



INSTALLATION, OPERATION & MAINTENANCE MANUAL IOM1006

HYDRAULIC DOUBLE ACTING (DA) LINEAR ACTUATOR

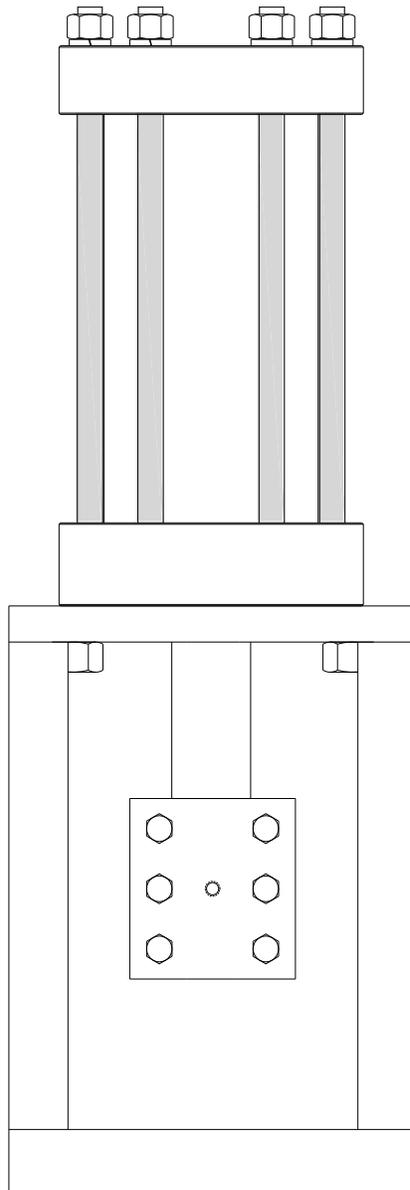




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1 Introduction

1.1 Company Background

Automation Technology was founded in 1995 as a manufacturer of pneumatic and hydraulic valve actuators. With products in a wide range of applications such as petrochemical, pipelines, refineries, pulp and paper, agriculture, pharmaceutical, municipalities, mining, power plants and marine transportation, ATI has succeeded in becoming a global leader in automation technology.

1.2 Scope & Purpose of Manual

This manual is intended to assist those who are involved with the installation, operation and maintenance of the ATI Hydraulic Double Acting (DA) Linear Actuator. This manual should be reviewed and thoroughly understood PRIOR to installing, operating or providing maintenance on the device. Refer to separate instruction manuals for details regarding optional accessories and other equipment used with these actuators.

Failure to read and comply with all applicable installation, operation and maintenance instructions may result in bodily injury or equipment damage and will void the Product warranty.

1.3 Company Contact

For any questions or clarifications, contact ATI or your nearest ATI Authorized Representative.

Email: Sales@ATIactuators.com

Web: <http://www.ATIactuators.com/>

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Houston, Texas, USA
Phone: +1 713 934-0171
US Toll Free: 800-924-8037

ATI Europe – Customer Support
Manchester, United Kingdom
Phone: +44 161 830-2146

2 Reference Documents

The following documents are referenced within this publication. These address options and accessories, and one or more of these documents may be required to complete installation, operation or maintenance of the as-built Product.

- IOM1004 Hydraulic SRE
- IOM1005 Hydraulic SRR
- IOM1006 Hydraulic DA
- IOMS002 JS2 Bi-directional Mechanical Override
- IOMS 003 ATI HO1-HO2 Hydraulic Override
- IOMS 004 Fastener Torque Guide
- IOMS 005 HD Threaded Coupling Valve Stem Connection
- IOMS 006 Split Coupling Valve Stem Connection
- IOMS007 Troubleshooting Guide
- IOMS 008 Hydraulic Snubber
- IOMS 010 ATI Linear Hydraulic Actuator Thrust Chart
- IOMS 011 Gas-charged Hydraulic Accumulators



3 Definitions

Term/Abbreviation	Definition
ATI	Automation Technology LLC, the manufacturer of the Product.
bore size	Nominal Inside Diameter of the power cylinder of the Product.
cycle	Operating the actuator from full open to full close and back to full open, or from close to open, back to close. When mounted to the valve, this is 2 full stroke operations, one time in each direction.
MAST	Maximum Allowable Stem Thrust: the maximum allowable thrust, as specified by the valve manufacturer, that can be safely applied the stem without physical permanent damage.
MAOP	Maximum Allowable Operating Pressure: the pressure below which an actuator will operate normally, producing thrust according to the published tables. Above this pressure and below the MAWP, the actuator may experience deformation of components which could lead to a shorter life and less efficient creation of thrust.
MAWP	Maximum Allowable Working Pressure: the maximum design pressure for the Product and the maximum pressure allowed at full stroke.
hydraulic actuator	A hydraulic actuator uses compressed liquid as the power medium to produce mechanical motion.
Product	Hydraulic Double Acting (DA) Linear Actuator. "Product" in this manual refers to the Applicable Product for this publication as defined in section 1.2.
stroke	Measure of valve openness. Full stroke is the travel distance to move the valve from its full closed to its full open position. In control valve applications, stroke is often described in percentage terms—full closed is 0%, full open is 100%—and stroke is generally proportional to the amount of flow through the pipe.
travel	Measure of the distance of linear actuator movement. The maximum travel is determined by the internal design gaps between the actuator piston and internal surfaces of actuator heads or other fixed stops. Maximum travel usually exceeds Stroke requirements, and adjustable travel stops are used to limit travel to match the stroke requirement and to prevent over-travel that can damage the valve or other equipment.

4 Product Description

4.1 General Description & Typical Applications

ATI linear actuators are suitable for operating valves, dampers, and other industrial equipment, in On-Off and Modulating heavy-duty service. The ATI Hydraulic Double Acting (DA) Linear Actuator is a double-acting piston actuator that provides high thrust output with minimal friction for short- and long-stroke applications, including rising-stem valves and other industrial, fluid-handling process equipment.

The actuator includes a flange that will mount directly to the valve or to an adapter flange that mounts to the valve bonnet or to a mounting flange of the damper or other equipment. ATI supplies a flange that is custom machined to fit the application.

The actuator may include an optional coupling or clevis for the connection of the actuator piston rod to the valve stem or other equipment. Refer to IOMS005 and IOMS006 for common coupling options, or refer to order documentation for customized coupling solutions.

Adjustable stops are available as an option to limit actuator travel and protect the valve stem or other equipment from potential actuator thrust limits at full supply pressure. External, adjustable stops are common for most on-off applications. Internal, fixed stops are available if specified with the order.



The actuator may include an optional mechanical override or an optional hydraulic override or hydraulic snubber. The overrides allow for valve operation in the case of a loss of pneumatic supply pressure. The snubber is available for speed control, to dampen sudden movements to the actuator due to process conditions. Refer to IOMS002, IOMS003 and IOMS008 for more information.

The actuator is designed for assembly of optional accessories (positioner, signaling limit switches, position transducer, etc.) by means of mechanical linkages. These accessories are generally attached to the linear actuator's stem coupling.

ATI can supply different types of control systems following customer requirements. Common solutions include speed controls, cushioning at end of travel, positioning with analog 4-20mA or digital feedback or control.

4.2 Theory of Product Operation

The Product utilizes a hydraulically-controlled piston that is sealed against the inside of a cylinder. Supply pressure acts against the piston to generate thrust that varies with the differential pressure across the fixed area of the piston. From equilibrium, the actuator operates by differential of forces that is created by increasing supply pressure on one side of the piston (and/or decreasing pressure on the opposite side of the piston). This pressure differential causes the piston to move up or down, changing the position of the actuator and the valve or other device to which it is connected.

Travel of the actuator is limited by the total travel of the piston within the cylinder. Actuators manufactured with external stem couplings may include optional, external stops that can adjust the travel distance for the actuator. Refer to IOMS005 and IOMS006 for common options for external, adjustable stops. Actuators manufactured with internal tube stops may be adjusted at the time of actuator assembly by trimming or shimming the tube stop. The allowable travel adjustment using internal tube stops should be agreed prior to order placement.

Optional manual overrides are available to extend or retract the actuator on loss of supply pressure or loss of control signal. Refer to IOMS002 and IOMS003 for more information.

4.2.1 Hydraulic Operation – Retract

When supply pressure is applied to the port(s) of the lower head and pressure is exhausted from the port(s) of the upper head, the piston drives the actuator to retract the piston rod. In a typical push-to-close valve design, supply pressure to the lower head retracts the piston rod to *pull* the valve *open*.

4.2.2 Hydraulic Operation – Extend

When supply pressure is applied to the port(s) of the upper head and pressure is exhausted from the port(s) of the lower head, the piston drives the actuator to extend the piston rod. In a typical push-to-close valve design, supply pressure to the upper head extends the piston rod to *push* the valve *closed*.

4.2.3 Manual Operation

Refer to IOMS002 & IOMS003, as applicable, for details on operation of optional mechanical overrides (JS2) or the hydraulic override (HO1/HO2). Note that inherent limits of Human Factors make it impractical to apply mechanical overrides (JS2) to bore sizes above 3.25" and impractical to apply a hydraulic override (hand pump) for bore sizes 16" and larger. Consult ATI for override recommendations for specific applications.

4.3 Product Specifications

<p>4.3.1 Operating Pressure</p>	<p>The working pressure range for a standard ATI Hydraulic Double Acting (DA) Linear Actuator is as follows:</p> <p>MINIMUM: 200 psig (13.8 bar) MAXIMUM (MAWP): 3000 psig (207 bar)</p> <p>Consult ATI for supply pressure outside of these Min. & Max. limits.</p>
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4.3.2 Temperature Limits	<p>Operating Temperature of the Product varies with seal selection at the time or order placement:</p>						
	<table border="1" data-bbox="646 235 1386 386"> <thead> <tr> <th>Seal Material</th> <th>Operating Temperature*</th> </tr> </thead> <tbody> <tr> <td>Urethane – <i>standard</i></td> <td>-40°F to +200°F (-40°C to +93°C)</td> </tr> <tr> <td>FKM (Viton)</td> <td>-20°F to +400°F (-29°C to +204°C)</td> </tr> </tbody> </table> <p><i>* Operating temperature limits must be confirmed for the fluid selected for use. Maximum Operating Temperature limit listed for the seals in the actuator is typical for use with petroleum-based hydraulic fluids that are properly dehydrated and filtered. Standard petroleum-based hydraulic oils and vegetable-ester or synthetic-ester hydraulic oils should typically be operated below a temperature of +150°F (+65°C). Water-glycol based hydraulic oils are not recommended for actuators because of fluid stability issues that lead to corrosion; if water-glycol based fluid is used, to avoid degradation of standard seal materials, the maximum temperature should be less than +140°F (+60°C) and it is recommended to limit maximum temperature below +122°F (+50°C), and the water-glycol fluid must be circulated regularly to maintain and monitor the emulsion for water separation. Refer to section 9.2 for more information on fluid selection.</i></p> <p>Ambient Temperature recommendation</p> <p>MINIMUM: 0°F (-18°C) <i>Recommended MINIMUM Ambient Temperature assures good flow of standard hydraulic fluids. Materials of construction are suitable to the minimum Operating Temperature of seals, or to the minimum Operating Temperature of the fluid selected for use, or to the minimum Operating Temperature rating of metal components specific for the order -20 °F (-29 °C), whichever is greater.</i></p> <p>MAXIMUM: +122°F (+50°C) <i>Recommended MAXIMUM Ambient Temperature is based on the burn threshold established in ISO 13732-1; maintaining a surface temperature at or below this value ensures safety of personnel that may contact the equipment. Standard materials of construction are otherwise suitable to the maximum Operating Temperature of all seals, +400 °F(+204 °C).</i></p> <p>Consult ATI for alternate seal constructions for special applications.</p>	Seal Material	Operating Temperature*	Urethane – <i>standard</i>	-40°F to +200°F (-40°C to +93°C)	FKM (Viton)	-20°F to +400°F (-29°C to +204°C)
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FKM (Viton)	-20°F to +400°F (-29°C to +204°C)						
4.3.3 Fluid Type	<p>The Product is designed and constructed of heavy duty materials for operation in hydraulic systems using petroleum-based fluids. Optional materials of construction are available for operation with other fluids.</p> <p>Refer to section 9.2 for more information.</p>						
4.3.4 Duty Cycle & Cycle Speed	<p>The Product is capable of intermittent duty and continuous modulation when operated within recommended temperature limits with properly filtered fluid.</p> <p>Consult ATI for cycle speeds faster than 0.5 second per inch of travel. Speeds faster than 1 second for full stroke have been achieved with proper sizing and system design.</p>						



4.3.5 Service Life	<p>ATI actuators can be operated with petroleum-based hydraulic fluids up to 5 years without maintenance. In harsh environments and safety critical applications, more frequent maintenance intervals and a proper fluid monitoring program should be considered to ensure reliable Product performance.</p> <p>With regularly schedule maintenance using genuine ATI components (seals), the service life of an ATI Hydraulic Double Acting (DA) Linear Actuator has been extended to 20 years and longer.</p>																											
4.3.6 Lubrication	<p>For normal duty, the actuator is self-lubricated for the life of the Product.</p> <p>The hydraulic fluid should be filtered and monitored for cleanliness to a contamination threshold of 20/18/15 per ISO 4406 (NAS 9). Lower contamination thresholds are recommended to maximize service life: For operating pressures to 2000 psig, it is recommended to maintain fluid to a cleanliness level better than 17/15/12 (NAS 6). For operating pressure to 3000 psig, maintain fluid to a cleanliness level better than 16/14/11 (NAS 5).</p> <p>Refer to section 9.2 for additional information.</p>																											
4.3.7 Lifting Point Load Ratings	<p>Actuators are provided with a provision for lifting the actuator. For bore sizes not listed, refer to order documentation for engineered solutions.</p> <table border="1" data-bbox="646 835 1279 1150"> <thead> <tr> <th>Bore Size</th> <th>Typical Lifting Provision</th> <th>Load Rating lbf (kN)</th> </tr> </thead> <tbody> <tr> <td>2</td> <td>2X 3/8-16UNC</td> <td>2300 (10.6)</td> </tr> <tr> <td>2.5-3.25</td> <td>2X 1/2-13UNC</td> <td>4300 (19.3)</td> </tr> <tr> <td>4</td> <td>2X 5/8-11UNC</td> <td>6900 (30.7)</td> </tr> <tr> <td>5</td> <td>2X 3/4-10UNC</td> <td>10000 (44.8)</td> </tr> <tr> <td>6-8</td> <td>2X 1-8UNC</td> <td>18300 (81.4)</td> </tr> <tr> <td>10-12</td> <td>2X 1 1/8-12UNF</td> <td>23700 (105.6)</td> </tr> <tr> <td>14</td> <td>2X 1 1/4-12UNF</td> <td>29200 (130.3)</td> </tr> <tr> <td>16</td> <td>2X 1 3/8-12UNF</td> <td>35300 (157.3)</td> </tr> </tbody> </table> <p>Load ratings require minimum thread engagement equal to 1X the nominal bolt diameter. Review sections 5.2 and 6.1 for safety warnings before lifting the Product. Follow the installation, operation and safety instructions for the hoist rings, lifting straps or other lifting equipment selected for use with these Lifting Points.</p>	Bore Size	Typical Lifting Provision	Load Rating lbf (kN)	2	2X 3/8-16UNC	2300 (10.6)	2.5-3.25	2X 1/2-13UNC	4300 (19.3)	4	2X 5/8-11UNC	6900 (30.7)	5	2X 3/4-10UNC	10000 (44.8)	6-8	2X 1-8UNC	18300 (81.4)	10-12	2X 1 1/8-12UNF	23700 (105.6)	14	2X 1 1/4-12UNF	29200 (130.3)	16	2X 1 3/8-12UNF	35300 (157.3)
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16	2X 1 3/8-12UNF	35300 (157.3)																										
4.3.8 Travel	<p>The range of travel is specified at order placement. Standard limits of travel distance for external stops are as follows:</p> <p>MINIMUM: 1 inch (25mm)*</p> <p>*Optional, adjustable stops can limit stroke below 1 inch. Refer to IOMS005 & IOMS006 for details on stops included valve stem connections.</p> <p>MAXIMUM: Length equal to 2 x Bore Size</p> <p>Consult ATI for applications with Travel > 2 x Bore Size.</p>																											
4.3.9 Bore Size & Thrust	<p>See IOMS 010 (ATI Linear Hydraulic Actuator Thrust Chart) for hydraulic cylinders from 2 inch to 30 inch diameter.</p> <p>Consult ATI for special constructions that exceed limits of the Thrust Chart.</p>																											



4.3.10 Pressure Connections	<p>1/8 NPT to 1-1/4 NPT, varies with Bore Size and order requirement</p> <table border="1" data-bbox="646 205 1312 550"> <thead> <tr> <th>Bore Size</th> <th>Standard *</th> <th>Common Options</th> </tr> </thead> <tbody> <tr> <td>2-2.5</td> <td>One (1) 1/4 NPT</td> <td>Two (2) up to 3/4 NPT</td> </tr> <tr> <td>3.25-5</td> <td>One (1) 3/8 NPT</td> <td>Two (2) up to 3/4 NPT</td> </tr> <tr> <td>6</td> <td>One (1) 1/2 NPT</td> <td>Two (2) up to 3/4 NPT</td> </tr> <tr> <td>7-8</td> <td>One (1) 3/4 NPT</td> <td>Two (2) up to 1-1/4 NPT</td> </tr> <tr> <td>10-12</td> <td>One (1) 1 NPT</td> <td>Two (2) up to 1-1/4 NPT</td> </tr> <tr> <td>14-30</td> <td>One (1) 1-1/4 NPT</td> <td>Two (2) up to 1-1/4 NPT</td> </tr> </tbody> </table> <p>* ATI will include 1, 2, or more, pressure connections meeting other specifications, such as SAE O-ring and SAE 4-bolt manifold, to accommodate customer requests.</p>	Bore Size	Standard *	Common Options	2-2.5	One (1) 1/4 NPT	Two (2) up to 3/4 NPT	3.25-5	One (1) 3/8 NPT	Two (2) up to 3/4 NPT	6	One (1) 1/2 NPT	Two (2) up to 3/4 NPT	7-8	One (1) 3/4 NPT	Two (2) up to 1-1/4 NPT	10-12	One (1) 1 NPT	Two (2) up to 1-1/4 NPT	14-30	One (1) 1-1/4 NPT	Two (2) up to 1-1/4 NPT
Bore Size	Standard *	Common Options																				
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14-30	One (1) 1-1/4 NPT	Two (2) up to 1-1/4 NPT																				
4.3.11 Bolt Torque	<p>Refer to order documentation for special bolt tension requirements. Follow bolt tension requirements in Section 9.1.2 during seal maintenance. Follow IOMS004 for general bolt tension specifications for accessories, tie rods and structural connections.</p>																					
4.3.12 Protective Coating	<p>The ATI standard protective coating includes surface degrease, surface abrasion, and 2 coats of an aliphatic polyurethane paint. The standard protective coating is applied to all environmentally-exposed carbon steel surfaces, with exception of the exposed portion of piston rods, threaded connections, and any threaded drive shafts (such as the ACME thrust shaft in the JS2 manual override). In some assemblies, the standard coating may also cover some stainless steel materials that are integral to the assembly of carbon-steel components.</p> <p>Consult ATI at time of order placement for specific details on the specification(s) to be used for protective coating(s).</p>																					
4.3.13 Warranty	<p>Complete warranty terms and conditions are included in section 11 of this manual.</p> <p>ATI actuators are warranted against defects in material and workmanship for a period of two (2) years after the date of factory shipment. Refer to Product nameplate for serial number to confirm date of shipment. The warranty does not cover accessory components installed by others or materials that are installed inappropriately, used inappropriately, or modified or repaired without approval by ATI.</p> <p>NON-WARRANTY CLAUSE: Contents of this publication are periodically checked for compliance with the associated Products, and corrections are made as necessary for subsequent publications. ATI also modifies the Product in this publication (within limits of Optional Certifications) to meet special requirements for specific customer orders. Therefore, ATI cannot exclude the possibility of discrepancies between this publication and the Product and special documentation that is prepared for a particular shipment, and ATI does not accept liability for discrepancies between information in this publication and the Product.</p>																					



<p>4.3.14 Optional Certifications</p>	<p>When Certification is specified as an order requirement, ATI will manufacture using materials and specific design criteria defined for one or more of the following:</p> <ul style="list-style-type: none"> Pressure Equipment Directive (PED) 2014/68/EU <ul style="list-style-type: none">  Notified Body No. 0035 Certificate # 01 202 USA / Q-12 4842 ATEX 2014/34/EU Group II Category 2 Gas & Dust <ul style="list-style-type: none">   0035 II 2GD c TX <p><i>PED ATEX Notified Body: TÜV Rheinland, Registration 0035 Tel. +49(221)806-9000, Other contact www.tuv.com/germany/de/</i></p> Customs Union Technical Regulations (CU TR) 010/2011 & 012/2011 <ul style="list-style-type: none">   II Gb c T* X/ III Db c T* X <p><i>ATI H-series and HDH-series hydraulic linear actuators have been evaluated for ignition hazard and certified for CUTR 012/2011 under “protection by constructional safety.” To ensure conformity with CU TR, only ATI parts and materials can be used.</i></p> <p><i>CU TR Notified Body: MinPromTest, Registration 1137746632726 Tel. +7(495)723.23.71, Other contact minpromtest.ru/rekvizity-kompanii/</i></p> <p><i>Refer to product nameplate for production year of manufacture.</i></p>
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5 Safety Warnings

THIS MANUAL COVERS GENERAL INSTRUCTIONS AND DOES NOT CLAIM TO ADDRESS ALL SAFETY FACTORS ASSOCIATED WITH ATI PRODUCTS OR THE ACCESSORIES THAT MAY BE MOUNTED TO ATI PRODUCTS. FOLLOWING THESE INSTRUCTIONS AND GUIDELINES WILL HELP IN PREVENTING PERSONAL INJURY, PROPERTY DAMAGE, AND DAMAGE TO THE PRODUCT.

ACTUATORS AND VALVES COME INTO CONTACT WITH CAUSTIC GASES AND FLUIDS IN MANY APPLICATIONS. AS A RESULT, ALL TOXIC OR FLAMMABLE FUMES MUST BE VENTED AND LIQUIDS MOVED TO A SAFE LOCATION TO ENSURE SAFETY.

FOR GENERAL SAFETY REQUIREMENTS AND RISK ASSESSMENTS OF HYDRAULIC POWER SYSTEMS, REFER TO BS EN 982, ISO 4413, AND ISO 12100.

5.1 Personnel Requirements

DO NOT INSTALL, OPERATE, OR MAINTAIN AN ATI PRODUCT UNLESS TRAINED AND QUALIFIED IN PRODUCT AND ACCESSORY INSTALLATION, OPERATION AND MAINTENANCE.

PROPER INSTALLATION OF THE PRODUCT IS CRITICAL TO PERFORMANCE AND SAFETY. DUE TO THE MANY VARIATIONS OF ACTUATORS, VALVES, AND RELATED CONTROLS, THE GENERAL INSTRUCTIONS IN THIS MANUAL MAY NOT ADDRESS SPECIFIC ISSUES AT A PARTICULAR INSTALLATION. EACH TECHNICIAN FOLLOWING THESE INSTRUCTIONS MUST BE COMPETENT, TRAINED, AND HAVE A WORKING KNOWLEDGE OF VALVES, VALVE ACTUATORS, ACTUATOR CONTROLS, AND THE SPECIFIC APPLICATION FOR THE INTENDED PRODUCT(S).

IT IS THE RESPONSIBILITY OF THE USER TO ENSURE PROPER SAFETY. ALWAYS TAKE NECESSARY PRECAUTIONS AND UTILIZE PROPER PERSONAL PROTECTIVE EQUIPMENT (PPE) WHEN DEALING WITH COMPRESSED GAS, PRESSURIZED HYDRAULIC FLUID, PINCH POINTS, AND ELECTRICITY. IT IS THE USER'S RESPONSIBILITY TO UTILIZE APPROPRIATE PROTECTION AGAINST HEARING DAMAGE WHEN WORKING NEAR THE ACTUATOR AND CONTROLS.



5.2 Potential Hazards

The Product has been designed in accordance with best practices for operational reliability, but as an industrial machine, it bears the risk of hazards if handled or operated improperly. Only trained, qualified personnel should work on or near the Product.

Some potential risks from installation include rigging & lifting. Risks during maintenance and operations include stored energy hazards, pinch points, overpressure conditions, and ignition hazards.

Rigging & Lifting

The Product includes a provision for lifting, refer to section 4.3.7 and order documentation. This provision does not address all possible assemblies that will include the additional weight of the valve and related controls. The user must ensure that the package weight including this Product does not exceed the rated limit of these lifting points. For cases where this limit is exceeded, the actuator and valve or other equipment must be rigged and lifted separately. Refer to rigging instructions in section 6.1 for lifting recommendations.

Before rigging, ensure the crane/hoist/rigging hardware lifting capacity can safely accommodate the desired load. Dropping the Product and any attached accessories or the attached valve may cause personal injury and/or equipment damage. For all mounting procedures, use adequately rated chain(s) & sling(s) with an adequately rated hoist or crane to lift and maneuver the Product. Use caution during lifting and handling to prevent uncontrolled movement or sudden shock loads.

Stored Energy Hazards & Noise

The Product is powered by supply pressure up to the maximum pressure defined in section 4.3.1. It is normal for actuator controls to permit a sudden release of this supply pressure. It is also required that this pressure be released before maintenance activities may begin on the Product. The release of pressure can produce excessive noise caused by sudden discharge at sonic velocity.

Depending on configuration of supply and exhaust lines during installation, this sudden pressure discharge may exhaust at the actuator. Users must be aware of the hydraulic system operation and use appropriate personal protection equipment (PPE) to avoid injury from pressure discharge.

Discharge any accumulator pressure in the hydraulic system before attempting to remove or repair the actuator or any component of the hydraulic control system.

Sharps & Pinch Points

Actuators may be equipped with optional external stops and mechanical switch trip arms for controls accessories. During operation, sudden movements in actuator position can create a pinch-point hazard for personnel working very close to the Product. Stay out of the line of movement of the piston rod at all times.

Warning labels and tags located on the Products are made of metal foils that vary in thickness. Because the metal tags have sharp edges, personnel installing, handling, or working around the tags should protect against cuts or injury.

Overpressure

The maximum supply pressure (MAWP) for the Product is defined in section 4.3.1. Whenever possible, actuators should be sized so that thrust at MAWP does not exceed MAST. For some applications, however, users may regulate supply pressure below MAWP to limit output thrust below the MAST of the valve or other connected equipment. Users must understand the limits of maximum thrust of the Product at MAWP as compared to the safe MAST value for connected equipment, and the user is responsible for ensuring that supply pressure is regulated, with safety relief valves if necessary, to limit Product maximum thrust to a safe value. Operating Product so that thrust exceeds MAST may cause permanent damage to connected equipment and void relevant warranties.

Ignition Hazard

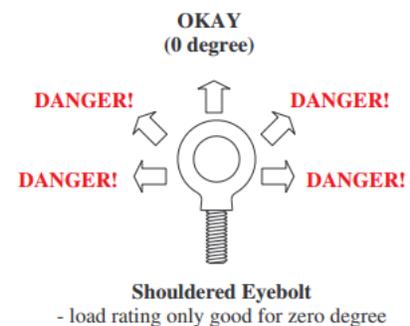
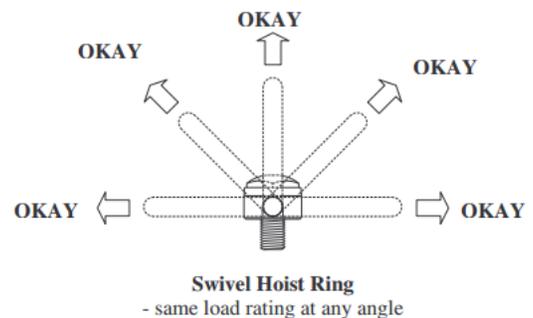
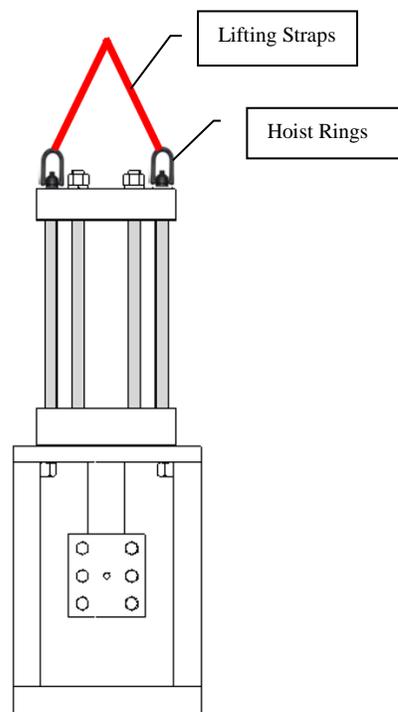
Based on the Ignition Hazards Assessment conducted per EN13463-1 & EN 1127-1, ATI Linear Valve Actuators do not have any potential or effective ignition sources in normal operation or in the event of a malfunction due to application limitations, design inherent safety and materials of construction. This hazard analysis is specific to the actuator and does not consider the addition of optional accessories such as electronic positioners, transmitters or other control components. This hazard analysis also does not consider the fire hazard that may result if uncontrolled, pressurized hydraulic fluid is sprayed near an ignition source.

6 Handling and Storage

6.1 Receiving the Product

Proper care and precautions should be taken when unloading and handling the actuator, especially when rigging and lifting. Ensure that the valve is not connected to the actuator.

- During lifting and transport, fully retract the piston rod. Always protect the extended portion of the piston rod. If wrapping in plastic, ensure that the wrap can breathe, so that it does not trap moisture during extended storage.
- If lifting vertically with the piston rod retracted, ensure that ports are sealed with metal plugs, and be prepared for movement of the piston rod during transit. The weight of the piston and rod will cause entrapped air to compress, which will result in the piston rod extending from the actuator.
- For bore sizes up to 16" with lifting provisions per section 4.3.7, ATI recommends that the actuator be lifted using appropriately rated hoist rings threaded into the upper head, as shown in the diagram below. Swivel hoist rings are depicted only to distinguish type from typical shouldered eyebolts. Refer to 4.3.7 for load ratings of actuator lifting points. Do not exceed the load rating for the hoist rings selected for use with the actuator.





- Check that the actuator has not been damaged during transport.
- Check that the model, serial number and performance data on the data-plate match those in the order acknowledgement, test certificate and delivery note.
- Check that the fitted accessories comply with those listed in the order acknowledgement and the delivery note.
- For actuators shipped assembled to the valve, the settings of the mechanical stops and the settings of limit switches (if applicable) have been completed during assembly of the actuator. These settings should be checked before start-up.
- For actuators shipped separately from the valve, the settings of the mechanical stops and the settings of limit switches (if applicable) may require adjustment after completing assembly with the valve.

6.2 Storage and Preservation

ATI Products leave the factory in excellent working condition and with an excellent finish (these conditions are guaranteed by individual inspection certificates). To maintain these characteristics until the Product is installed, it is necessary to take appropriate measures during the storage period.

- Products contain resilient seals, and Products should not be stored in environments that are harmful to resilient seals.
- Plugs must be fitted in all connection ports. Plastic plugs are typically used to protect against the entry of foreign matter during transport, and these plastic plugs do not have a weatherproof function. If equipment is stored outdoors, the plastic protection plugs must be replaced by metal plugs to ensure weatherproof protection.
- If actuators are supplied separately from the valves, they must be placed onto a wooden pallet so as not to damage the coupling flange to the valve. In case of long-term storage, the coupling parts (*e.g.* flange and stem connection) must be coated with protective oil or grease to prevent corrosion, and any exposed shafts (*e.g.* piston rods) must be coated with protective oil to prevent corrosion of sealing areas during idle storage. If possible, cover the mounting flange with a protection disk, and store the actuator in the orientation intended for its use (*e.g.* store linear actuators in the vertical position). It is preferable to fill the actuator cylinder with petroleum-based hydraulic oil while in storage.
- In case of long-term storage, it is advisable to keep the actuators covered and in a dry place or to provide at least some means of weather protection. All plastic protection plugs must be replaced by metal plugs to ensure weatherproof protection. Care should be taken to plug all open ports to keep foreign particles and moisture from entering the Product. If the cylinder cannot be filled 100% with petroleum-based hydraulic oil during storage, it is recommended to use inert, dry gas (such as nitrogen) to purge all oxygen from the cylinder before sealing with metal plugs. Protect the exposed portion of the piston rod with with grease, wax, oil, or a Denso tape system.
- It is recommended that the actuator be periodically operated with petroleum-based hydraulic oil at least three (3) cycles every 6 months for covered storage and at least three (3) cycles every 3 months for unprotected outdoor storage. Prior to operation, use a clean, soft cloth dampened with an appropriate oil-based solvent to remove any dirt, dust, grease and/or other contaminants from exposed sealing surfaces (*e.g.* the piston rod). After such operations, apply rust preventative to exposed sealing surfaces, and carefully plug all the threaded connections of the actuator and controls (if existing).

7 Installation Instructions

7.1 Mount to Valve Body

Prior to assembly, inspect the actuator as described in section 6.1 and confirm that the intended assembly orientation for the actuator complies with the system's geometry. Linear actuators can only work properly if they are installed so that no external forces are applied to create side loads on the piston rod. Vertical mounting is always recommended. Operating actuators horizontally or at any inclination other than vertical requires that the



user properly design, construct and maintain a support structure so that side loads are never introduced to the actuator assembly.

Use a clean, soft cloth dampened with an appropriate oil-based solvent to remove any dirt, dust, grease and/or other contaminants from exposed sealing surfaces (*e.g.* the exposed surface of the piston rod).

7.1.1 Vertical Mount on Valve

The stem coupling connection with the actuator determines the best method for installing an actuator to a valve. Refer to IOMS005 and IOMS006 for instructions specific to each coupling configuration (HD Threaded Coupling and Split Coupling, respectively). For spring return configurations, refer to instructions in IOM1004 or IOM1005. Refer to order details for other engineered solutions.

The instruction that follows is one option typical for assembling a linear actuator to a rising-stem valve in on/off service using an HD Threaded Coupling described further in IOMS005. This instruction assumes the actuator is required to extend to close the valve and retract to open the valve.

Refer to the sketch in “Appendix A – Exploded View of Linear Actuator” for the parenthetical references that follow in this section.

1. Position the subject valve to the full closed position (tight shut off).
2. Remove the valve hand wheel and hand wheel drive assembly. (See valve manufacturer’s assembly/disassembly instructions).
3. Move the actuator to the full closed position (Item 1 piston rod fully extended). If direct mounting or if no coupling, skip to step 7.
4. Completely remove the coupling block assembly (Item 2) by removing the coupling block bushing retaining cap screw and lock washer (Items 3 & 4) from the coupling block.
5. Remove the pin spanner wrench (Item 5) from inside the adaption bracket.
6. With the separated coupling block, position spanner wrench (Item 5) in holes located in the coupling block bushing (Item 6) and turn counter clockwise until completely out of the coupling block. It is not necessary to remove the piston rod insert (Item 7) or set screw (Item 8).
7. Position the actuator in the full open position (Item 1 piston rod fully retracted).
8. If necessary remove position indicator guide, screws, and lock washers (Items 9, 10 & 11).
9. If necessary remove position indicator and stud (Items 12 & 13).
10. Position actuator and adaption bracket to final adaption or valve as per application. Attach with appropriate fasteners to recommended torque specs.
11. Position coupling block assembly over valve stem and thread on clockwise for right hand threads or counter clockwise for left hand threads. Thread down on valve stem until bottom of coupling block assembly is within 1/8” to 1/4” of the bottom of the adaption bracket. It is not necessary to remove threaded insert (Item 15). If direct mounting or if no coupling, follow specific application instructions and skip to step 15.
12. Align the coupling block assembly to locate the position indicator hole with centerline of the adaption bracket.
13. Slowly move the actuator to the full closed position (Item 1 piston rod fully extended) to install piston rod into the coupling block assembly.
14. Reinstall coupling block bushing (Item 6) with pin spanner wrench (Item 5). NOTE: DO NOT FULLY TIGHTEN UNTIL STEP 16 IS COMPLETED.
15. Reinstall position indicator and stud (Items 12 & 13) if removed in Step 9.
16. Reinstall position indicator guide, screws, and lock washers (Items 9, 10 & 11) if removed in Step 8.



17. Tighten coupling block bushing (Item 6) with pin spanner wrench (Item 5), then install coupling block bushing retaining cap screw and lock washer (Items 3 & 4).
18. Cycle actuator and check for full open and full close. Adjustment may be necessary by repositioning the stop adjustment bolts (Item 14).
19. Reinstall pin spanner wrench on inside adaptation bracket.

7.1.2 Horizontal Mount with Valve

ATI recommends that a Hydraulic Double Acting (DA) Linear Actuator be installed in the vertical orientation, with the actuator travel perpendicular to grade, to ensure long life with minimal maintenance of dynamic piston seals and bearings.

Special care must be taken when orienting a linear actuator for service in a horizontal position (where actuator travel is horizontal to grade). To avoid cantilever loads on the valve stem and adaption bracket, it is the customer's duty to ensure proper support for the horizontal actuator. Proper support includes ground support and/or ceiling suspension at the actuator center of mass or at both ends of the actuator.

7.2 Connection to Valve Stem

Refer to IOMS005 and IOMS006 for common stem coupling configurations (HD Threaded Coupling and Split Coupling, respectively). Refer to order documentation for stem coupling solutions that are engineered for special applications.

7.3 Setting the Stroke Length

WARNING: Actuators may be equipped with optional external stops and mechanical switch trip arms for controls accessories. During normal operation, movements in actuator position can create a pinch-point hazard for personnel.

7.3.1 Adjusting External Stops

Refer to IOMS005 and IOMS006 for additional details specific to each coupling configuration (HD Threaded Coupling and Split Coupling, respectively). For other actuator configurations, refer to instructions in IOM1004 or IOM1005—linear actuators for spring return extend (SRE) and spring return retract (SRR) service.

The instruction that follows is one option, typical for assembling a linear actuator to a rising-stem valve in on/off service using an HD Threaded Coupling described further in IOMS005. This instruction assumes the actuator is required to extend to close the valve and retract to open the valve, and this instruction assumes that external stops were included with the stem coupling and actuator.

To set the retract stop position (valve full open): Adjust the upper travel stop screws in the actuator stem coupling so that the valve is fully open as the actuator reaches the up stop position.

For many valve configurations and for applications that prohibit external stops, it is possible to eliminate the external open (up) travel stops and install the ATI Linear Actuator so that the upper head of the power cylinder acts as an internal stop for the actuator piston in the full open (retract) position.

To set the extend stop position (valve full close): The setting of the closed valve position is performed by adjusting the lower travel stop screws in the actuator stem coupling. For many valve configurations and applications, it is possible to use the valve seat as the stop. The external stops are set approximately 1/4 turn to 1/2 turn gap between the stop the lower plate, to ensure the valve seals, with the stops acting as protection against over-travel.



7.3.2 Adjusting Internal Stops

If the Product contains internal stops (*e.g.* tube stops or other up-stops configurations), the adjustable limit of the stop must be agreed prior to order placement, and the actual stop setting must be made prior to completion of actuator assembly. Adjusting the length of the tube stop after shipment requires actuator disassembly, component machining (trimming or replacing the stop), reassembly and retesting.

7.4 Setting the Stroke Time

Stroke time is typically not adjustable at the hydraulic actuator. The operating speed of the actuator is constrained by the size and number of supply/exhaust ports included for the order. Stroke time is adjusted by modifications to the control circuit for the actuator. To accelerate stroke speed, fluid must either be supplied at a faster rate, or fluid must be exhausted at a faster rate. For assistance in adjusting speed of an automated valve, or for any stroke speed faster than 0.5 seconds per inch of travel, contact ATI or your local automation specialist.

If the actuator is purchased with optional cushions to reduce piston speed at one or both ends of travel, then an adjustable needle throttle valve may be integral to each head of the actuator. Turn the throttle to adjust the end of travel speed. Depressurize the cylinder while making throttle adjustments. Consult order documentation for more information.

If the actuator is purchased with an optional hydraulic override or with an optional hydraulic snubber, then speed control valves in the hydraulic circuit may be adjusted to dampen sudden movements to the actuator due to process conditions. Refer to IOMS003 or IOMS008 for details on installation and operation of a Hydraulic Override or Hydraulic Snubber.

8 Preparation for Start-up

Review Product Description and Theory of Product Operation in Section 4.

8.1 Hydraulic Connections

Connect the hydraulic supply and exhaust lines to the actuator and controls using fittings and/or pipes in accordance to site specifications. Connection must be sized appropriately to ensure necessary flow rate of fluid to the actuator. Piping must be suitably fastened so as not to cause excessive stress or cause the threaded connections to loosen if the system undergoes strong vibrations.

IMPORTANT: Every precaution must be taken to ensure that any solid or liquid contaminants that may be present in hydraulic fill lines and pipework are removed before connection and pressurization, to avoid possible damages or other loss of performance to the Product. Connections should be made by qualified staff using pipes and connections appropriate for system specifications.

The inside of pipes and connecting elements must be cleaned before use. The ends of the tubes must be deburred and cleaned. Pipes should be washed with suitable substances and purged with air or nitrogen, then flushed using an appropriate hydraulic flushing procedure. It is recommended that fluid should be filtered and the flushing should continue until reaching one level beyond the system's target cleanliness level. For example, if the target is ISO 4406 17/15/12, continue to flush the system until ISO 16/14/11 is reached.

Once the connections are completed, operate the actuator and check that it functions correctly, that the operation times meet the plant requirements and that there are no leakages in the hydraulic connections. **Cycle test the actuator at low pressure (25% of design pressure) to full extend and full retract positions. If there is no indication of leakage, repeat the cycle test at design pressure.**

8.2 Electrical Connections

The standard Hydraulic Double Acting (DA) Linear Actuator does not have electrical connections, but optional accessories may be included that require electrical connection. Refer to additional manuals or data sheets for specific wiring details for each accessory.

Connect the electrical feed, control and signal lines to optional accessories of the actuator by linking them with the terminal blocks of the electrical components. In order to do this, the housing covers must be removed without damaging the coupling surfaces or seals. Follow the installation instructions for each accessory.

For electrical connections, use components (cable glands, cables, hoses, conduits, wire) that meet the requirements and codes applicable to site specifications (ingress protection and/or hazardous area protection). If conduits are used, it is advisable to carry out the connection to the electrical enclosures by inserting flexible conduit so as not to cause anomalous stress on the housing cable entries.

Replace the plastic plugs of the unused enclosure entries with metal plugs, to guarantee weatherproof tightness and to comply with the hazardous area code requirements (as applicable).

After connections are complete, check that the feed voltage value of each component is correct and that controls and signals work properly. Ensure that the actuator piston rod extends/retracts/fails in place, as appropriate, upon loss of supply pressure or loss of control signal.

8.3 Oil Fill & Air Purge

Ensure the hydraulic fluid meets the specification for the system and the specific construction for the cylinder. Refer to sections 4.3.3, 4.3.6 and 9.2 for more information. If the wrong oil is used, seals or internal surfaces of the actuator can be damaged, resulting in system leaks and loss of function.

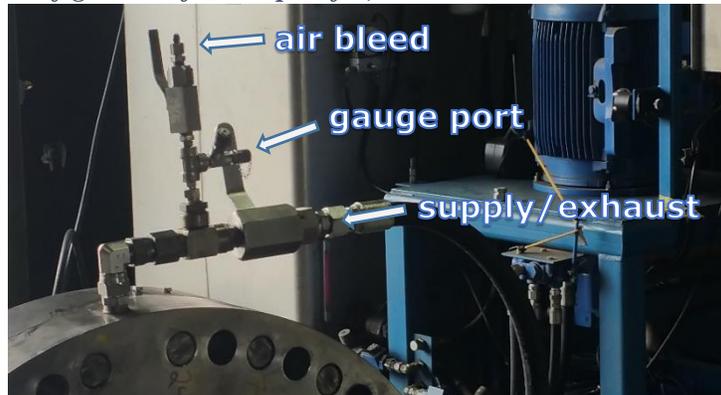
Entrapped air will cause hydraulic cylinders to stroke erratically. Cylinders must be stroked several times to purge this air from all internal cavities. Before attempting air purge, ensure the system is not pressurized. During the air purge operation, direct any air bleed in a safe direction.

8.3.1 Oil Fill

Fill each chamber on each side of the piston through the supply/exhaust port. With the actuator in its full closed position (full extend), pump hydraulic fluid into the lower port; fluid pressure will cause the piston to retract. Then from the full open position (full retract), pump hydraulic fluid into the upper port; fluid pressure will cause the piston to extend. If the actuator is supplied with 2 ports at each end and oriented so that the access point for one port is lower than the other, then this process may be accelerated by filling from the lower ports and by using the upper ports for air purge.

NOTE: If properly maintained and disconnected from its valve, most ATI double-acting actuator pistons will move with less than 3 psi of differential pressure. Substantially more pressure is required to overcome friction in the valve, to overcome backpressure in the fluid return circuit to the reservoir, or to overcome actuator spring forces, if applicable.

Configuration for one port fill, bleed and test





8.3.2 Air Purge

Cycle the actuator without building pressure until air is purged from all lines. If the actuator is fitted with optional air bleed ports, these may be opened to speed the process of filling and purging internal cavities. If the actuator is fitted with more than one port in each head, the second port may be opened for use as an air bleed, otherwise an air bleed must be installed in the fill line to the actuator.

Position the actuator to its full extend (valve closed) position, so that the internal piston is in contact with the lower head, or as close to the lower head as the valve position will allow. Depressurize the system and open the air bleed valve in the lower chamber while pumping fluid into the lower annulus. When oil flows from the air bleed, close the bleed. Pressurize the lower chamber to the minimum pressure required to fully retract the actuator. With the actuator at its full retract (valve open) position, fill the upper chamber with fluid, allowing air to bleed from one of the port connections in the upper head. When 100% filled with oil, seal any bleed ports and continue with system pressure testing.

8.3.3 Oil Drain

During transportation and for some maintenance activities, it may be necessary to drain all oil from the actuator.

If oriented horizontally with a set of ports pointing to ground, open all ports and allow fluid to drain from the lower ports.

If the actuator is in the vertical position, retract the actuator so that the piston pushes fluid out of the upper chamber to the hydraulic supply reservoir. With the lower chamber blocked to hold the actuator in place, break a supply connection to an upper port so that air can enter the upper chamber, and then drain the lower chamber.

WARNING: If the actuator is in a vertical orientation, the piston rod will move under its own weight, so beware of pinch points throughout drain and fill processes. Always drain through a ball valve that can be closed to stop the flow. Do not simply break a connection resulting in uncontrolled flow.

Drain fluid from the lower port through a ball valve to the hydraulic supply reservoir. If the actuator is fitted with optional air bleed connections, then these bleed ports can be opened to speed the process of draining the last of the fluid from the actuator after the piston reaches its end of travel. (Note that if the weight of the rod and piston are not sufficient to move extend the actuator to drain the lower chamber, then apply pressure to the upper chamber using an inert gas supply.)

As an alternative to using actuator movement to drain both chambers, if the actuator cannot be retracted to drain the upper chamber in a vertical assembly, the user may feed a flexible suction line (approximately 3/8" or 1/2" diameter) through one of the upper head ports, and suction fluid out of upper chamber with a pump. For the lower chamber, open ports and drain until actuator is fully extended.

8.4 Start-up

Prior to start-up in a hazardous area, ensure that the Product and all accessories are certified for the risk of ignition hazard at the site.

During start-up, ensure that all accessories are properly connected and calibrated for use, as follows:

1. Check that the pressure and quality of the fluid supply (contamination threshold and dehydration) are as prescribed. Check that the feed voltage values of the electric components (solenoid valve coils, micro-switches, pressure switches, etc.) are as prescribed. Before start-up for operation under maximum design pressure, clean or replace all filtering elements.
2. Check that the actuator controls work properly (remote control, local control, emergency controls).
3. Check that the required remote signals (valve position, supply pressure, etc.) are correct.
4. Check that the setting of the actuator control unit components, (pressure regulator, pressure switches, flow control valves, etc.) meet site requirements.



5. Check that there are no leaks in hydraulic connections. After oil heats to its working temperature, check that all joints and connections are tight.
6. In accordance with the applicable protective coating specification(s), repair any protective coating that has been damaged during transport, storage or assembly.

9 Maintenance & Operation

For assistance when troubleshooting an ATI Hydraulic Double Acting (DA) Linear Actuator, contact your nearest ATI representative. Contact details are in Section 1.3.

9.1 Safety Reminder

IMPORTANT: BEFORE CARRYING OUT ANY MAINTENANCE OPERATION, IT IS NECESSARY TO ISOLATE FEED LINES AND EXHAUST ALL PRESSURE FROM THE ACTUATOR AND ALL CONTROL MANIFOLDS AND VESSELS. ENSURE THAT ANY ELECTRICAL CONNECTIONS TO ACTUATOR CONTROLS ARE DE-ENERGIZED. IF PRODUCT OPERATION IS REQUIRED FOR TROUBLESHOOTING OR PARTIAL STROKE TESTING, THE MAINTENANCE PERSONNEL MUST ENSURE THAT ELECTRICAL AND PRESSURE CONNECTIONS ARE IN A CONTROLLED STATE (LOCKOUT/TAGOUT) FOR SAFE OPERATION.

9.1.1 Routine Maintenance

ATI actuators have been designed to work for long periods in the harsh conditions with minimal maintenance. As with any mechanical equipment, the service interval is determined by stroke frequency, environmental conditions, and other conditions of use. The customary service interval for routine maintenance is one (1) to five (5) years. More frequent service may be required.

It is advisable to periodically check the actuator as follows:

1. Check that the actuator operates the valve correctly and with the required operating times. If the actuator operation is infrequent, carry out a few opening and closing operations with all existing controls (remote control, local control, emergency controls, etc.), if site conditions allow.
2. Check that the signals to the remote control device are correct.
3. Check that the supply pressure value is within the required range.
4. Oil should be sampled periodically to check for cleanliness and water content. Refer to Section 4.3.6 for recommended contamination thresholds. Filters in the control circuit should be cleaned or replaced regularly. Filters of a sintered cartridge style should be washed with nitrate solvent and purged with pressurized air. Filters made of cellulose must be replaced when clogged.
5. Check that the external components of the actuator are in good conditions. Tighten any loose connections.
6. Check that there are no leaks in the hydraulic connections.
7. In accordance with the applicable protective coating specification(s), repair any protective coating that has been damaged.

9.1.2 Replacing Actuator Seals

Refer to the sketches in “Appendix A – Exploded View of Linear Actuator” and in “Appendix B – Seal Maintenance” for the component references in this section.

If there are leaks in the cylinder or a malfunction in the mechanical components, or in case of scheduled preventive maintenance, the actuator must be disassembled and seals must be replaced.

For large bore cylinders supplied with primary piston seals of the PIP Profile (Polypak) style, note that these seals have a preferred pressure direction. PIP seals are installed on the piston with its preferred direction to support the spring force (for applicable SR applications) or to support the weight of the piston and rod (for DA applications assuming the preferred side is typically the lower chamber to retract the actuator). In DA applications with a PIP



seal that should hold pressure for extended periods in the non-preferred direction, a block valve or holding valve in the control circuit on the non-pressure side of the actuator will slow or eliminate this bleed.

The Standard contents in the ATI Maintenance Seal Kit for linear actuators are listed below. If additional seals are required for a customized design, they will be provided with the ATI Maintenance Seal Kit for the actuator serial number.

Manufacturer's Maintenance Seal Kit

Item # (App. B)	Description	Qty
AA	Head Seal, <i>primary</i>	2
BB	Piston Seal	1
CC	Piston Wear Band	2
DD	Piston Rod Seal	1
EE	Bearing Seal	1
FF	Rod Seal	1
GG	Rod Wear Band	1
HH	Rod Wiper	1

The instruction that follow is applicable for seal replacement in a standard linear hydraulic, double acting (DA) actuator. For other configurations, refer to instructions in IOM1004 or IOM1005—linear hydraulic actuators designed for Spring Return Extend (SRE) or Spring Return Retract (SRR) service.

Inspect the bearing, the piston, the cylinder and all component seal surfaces for damage. Contact ATI for replacement parts, if needed.

Clean all exposed, internal surfaces of all actuator components.

Install new seals and wear band in the bearing (Items EE, FF, GG and HH), and reassemble the bearing and its retainer in the lower head.

Install wear bands on the piston (Items CC) before attempting to install the piston seal (Item BB). It is optional for larger bore sizes to use grease or an adhesive under each end of each wear band to help hold it in position on the piston during installation in the cylinder.

1. Before rigging, ensure the crane/hoist/rigging hardware lifting capacity can safely accommodate the desired load.
2. Thread lifting eyes into upper head.
3. Detach the actuator from valve and place actuator in an upright position on a disassembly platform.
4. Loosen the tie rod nuts in a criss-cross pattern.
5. Remove nuts and lock washers.
6. Lift upper head off of actuator with crane and place on a flat surface.
7. Remove tie-rods from lower head.
8. Thread lifting eye into piston rod. (In some assemblies, this will require removal of a locking bolt from the top of the piston rod, and in some cases this locking bolt may be a Left Hand thread.)
9. Attach lifting straps and extract piston/piston rod assembly from cylinder tube.
10. Place piston/piston rod assembly on a flat surface.
11. Remove wear bands (Items CC) and seal (Item BB) from piston.
12. Attach lifting hardware and rigging straps to cylinder tube. Take extra precaution to avoid scarring the inner diameter of the metal cylinder tube. Lift cylinder vertically and place on a flat surface



13. Remove seal (Item AA) from lower head and from the upper head, and clean the grooves with a light degreaser.
14. Flip lower head upside down.
15. Extract cap screws from lower head and remove bearing retainer and bearing.
16. Remove wiper ring (Item HH), static seal (Item EE), rod seal (Item FF), and wear band (Item GG) from bearing.
17. Clean the bearing with a light degreaser.
18. Lightly grease the new bearing seals (Item EE and FF) and install on bearing.
19. Without grease, install the new wiper ring (Item HH) on the bearing.
20. Insert bearing in the lower head and reinstall the bearing retainer, and flip the lower head.
21. Lightly grease new head seals (Item AA) and install on lower head and on upper head.
22. Remove the piston rod from the piston. Note that thread locking compound is applied to this threaded connection during assembly. As a result, disassembly will require heat to loosen the thread locking compound. To remove the piston rod seal (Item DD), use a torch to apply concentrated heat to the assembly for several minutes to raise temperature at the threaded connection to 550°F (288°C), softening the thread locking compound. Unthread the piston rod while warm, and set aside to cool.
23. After the piston rod has completely cooled, remove piston rod seal (Item DD) and clean the threads on the rod and in the piston.
24. Clean the piston rod seal groove with a light degreaser.
25. Clean the piston seal groove. Lubricate and install a new piston seal (Item BB).
26. Without lubrication, install new wear bands (Item CC). Trim to length if necessary. If desired, use a heavy grease or a small amount of adhesive (e.g. RTV) to hold ends of the band against the piston before re-installing in the cylinder.
27. Reassemble in the reverse order of disassembly. Take care to protect seals during assembly operations, with particular attention to the head seals when installing the cylinder and to the seal at the piston OD and the rod seal in the bearing ID when installing the piston and rod assembly in the cylinder and lower head.

9.1.3 Replacing Accessory Seals

Refer to appropriate component data sheets and original equipment manuals for details on maintenance of accessory components.

9.2 Lubricating Mechanism

For normal duty, a hydraulic actuator is self-lubricated for the life of the Product.

Oil in a hydraulic system performs multiple functions of lubrication, power transmission and corrosion protection. The oil is a vital factor for long-term reliability of the actuator and all system components. The actuator cylinder must be filled completely with a hydraulic fluid that provides inherent corrosion protection to carbon steel materials. This hydraulic fluid should be inspected regularly to ensure that water and other contaminants are properly filtered and to ensure that air remains purged and the cylinder 100% filled with oil.

The following oils are used by ATI for standard working temperature and are suitable for use with the Product:

MANUFACTURER	EXXONMOBIL	CHEVRON	SMITTY'S
TYPE	HUMBLE HYDRAULIC H32	AW32	SUPERS R&O 32
COLOR	AMBER	YELLOW	AMBER
VISCOSITY AT 40°C	31 cST	30.4 cST	30-42 cST
FLASH POINT	206°C / 403°F	220°C / 428°F	200°C / 390°F
POUR POINT	-18°C / 0°F	-25°C / -13°F	-23°C / -10°F



The following oils are used by ATI for cold temperatures and are recommended for use with the Product:

MANUFACTURER	CHEVRON	PHILLIPS66
TYPE	HYDRAULIC OIL 5606A	ARCTIC LOW POUR
COLOR	RED	YELLOW
VISCOSITY AT 40°C	15 cSt	15 cSt
FLASH POINT	82°C / 180°F	103°C / 217°F
POUR POINT	-63°C / -81°F	-60°C / -76°F

Use of other hydraulic fluids may be suitable if proven compatible with seal specification in the actuator. Consult ATI with questions on alternatives.

The use of nitrogen atmospheres is optional. If operating oils of a vegetable-base or other bio-based fluids, operating the system with a nitrogen purge will limit the oxidizing effects of air, and extend the life of the hydraulic fluid and the corrosion protection of the hydraulic fluid system.

9.3 **Parts Ordering**

Every ATI actuator is assigned a unique serial number prior to shipment. In correspondence with ATI or your local ATI Representative, include the serial number from the ATI actuator nameplate. If documentation from the original order is available, include the ATI part number from the ATI Order Acknowledgement or ATI Shipping Documents.

Warning: To ensure compliance to certification requirements, use only genuine ATI replacement parts. Rebuilding an ATI Product with components that are not supplied by ATI may void the Product warranty, void the Product Certification, adversely affect Product performance, and/or cause personal injury and property damage.



10 Disposal

At the end of its functional life, users may carry out recycling or disposal of the Product and its accessories using these instructions as a guide.

1. Any disposal or recycling must be performed according to site requirements and local regulatory requirements.
2. It is the user's responsibility to ensure Product is safely depressurized and that cleaning and disposal of any fluids is performed in accordance to local regulations. In some applications, the Product may have been in contact with caustic gases and fluids, which must be cleaned prior to Product disposal.
3. Product may be dismantled for part sorting. **READ AND FOLLOW THE APPROPRIATE PRODUCT AND ACCESSORY MANUAL(S) BEFORE DISMANTLING. BEWARE OF STORED ENERGY HAZARDS AND OBSERVE ALL WARNING INSTRUCTIONS MARKED ON THE PRODUCT(S) AND IN THE MANUAL(S).**
4. Sort dismantled parts according to their material. A majority of the material in the Product, more than 98% by weight, can be recycled. Forward sorted parts according to local practice for recycling or disposal.

Materials of construction may be noted in order documentation. If a list of materials is not available, the metal components may be sorted by using a magnet to inspect for ferrous content, as follows:

- Carbon steel may be recycled: Majority of material is carbon steel, ~90% by weight. Carbon steels are ferrous and will hold a magnet.
- Stainless steel may be recycled: Some materials, fittings and many fasteners are stainless steel, typically 300 series, which will not hold a magnet. Some piston rods and pins are made of 17-4 stainless, which is magnetic and can be confirmed by referencing order documentation.
- Bronze may be recycled: Bearings are often made of bronze / brass. This material is dark yellow in color with perhaps a green oxide, and it is non-ferrous and will not hold a magnet.
- Aluminum may be recycled: Some special Product constructions many optional accessories contain aluminum components, less dense and lighter in weight than stainless steels, also non-magnetic.
- Plastic may be sorted for recycling or discarded with mixed waste: Optional accessory covers and some position indicators are made of plastic.
- Electronics must be disposed according to local regulations. Optional valve controllers, positioners, transmitters and some other electronic components are manufactured with solder and capacitors that can be harmful if allowed to leach into the environment. Recycling and disposal of electronics must be done according to applicable regulations.
- Soft parts—elastomeric seals, engineered (PTFE) seals and some bearings throughout the assembly—are not recyclable. Soft goods that have been cleaned of caustic fluids may be discarded with mixed waste.

If local requirements disallow sorting for recycling or other disposal, contact ATI about returning Product to the manufacturer for recycling. ATI will only accept devices that have been cleaned of any caustic fluids, and a fee will be charged for labor and handling of the Product.



11 Terms and Conditions/Warranty

Except as otherwise expressly agreed to in writing by an authorized representative of Automation Technology, LLC. (hereinafter "ATI"), the following terms and conditions (these "Terms and Conditions") shall apply to all offers for the purchase or sale of products manufactured or supplied by ATI under brand names including, but not limited to "ATI", "Gevalco", etc.

A. **CONDITIONAL ACCEPTANCE; REJECTION OF PURCHASER TERMS** – All orders and acknowledgements of Purchaser shall constitute only consent to these Terms and Conditions and a representation that Purchaser is solvent. All quotations and offers of sale by ATI are expressly limited to these Terms and Conditions and are subject to written acceptance by ATI. Any such acceptance by ATI is expressly conditioned upon assent of Purchaser to these Terms and Conditions, and ATI hereby expressly objects to and rejects as material alterations to these Terms and Conditions any terms or conditions of Purchaser, whether contained in Purchaser's order, acknowledgement or otherwise, that are different from or in addition to these Terms and Conditions.

B. **PRICES** - ATI quotations are valid for thirty (30) days from date of issuance, unless otherwise stated by ATI in writing, and are subject to withdrawal or change at any time prior to acceptance by ATI. Prices are ex works, in United States Dollars, and firm for thirty (30) days from date of ATI's written acceptance of Purchaser's order and an unconditional authorization for the immediate manufacture based on customer supplied information. If for any reason authorization does not commence within such thirty (30) days, prices in effect at the time of release for manufacture will apply, unless otherwise stated in writing. All sales, use, excise, value-added, import, export and other taxes, duties, customs and the like (collectively "Taxes") are the responsibility of Purchaser and will be added to the price to the extent that ATI pays on Purchaser's behalf or is required by law to pay in connection with the sale. ATI reserves the right to invoice and be paid for any Tax at the time of shipment or any time thereafter. All orders are subject to laws and regulations that are in effect and that become effective prior to delivery. Typographical or clerical errors in quotations, orders and acknowledgements are subject to correction by ATI. Prices do not include installation or any other service, unless so stated expressly in the quotation or ATI's order acknowledgement. Prices include one (1) copy of any applicable manuals. Any additional manuals or other printed materials requested by Purchaser are subject to additional cost, to be quoted at or near the time that such materials are requested by Purchaser.

C. **PAYMENT** - Payment from Purchaser is due within thirty (30) days from date of first invoice, unless otherwise stated on ATI's quotation or order acknowledgement. For international orders, ATI reserves the right to require, before commencing filling the order, security in the form of a letter of credit or the like, in a form and from a bank or guarantor acceptable to ATI. Subject to any applicable usury law that would void or render invalid or unenforceable this sentence, in which case the specified rate will be deemed to be reduced to the maximum allowed by law, simple interest at the rate of 1.5 percent per month will apply to balances unpaid within 30 days from date of first invoice. ATI will invoice upon making available for shipment. ATI reserves the right to payment and Purchaser will be responsible for any cost associated with storage of products or delay in making products available for pickup that occurs at the request of Purchaser.

D. **FORCE MAJEURE** – In no event shall ATI be liable for non-delivery or delay in delivery, or for failure or delay in the performance of any obligation contained herein, that arises directly or indirectly from acts of God, unforeseeable circumstances, acts (including delays or failure to act) of any governmental authority (de jure or de facto), war (declared or undeclared), terrorism, riot, revolution, priorities, fires, floods, weather, strikes, labor disputes, sabotage, epidemics, factory shutdowns or alterations, embargoes, delays or shortages in transportation, delay in obtaining or procuring or inability to obtain or procure labor, materials or manufacturing facilities, delay in obtaining or inability to obtain timely instructions or information from the Purchaser, or any other cause or circumstance of any other kind beyond ATI's reasonable control. The foregoing provision shall apply even though such causes or circumstances may occur after ATI's performance has been delayed for other causes or circumstances.

E. **SHIPPING** – (a) Products are sold ex works. Risk of loss is the responsibility of and title transfers to Purchaser once products are made available at Seller's facility for pickup by Purchaser or its carrier.

(b) Acknowledged ship dates represent the estimated date of availability for pickup, rather than actual shipment or delivery at destination for which Purchaser is responsible. All indicated shipping dates are estimates, based on prompt receipt of all necessary information from Buyer necessary to process the order. ATI will use its best reasonable efforts to make products available for pickup by such dates, but there is no guarantee to do so. Indicated time periods for pickup availability are estimated from the latest to occur of: 1) ATI's acceptance of Purchaser's order, 2) ATI's receipt of valve dimensional information, if applicable, 3) ATI's receipt of Purchaser supplied components required to manufacture or supply the products, if applicable, or 4) ATI's receipt of drawings approved by Purchaser. Products ordered on an "in stock" basis are subject to prior sale to other customers. Acknowledged ship dates are subject to changes caused by additions to or modification of the original order agreed to by both Purchaser and ATI.

(c) Under no circumstances shall ATI have any liability whatsoever for loss of use or for any indirect or consequential damages as a result of delayed delivery.

(d) Purchaser is responsible for payment of carrier and all other shipping costs and for making all arrangements necessary for pickup, transport, export, import and delivery to Purchaser's destination. Without prejudice to any ex works rights of ATI and obligations of Purchaser, Purchaser consents in advance to ATI shipping collect any products that Purchaser fails to pick up, and Purchaser will remain responsible for all associated pickup, transport, export, import and delivery costs, including any unknown to ATI or Purchaser at the time of shipment.

F. **DESIGN** - Due to continuous product development, ATI reserves the right to modify designs, materials and specifications without prior notice.



G. CANCELLATION - Orders acknowledged by ATI are not subject to cancellation or suspension except with the advance written consent of ATI and upon terms which will compensate ATI for and indemnify ATI from and against loss or damage occasioned by such cancellation or suspension, including without limitation for all costs and expenses already incurred or commitments made by ATI in connection with the processing, purchasing, handling, and fabrication of equipment for the order and a reasonable profit thereon. ATI's determination of such termination charges shall be conclusive.

H. INSPECTION - Final inspection and acceptance of products must be made at ATI's facility and shall constitute a waiver by Purchaser of any claim for loss or damage, except for latent defects not reasonably discoverable by such inspection. Purchaser's representative may inspect products during normal business hours and must do so in a manner that does not interfere with ATI operations.

I. ATI WARRANTY; EXCLUSIVE PURCHASER REMEDY – All products manufactured by ATI are warranted against defects in material and workmanship for a period of two (2) years after the date that the products were made available for pickup by Purchaser. ATI's warranty excludes any defects resulting from improper or abnormal shipping, operation or maintenance. Purchaser must immediately, and in no event later than thirty (30) days after becoming aware of a suspected defect, notify ATI in writing of any such suspected defect. Within a reasonable time following ATI's receipt of such notice, investigation and confirmation of a defect, ATI will have the right and the obligation, in its sole discretion, to repair at no cost to Purchaser such defect or replace the defective product or component thereof with a non-defective product or component thereof. Repair or component replacement by non-ATI authorized agents WILL VOID all remaining warranty on the product. Products purchased by ATI from a third party for resale to Buyer ("Resale Products") shall carry only the warranty extended by the original manufacturer. ATI's repair or replacement obligations under this Paragraph I do not extend to any labor or other loss or damage occasioned by, incidental to, or in consequence of any such defect. Purchaser's sole and exclusive remedy and ATI's obligation and liability for breach of warranty are expressly limited to such repair or replacement. Goods repaired or replaced during the warranty period shall be in warranty for the remainder of the original warranty or ninety (90) days, whichever is longer. All other remedies of Purchaser are hereby expressly excluded. THE WARRANTY CONTAINED IN THIS PARAGRAPH I IS THE SOLE AND EXCLUSIVE WARRANTY PROVIDED BY ATI WITH RESPECT TO ITS PRODUCTS AND SUPERSEDES AND IS IN LIEU OF ANY AND ALL OTHER WARRANTIES, WHETHER EXPRESS, IMPLIED, STATUTORY OR OTHERWISE, INCLUDING WITHOUT LIMITATION ANY IMPLIED WARRANTY OF MERCHANTABILITY OR FITNESS FOR PARTICULAR PURPOSE, ALL OF WHICH ARE HEREBY EXPRESSLY DISCLAIMED. Purchaser acknowledges and agrees that ATI Manuals, printed materials and any other documentation do not constitute warranties of any kind, including with respect to quality or performance. Purchaser is expected to determine the suitability of ATI products for ordinary and Purchaser's particular purposes.

J. EXCLUSION OF CONSEQUENTIAL DAMAGES; LIMITATION OF DIRECT DAMAGES - ATI shall not be liable for and Purchaser shall have no right to recover from ATI for any indirect, special or consequential damages, even if ATI has actual notice of any special circumstances from which any such damages might arise. Moreover, subject to Paragraph I which would completely bar any such recovery of direct damages if ATI honors its warranty, in no event shall any recovery of direct damages against ATI exceed the amount of the order price attributable to the portion of the product or products that is determined to have caused any alleged loss, damage or injury that is compensable under these Terms and Conditions and not remedied by ATI.

K. RETURNS – No product may be returned for credit or adjustment without written permission and tagging instruction from ATI. Upon receipt of approved returns, any handling/restocking charges and/or cost to recondition for resale, will be the responsibility of Purchaser.

L. GOVERNING LAW; VENUE AND JURISDICTION - All sales of products by ATI and any disputes arising out of or related to such sales or products or these Terms and Conditions shall be governed by, and these Terms and Conditions shall be construed in accordance with, the laws of the State of Texas, without regard to its conflicts of law principles that would apply the law of another jurisdiction. The United Nations Convention on Contracts for the International Sale of Goods is expressly disclaimed by and excluded from these Terms and Conditions. ATI's offer of sale may only be accepted in Harris County, Texas and any resulting contract is performable in whole or in part in Harris County, Texas. Venue for any litigation arising out of such sale, products or contract shall be proper in the state or federal district courts of Houston, Harris County, Texas, U.S.A., to the exclusive jurisdictions of which Purchaser hereby expressly submits.

M. NON-WAIVER – Any waiver by ATI of any breach of any of these Terms and Conditions must be set forth in a writing signed by an authorized representative of ATI and shall not constitute a waiver of or otherwise prejudice ATI's right to demand strict performance of any other term or condition of these Terms and Conditions.

N. REMEDIES CUMULATIVE – ATI's remedies pursuant to these Terms and Conditions and applicable law are cumulative in nature and election or pursuit of any such remedy shall not prohibit ATI from electing or pursuing any other such remedy.

O. SEVERABILITY – In the event that any provision or portion of any provision of these Terms and Conditions is held void, invalid or unenforceable, such void, invalid or unenforceable provision or portion thereof shall be deemed severed from these Terms and Conditions, and the balance of these Terms and Conditions shall remain in full force and effect.

P. EXPORT / IMPORT - Buyer agrees that all applicable import and export control laws, regulations, orders, and requirements, including without limitations those of the United States will apply to the receipt and use of the Goods and Services provided by ATI. In no event shall Buyer use, transfer, release, import, export, re-export Goods in violation of such applicable laws, regulations, orders, or requirements.

Q. BUYER SUPPLIED DATA – To the extent that Seller has relied upon any specification, information, representation of operating conditions or other data or information supplied by Buyer to ATI, in the selection, or design of the Goods and the preparation of ATI's quotation, and in the event that actual operating conditions or other data differ from those represented by Buyer and relied on by ATI, any warranties or other provisions contained herein are null and void. To the degree such data errors cause re-design or re-manufacture of the Goods, Buyer shall be responsible for additional costs incurred by ATI.

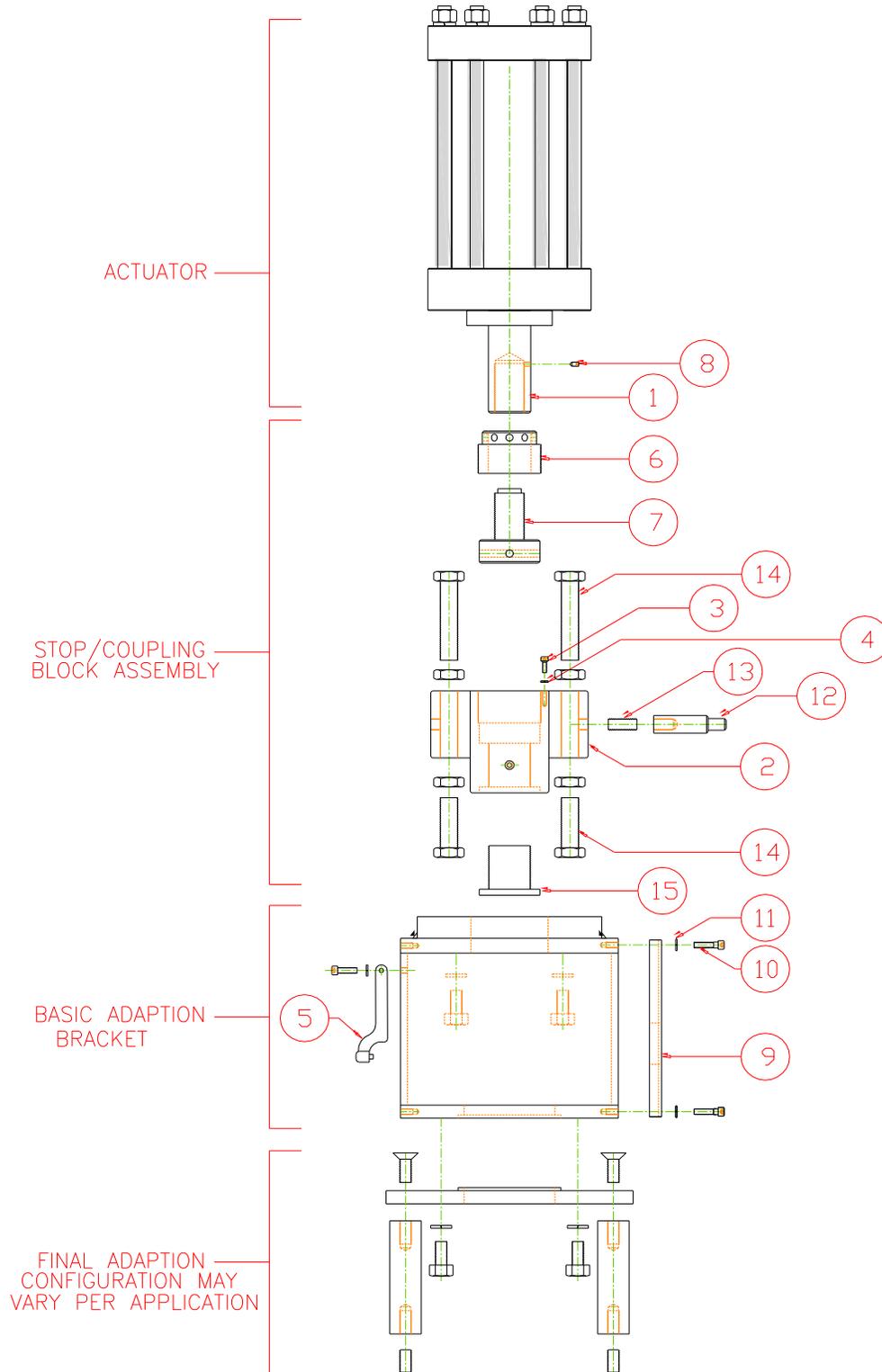


12 Revision Record

Refer to the NON-WARRANTY CLAUSE in section 4.3.13.

Rev #	Issue Date	Description	Reviewed	Approved
IR	12/28/2010	Initial Release	A. Ali	S. Michalcik
A	2/27/2012	Update Terms and Conditions	A. Ali	S. Michalcik
B	8/04/2014	Update Section 1.4 Receiving/Lifting to recommend the use of hoist rings for the lifting of DA and SRR actuators (ECN# 741)	D. Rojas	J. Pollard
C	5/25/2017	Format and editorial update to all sections to align with IOM 1001-1003 and 1025.	J. Pollard	D. Leese

APPENDIX A – EXPLODED VIEW OF LINEAR ACTUATOR



APPENDIX B – SEAL MAINTENANCE

Adapted from Drawing 28867

