**

- Pressure gauges for pressure & return
- Filter differential pressure sensor & alarm
- Flow rates from 1 to 200 gpm
- Pressure & return accumulators
- Hydraulic hoses for pressure and return
- Flushing block for header system cleaning
SERVOAMPLIFIER

Designed and manufactured by BAFCO, the Model 852 Servoamplifier provides optimum drive capabilities for the MOOG™ or other manufacturer's servovalve.

- Receives and conditions a 4-20 ma signal from an external control system
- Receives and conditions output signal from the LVDT position feedback device
- Sends appropriate output signals to the servovalve
- Includes an integral power supply, which requires 110 or 220 vac, at 50/60 hz or 24 vdc at 1 amp.
- Analog or digital multi-meter for valve position, servo output and command signal
- Provides adjustable minimum closed position and maximum linear stroke length
- Many other styles available such as multiple servoamplifiers in one enclosure

POSITION FEEDBACK (LVDT)

The accuracy of any positioning system is dependent on the accuracy of the position feedback device. The BAFCO Model 773 Linear Actuator incorporates BAFCO's own Model 642 LVDT (Linear Variable Differential Transformer), which provides effective infinite resolution, extremely high accuracy, linearity and repeatability.... and can be used in extremely hostile environments at temperatures from -40°F to +200°F with a temperature shift of < 0.5% per 100°F max.

AVAILABLE EXCITATION VOLTAGES:
- ±12 VDC (±8 to ±18 vdc range)
- ±24 VDC
- Other voltages available

AVAILABLE OUTPUTS:
- +3 to +7 vdc
- +0.5 to +9.5 vdc
- -3 to +3 vdc
- -2 to +2 vdc
- -4 to +20 ma
BAFCO 773 ACTUATORS

MORE CHOICE - LESS COMPROMISE

SPECIFICATIONS

Thrust output 8,000 to 200,000 lbs.
Stroke Length ¼” to 10” - longer if necessary
Speed - Full Stroke - Throttling up to 25 msec.
Speed - Full Stroke - Failsafe up to 25 msec
Hydraulic Pressure 3,000 psi max.
Throttling Command ±10 to ±40 ma
Failsafe Command 12, 24, 48, 115 vdc
Failsafe Reset Speed 0.5 sec. typical
Throttling Command +3 to +7 vdc
Position Feedback Signal (LVDT) +0.5 to +9.5 vdc
-3 to +3 vdc
“ +2 to +2 vdc
-4 to +20 ma
Resolution < 0.1%
Repeatability < 0.1%
Linearity < 0.3%
Hysteresis < 0.5%
Frequency Response to 30 Hz. or higher if needed
Temperature range -40° to +180° or higher if needed
Deceleration feature* .005 to .10 in. - open and closed
Mounting yokes available for any linear device
Materials of construction
❖ Cylinder Carbon Steel
❖ Servo Manifold Aircraft Grade Aluminum
❖ Piston Rod Stainless Steel
❖ Bearings Alloy Bronze
Electrical Classification NEC Class 1, Div. 2
Electrical Wiring Terminations Mil Connectors - Standard
Terminal Boxes - Optional
Hydraulic Connections SAE Code 61 - 4 Bolt
Hydraulic Fluid Any standard mineral base
or compatible synthetic fluid

Deceleration feature* - Snubbing rings are internal to the actuators at the end of both open and closed stroke. The snubbers use hydraulic fluid viscous frictional forces to rapidly decelerate the actuator the last .005” to .100” of travel, thus protecting the system from damage due to its high velocity. The deceleration feature has no moving parts and never requires adjustment.
SLIDE & PLUG VALVE ACTUATORS
For FCC Refineries

BUTTERFLY VALVE ACTUATORS
For Expander Turbines

FREQUENCY RESPONSE ANALYZERS

WEDGE TYPE GATE ACTUATORS

FURNACE DAMPER ACTUATORS

STEAM THROTTLE VALVE CONTROLS
For STEAM TURBINES
BAFCO, INC.

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HYDRAULIC ACTUATORS,
ELECTRONIC POSITIONING CONTROLS
AND
HYDRAULIC PUMPING UNITS
Developed by BAFCO Inc., under a Dual-Use Cooperative Agreement with the Office of Technology Transfer at Stennis Space Center, the Model 773 is a next generation linear actuator displaying increased accuracy, precision and operating speeds. Primarily designed to operate in systems that contain gases, liquids, or cryogenic materials the Model 773 has application in the aerospace or petro-chemical industries.
“The Model 773 meets National Fluid Power Association (NFPA) standards for cylinder performance along with U.S. and European standards for electrical component functions. It is a unique piece of equipment, which meets or exceeds established performance standards at a mid-range pricing levels.”

THE PROJECT AND RESULTS

Stennis Space Center provides testing of Space Shuttle Main Engines, rocket propulsion systems and related rocket components. Stennis maintains several test facilities with a number of cells, or positions, to perform propulsion testing. As the testing facilities continue to age, maintenance costs have increased. In an attempt to control component replacement costs, NASA partnered with BAFCO to resolve questions regarding manufacturing processes, delivery lead-time and high unit costs.

BAFCO identified four suppliers that manufactured components meeting the performance standards required by NASA. “We no longer have to individually engineer each component,” said Hamtil. “Our company has been able to purchase commercial off the shelf (COTS) components then modify them using BAFCO technology and expertise. Subsequently, production and delivery lead-time have been reduced. Production to delivery, the entire process has been reduced from 14 weeks to between four and eight weeks. Correspondingly, the unit price has been lowered.”

NASA purchased 30 of BAFCO’s Model 773 at a savings of more than $250,000. Prior to the project, purchase costs per unit ran between $20,000 and $22,000; upon completion, the cost per unit was reduced to between $11,000 and $13,000. According to Nicky Raines, E-1 stand director, the results of this project provided NASA with maximum benefit; an improved product, delivered quicker at a reduced cost.

To date, all 30 of the actuators have been installed in the E-Complex at Stennis; performance levels have met or exceeded those of all previously used actuators. “Performance and costs are always elements of concern to the Stennis Test Directorate,” said Haynes Haselmaier, a Mississippi Space Services support contractor. “Performance of test articles is dependent on the support systems surrounding them. We must have quality components to support rocket engine testing, but the delays we experienced in receiving units were constant and the costs involved seemed to be continually mounting. The successful completion of this project has provided NASA with a high performance actuator at a lower cost, significantly faster.”

COMMERCIALIZATION

Primarily designed to operate in systems that contain gases, liquids or cryogenic materials, the BAFCO Model 773 offers several advantages over previously produced linear actuators. These advantages include increased accuracy and precision, increased operating speeds and increased life expectancy. These advantages combined with the reduction in production and delivery lead-time and lower unit pricing will allow broader application of BAFCO’s Model 773.

BAFCO’s Model 773 sales, mostly to aerospace and petro-chemical customers who have installed the units in testing and production facilities, total almost $500,000. “Being mid-range in price with high-end performance, the BAFCO Model 773 has seen increased interest from aerospace, industrial and petro-chemical companies,” said Hamtil. “We are seeing increased interest and activity from domestic companies as well as international corporations. Domestically, several companies have requested specifications and price quotes on the Model 773 for installation in their facilities. Internationally, we have sold 4 actuators to a petroleum company in Yugoslavia and have quoted numerous other companies. Even other government agencies have shown interest, for example the United States Air Force has requested a quote on this particular actuator for application within a test facility presently under construction at Edwards Air Force Base in California.”

WHY DUAL-USE WAS IMPORTANT

“This agreement allowed our company to not only address a government need, but also to enhance our commercial product at the same time. As a result, the Model 773 is receiving increased interest from companies outside the traditional applications areas,” says Hamtil. “This Dual-Use project is an excellent example of how NASA and industry can partner to develop a NASA needed technology while at the same time help fulfill a commercial market place need,” said John Bailey, NASA Office of Technology Transfer Dual-Use manager. The Dual-Use concept of product development is based on the sharing of costs, risks and successes between the government and a commercial partner. In these projects, NASA can contribute technology development, unique facilities and know-how, engineering resources and funding. In turn, the commercial partner contributes unique expertise, facilities, manufacturing, marketing capabilities and potential cash resources. The result is an approach that provides flexibility and draws upon the capabilities of both parties.

Points of Contact

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FOR IMMEDIATE RELEASE

NASA ENGINE TESTING
IMPROVED BY DUAL-USE PROJECT

HANCOCK COUNTY, Miss. — A recently completed Dual-Use Cooperative Agreement between NASA’s Office of Technology Transfer at Stennis Space Center and BAFCO Inc. of Warminster, Penn., has produced an improved product for use on the rocket engine test stands at Stennis. The BAFCO Model 773 is a next-generation valve element designed to enhance performance in aerospace, industrial and chemical applications.

Stennis provides testing of Space Shuttle Main Engines, rocket propulsion systems and related rocket parts. The space center maintains several test facilities with a number positions for engine testing. To control the cost to replace parts, NASA partnered with BAFCO to improve manufacturing processes and delivery time.

“We no longer have to individually engineer each component,” said BAFCO President Jim Hamtil. “Our company has been able to purchase commercial off-the-shelf components, then modify them using BAFCO technology and expertise. Subsequently, production and delivery lead-time have been reduced. Correspondingly, the unit price has been lowered. Production to delivery, the entire process has been reduced from 14 weeks to between four and eight weeks.”

“This product is the result of a partnership between NASA and our company to resolve production problems and lower unit costs. It is a unique piece of equipment, which meets or exceeds established performance standards at mid-range pricing levels,” said Hamtil.

NASA purchased 30 of BAFCO’s Model 773 at a savings of more than $250,000.

-MORE-
All 30 of the units have been installed in the E-Complex at Stennis, and performance levels have met or exceeded those of all such products used before.

“Performance and costs are always elements of concern,” said Haynes Haselmaier, a Mississippi Space Services support contractor. “Performance of test articles is dependent on the support systems surrounding them. We must have quality components to support rocket engine testing, but the delays we experienced in receiving units were constant, and the costs involved seemed to be continually mounting. The successful completion of this project has provided NASA with a high performance actuator at a lower cost significantly faster.”

“This agreement allowed our company not only to address a government need,” said Hamtil, “but also to enhance our commercial product. As a result, the Model 773 is receiving increased interest from companies outside the traditional applications areas.”

Dual-use product development is based on the sharing of costs, risks and successes between the government and a commercial partner. In dual-use projects, NASA contributes technology development, facilities and know-how, engineering resources and funding. The commercial partner contributes unique expertise, facilities, manufacturing, marketing capabilities and potential cash resources. The result is an approach that provides flexibility and draws upon the capabilities of both parties.

“This dual-use project is an excellent example of how NASA and industry can partner to develop a NASA-needed technology while at the same time, help fulfill a commercial marketplace need,” said NASA’s John Bailey, Office of Technology Transfer Dual-Use manager.

For more information about NASA’s Dual-Use Technology Development Program at Stennis, call (228) 688-1929 or visit the Web site at http://technology.ssc.nasa.gov.

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For more information, call the NASA Public Affairs Office at Stennis at 1-800-237-1821(Option 3) in Mississippi and Louisiana only, or (228) 688-3341.
Partnership Improves Actuator, Saves Money

A Dual-Use Cooperative Agreement between the Office of Technology Transfer at Stennis Space Center (SSC) and BAFCO Inc. of Warminster, PA has produced an improved linear actuator for use on the rocket engine test stands at Stennis Space Center.

A linear actuator is the servomechanism that supplies or transmits a measured amount of energy for the operation of another mechanical system; accuracy, reliability and speed of the actuator are critical to proper performance of the entire system. The BAFCO Model 773 is a next-generation, high-thrust, high-response electro-hydraulic actuator designed to meet identified performance standards in aerospace, industrial and petro-chemical applications.

"This actuator is the result of a focused partnership between NASA and our company to resolve production problems, as well as high unit costs," said Jim Hamtil, president of BAFCO Inc. "The Model 773 meets National Fluid Power Association (NFPA) standards for cylinder performance, along with US and European standards for electrical component functions. It is a unique piece of equipment that meets or exceeds established performance standards at mid-range pricing levels."

Stennis provides testing of space shuttle main engines, rocket propulsion systems and related rocket components. Stennis maintains several test facilities with a number of cells, or positions, to perform propulsion testing. As the testing facilities continue to age, maintenance costs have increased. In an attempt to control component replacement costs, NASA partnered with BAFCO to resolve questions regarding manufacturing processes, delivery lead-time and high unit costs.

BAFCO identified four suppliers that manufactured components meeting the performance standards required by NASA. "We no longer have to individually engineer each component," said Hamtil. "Our company has been able to purchase commercial off-the-shelf (COTS) components and modify them using BAFCO technology and expertise. Subsequently, production and delivery lead-time have been reduced. Production to delivery, the entire process has been reduced from 14 weeks to between four and eight weeks. Correspondingly, the unit price has been lowered."

To date, all 30 of the actuators Stennis purchased from BAFCO have been installed in the E-Complex at Stennis, with performance levels having met or exceeded those of all previously used actuators. "This agreement allowed our company to not only address a government need, but also to enhance our commercial product at the same time. As a result, the Model 773 is receiving increased interest from companies outside the traditional applications areas," says Hamtil.

"This dual-use project is an excellent example of how NASA and industry can partner to develop a NASA-needed technology while at the same time help fulfill a commercial market place need," said John Bailey, NASA Office of Technology Transfer dual-use manager. The dual-use concept of product development is based on the sharing of costs, risks and successes between the government and a commercial partner. In these projects, NASA can contribute technology development, unique facilities and know-how, engineering resources and funding. In turn, the commercial partner contributes unique expertise, facilities, manufacturing, marketing capabilities and potential cash resources. The result is an approach that provides flexibility and draws upon the capabilities of both parties. Q

For more information, contact the Office of Technology Transfer at John C. Stennis Space, phone: 228/688-1929. Please mention you read about it in innovation.
Haynes Haselmaier, left, propulsion test technologist for the University of Southern Mississippi at Stennis Space Center, and Jonathan Dickey, Mississippi Space Services engineer, explain the BAFCO Model 773 linear actuator installed in the E-3 test stand at Stennis. The BAFCO valve part, developed through a recently completed Dual-Use Cooperative Agreement between the Office of Technology Transfer at Stennis Space Center and BAFCO Inc. of Warminster, Penn., has improved rocket engine testing at Stennis.