



INSTALLATION, OPERATION & MAINTENANCE MANUAL IOM1024

GAS MOTORS (GM) AND GAS MOTOR ACTUATORS





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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 Gas Motor (GM) and its use in rotary and linear Gas Motor Actuators. 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/>

ATI Global Headquarters – Customer Support, Design & Manufacturing
Houston, Texas, USA
Phone: +1 713 934-0171
US Toll Free: 800-924-8037

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.

- IOMS 004 Fastener Torque Guide
- IOMS 013 Muffler / Mist Extractor



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 Torque: the maximum allowable torque, as specified by the valve manufacturer, which 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 torque.
MAWP	Maximum Allowable Working Pressure: the maximum design pressure for the Product and the maximum pressure allowed at full stroke.
pneumatic actuator	A pneumatic actuator uses compressed gas as the power medium to produce mechanical motion.
Product	Multi-turn Gas Motor (GM). “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 valve applications, stroke is often described in percentage terms—full closed is 0%, full open is 100%.
TC2	ATI model designation for the mechanical control pressure pilots on the Product.

4 Product Description

4.1 General Description & Typical Applications

ATI Gas Motors utilize pipeline gas to power an ATI multi-turn gas motor that, when coupled to a gear operator, will actuate a rotary valve (part-turn, quarter-turn or 360°) or a linear, rising-stem valve. Pressurized gas up to 1500 psig is used to power a roller-bearing gear motor that is connected to spur gear train with a sufficient gear ratio to generate enough torque from the Gas Motor to replace a hand wheel, with enough power to close a 36” valve in 2 minutes or less.

ATI Gas Motors are direct coupled to the input shaft (hand wheel shaft) of a valve’s gear operator, allowing for remote operation of a valve that would otherwise be driven manually with a hand wheel operator. The actuator is suitable for any part-turn valve application or for any rising-stem valve application, when coupled with suitable gearing for the valve stem. The actuator is suitable for both on-off service and positioning service.

The actuator stroke is adjustable up to 1800 turns by means of mechanical cams that limit the number of turns required by the hand wheel shaft of the selected valve operator.

The housing of the gas motor actuator has a flange with threaded holes that mount directly to the valve operator flange. The Gas Motor may also mount to an adapter flange that is bolted or welded to the selected valve operator.

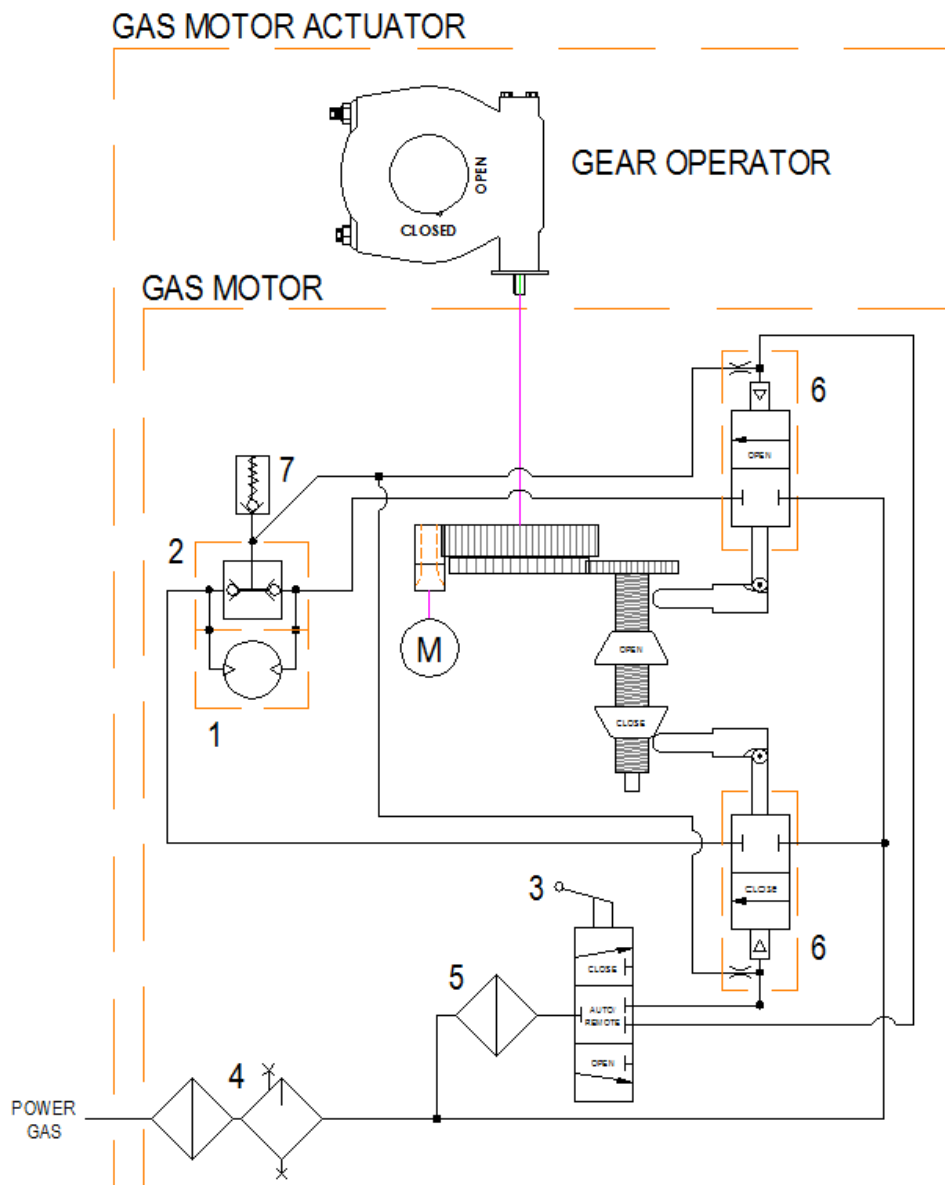
The Gas Motor has a bore and keyway machined according to the shape and dimensions of the hand wheel shaft. A stem coupling is provided, when necessary, with made-to-order hardware to transition the hand wheel shaft to the bore of the gas motor.

The actuator has an external shaft for manual operation by wrench or by hand wheel. For the standard construction Gas motor, the external shaft is covered for safety and the hand wheel is customer supplied.

The actuator is typically supplied with local/manual control using pipeline gas as the media for operation without the use of any regulating device. ATI can supply a range of control systems to meet customer's requirements.

4.2 Theory of Product Operation

Parenthetical references in subsections 4.2.1 through 4.2.4 are based on the drawing below—a piping and instrumentation diagram for the basic Gas Motor and Gas Motor Actuator. Refer to Appendix B and drawing 31059 for common options that are available with the Gas Motor.



The ATI Gas Motor is a high-pressure pneumatic multi-turn device powered by line gas or stored gas at pressures up to 1500 psig. The power gas enters the Gas Motor through a filter and lubricator (Item 4) that screens larger debris from the pipeline and to provide lubrication to dry gas that will pass across seals and moving parts of the motor. When not in operation, the power gas is isolated by the selector valve (Item 3) and the limit/pilot valves (Items 6).



The selector valve (Item 3) is connected to the power gas line through an additional filter (Item 5) to screen fine particles out of the pilot lines. When the selector valve is positioned to Open or Close, line pressure is fed to the piston of a limit/pilot valve, opening that valve and allowing power gas to the shuttle valve (Item 2) and motor (Item 1). The shuttle valve directs high-pressure gas flow to one port of the motor, and the shuttle valve diverts exhaust gas from the motor to its exhaust port. A check valve (Item 7) is mounted to the exhaust port of the shuttle valve to ensure that air does not mix with gas in the shuttle or motor cavities, and the check valve protects the motor from frozen precipitation that might otherwise collect in the exhaust cavities. Gas exhausts to atmosphere. When the actuator reaches each end of travel, a cam engages the plunger of the limit/pilot valve (Item 6) to mechanically shut off gas flow through that limit/pilot valve, which stops gas flow to the motor; the cams do not stop pilot signals from bleeding gas to the shuttle exhaust valve. After the Gas Motor Actuator has reached its intended position, the selector valve is shifted back to the center position, shutting the pilot signal, which bleeds to the exhaust shuttle assembly, at which time all power gas flow through the Gas Motor will stop.

The Gas Motor is designed to match the approximate torque of a human-powered manual hand wheel. When coupled to the input shaft of a gear operator, the Gas Motor allows for gas-powered operation of the manual gear. To avoid excessive loads on the valve, the Gas Motor includes travel limit cams that stop gas flow to the motor at end-of-travel open and closed limit/pilot valves (Items 6). Cam nuts are set to limit the number of turns of the input shaft; the cam settings have nothing to do with torque output of the motor. Output torque is a function of the gas pressure to the Gas Motor and the gear ratio in the Gas Motor (6:1 standard, 10:1 and 15:1 available as options).

When an ATI Gas Motor is coupled to a suitable gear operator, the assembly is a Gas Motor Actuator that is capable of operating part-turn, quarter-turn, 360°-turn, and rising-stem valves. To configure a Gas Motor Actuator assembly, select a gear operator for its mechanical advantage that, when matched to the available torque from the ATI Gas Motor at available supply gas pressure, achieves the necessary minimum torque/thrust at *minimum* supply pressure without exceeding MAST at *maximum* supply pressure. For cases where MAST at maximum supply pressure is a concern, contact ATI about options for pressure relief in the Gas Motor TC2 controls that will limit the MAOP to power the motor during each stroke.

4.2.1 Pneumatic Operation

The Gas Motor, rated for maximum pressure of 1500psig, uses high-pressure gas for all pneumatic operations by means of a 3-position selector valve (Item 3, positions are Close, Auto, and Open) through two (2) 2-way normally closed limit/pilot valves (Items 6) that control gas to the motor. Power gas enters the actuator through a filter/strainer and lubricator assembly (Item 4). The selector valve (Item 3) pilots either the close limit/pilot or the open limit/pilot to deliver gas to the motor through a high flow shuttle valve (Item 2). When the actuator reaches each end of travel, a cam engages the plunger of the limit/pilot valve to mechanically shut off all gas flow through one limit/pilot valve, preventing further motion in that direction.

The selector valve must be in the “Auto” position for any automatic or remote operation.

4.2.2 Pneumatic Operation – Opening

Turn the selector valve (Item 3) to the “Open” position and return to “Auto” when complete.

4.2.3 Pneumatic Operation – Closing

Turn the selector valve (Item 3) to the “Close” position and return to “Auto” when complete.

4.2.4 Manual Operation

Remove the external shaft cover. Using a wrench or hand wheel, rotate external shaft clockwise or counter clockwise depending on the desired closing or opening operation.

Caution: The external shaft for manual operation rotates during any power operation. A standard hand wheel shaft cover is provided for safety during normal operation.

4.3 Product Specifications

4.3.1 Operating Pressure	<p>The working pressure range for a standard ATI Gas Motor is as follows:</p> <p>MINIMUM: *400 psig (27.6 bar) MAXIMUM (MAWP): 1500 psig (103 bar)</p> <p>* <i>The Gas Motor will turn at lower pressures, but may not produce enough torque for its application.</i></p>				
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="646 491 1386 590"> <tr> <th>Seal Material</th><th>Operating Temperature*</th></tr> <tr> <td>FKM (Viton)</td><td>-20°F to +400°F (-29°C to +204°C)</td></tr> </table> <p><i>Standard FKM seal materials may be used in supply gas or nitrogen service. Low-temp Viton, Nitrile or Fluorosilicone are available in special constructions.</i></p> <p>Ambient Temperature recommendation</p> <p>MINIMUM: -17°F (-27°C) <i>Recommended MINIMUM Ambient Temperature assures good flow of standard lubricator oils. Cycling the motor in ambient temperatures slightly lower than -17°F will not damage the motor. If motor is to be frequently cycled at temperatures below -17°F, then a low temp lubricator oil should be used, or ethylene glycol may be added to the lubricator.</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 recommended to maximum ambient environmental temperature up to 85% of the lower value of Seal maximum operating temperature and Lubricator flash point [e.g. seal MAX = +400 °F(+204 °C) and lubricator FLASH POINT = +345 °F(+174°C), ∴ MAX Ambient = +293 °F (+ 145°C).</i></p> <p>Consult ATI for alternate seal constructions for special applications.</p>	Seal Material	Operating Temperature*	FKM (Viton)	-20°F to +400°F (-29°C to +204°C)
Seal Material	Operating Temperature*				
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4.3.3 Fluid Type	<p>The Product is designed and constructed for operation in high-pressure gas systems using natural gas or nitrogen power gas fluids. Consult ATI for operation with other gases.</p> <p>Refer to section 8.1 for more information.</p>				
4.3.4 Duty Cycle & Cycle Speed	<p>The Product is capable of intermittent duty when operated within recommended temperature limits with properly filtered fluid.</p> <p>Speed is not adjustable. Product speed is a function of the power gear ratio, which is fixed for each actuator and not adjustable. Throttling the flow rate of the gas to the motor may result in loss of output torque.</p>				



4.3.5	Service Life	<p>ATI Gas Motors can be operated for many years with no maintenance other than occasional refilling of the Oil Lubricator. Gas Motors operated regularly require more frequent inspections to keep the lubricator topped off with appropriate oil; refer to Sections 7.2 and 9.2.1. 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 ATI Products have been extended to 20 years and longer.</p>																								
4.3.6	Lubrication	<p>The Oil Lubricator must be filled during normal operation of the gas motor; the lubricator should be inspected at least one time per year and topped off as needed. High-duty applications may require more frequent inspection intervals. Power gearing and timing gears are also coated or packed with grease that should be periodically inspected and maintained.</p> <p>Refer to Sections 7.2 and 9.2.1 for additional information.</p>																								
4.3.7	Lifting Point Load Ratings	<p>Gas Motors are provided with a lifting eye for lifting the actuator.</p> <p>Load Rating: 700 lbf (3.4 kN)</p>																								
4.3.8	Travel / No of Turns	<p>The travel of a Gas Motor is defined by the number of turns allowed by the timing gears. The maximum range of turns must be specified at order placement. Typical limits for adjustment of turns are as follows:</p> <table><tr><th>Timing Gears TURNS (ratio)</th><th>Number of Turns Typical* MINIMUM</th><th>Number of Turns Typical* MAXIMUM</th><th>Gas Motor Turns per Inch of Cam Nut Travel</th></tr><tr><td>135 (3:1)</td><td>10</td><td>144</td><td>36</td></tr><tr><td>330 (7.5:1)</td><td>30</td><td>360</td><td>90</td></tr><tr><td>690 (15:1)</td><td>75</td><td>720</td><td>180</td></tr><tr><td>1390 (30:1)</td><td>150</td><td>1440</td><td>360</td></tr><tr><td>1800 (30:1)</td><td>390</td><td>1920</td><td>480</td></tr></table> <p>* The actual minimum and maximum number of turns will vary with tolerance stack up for parts throughout the timing gear and pilot valve assemblies, the load on the actuator near the trip point, and the available supply pressure to the gas motor.</p> <p>Consult ATI for applications requiring fewer turns or more turns.</p>	Timing Gears TURNS (ratio)	Number of Turns Typical* MINIMUM	Number of Turns Typical* MAXIMUM	Gas Motor Turns per Inch of Cam Nut Travel	135 (3:1)	10	144	36	330 (7.5:1)	30	360	90	690 (15:1)	75	720	180	1390 (30:1)	150	1440	360	1800 (30:1)	390	1920	480
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4.3.9	Output Torque	<p>The ATI Gas Motor operates most efficiently at full speed (near 250 rpm) and may reach MAX Torque listed in the table below. At slow speeds which can occur at motor start, near motor stall, or in applications near MINIMUM turns for the timing gears, full speed and maximum efficiency is not reached, and output torque will be nearer the MIN Torque listed below.</p> <p>Gas Motor Output Torque, 6:1 power gear ratio</p> <table><tr><th>Supply Pressure psig (bar)</th><th>MIN Torque ft-lbf (Nm)</th><th>MAX Torque ft-lbf (Nm)</th></tr><tr><td>400 (28)</td><td>72 (98)</td><td>85 (115)</td></tr><tr><td>500 (34)</td><td>93 (126)</td><td>110 (149)</td></tr><tr><td>600 (41)</td><td>110 (149)</td><td>130 (176)</td></tr><tr><td>700 (48)</td><td>131 (178)</td><td>155 (210)</td></tr><tr><td>800 (55)</td><td>148 (201)</td><td>175 (237)</td></tr><tr><td>900 (62)</td><td>170 (230)</td><td>200 (271)</td></tr><tr><td>1000 (69)</td><td>187 (254)</td><td>220 (298)</td></tr><tr><td>1100 (76)</td><td>208 (282)</td><td>245 (332)</td></tr><tr><td>1200 (83)</td><td>225 (305)</td><td>265 (359)</td></tr><tr><td>1300 (90)</td><td>246 (334)</td><td>290 (393)</td></tr><tr><td>1400 (97)</td><td>263 (357)</td><td>310 (420)</td></tr><tr><td>1500 (103)</td><td>284 (385)</td><td>335 (454)</td></tr></table> <p>Consult ATI for special constructions with other power gear ratios.</p>	Supply Pressure psig (bar)	MIN Torque ft-lbf (Nm)	MAX Torque ft-lbf (Nm)	400 (28)	72 (98)	85 (115)	500 (34)	93 (126)	110 (149)	600 (41)	110 (149)	130 (176)	700 (48)	131 (178)	155 (210)	800 (55)	148 (201)	175 (237)	900 (62)	170 (230)	200 (271)	1000 (69)	187 (254)	220 (298)	1100 (76)	208 (282)	245 (332)	1200 (83)	225 (305)	265 (359)	1300 (90)	246 (334)	290 (393)	1400 (97)	263 (357)	310 (420)	1500 (103)	284 (385)	335 (454)
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4.3.10	Pressure Connections	<p>Each motor is fitted with one (1) power gas supply port: 1/2 NPT</p> <p>The gas motor exhaust does not require a connection. The exhaust is fitted with 1" NPT female threads to pipe away the exhaust gas. Note that back pressure on the exhaust line may result in performance problems with the motor.</p>																																							
4.3.11	Bolt Torque	<p>Refer to order documentation for special bolt tension requirements. The standard flange for the Gas Motor is made of aluminum grade 6061-T6, and for this flange connection, it is recommended to follow guidelines for tensioning bolted connections per IOMS004 (Table 2) for stainless steel bolts.</p>																																							
4.3.12	Protective Coating	<p>The ATI standard protective coating includes a primer coat and a top coat. The top coat is an aliphatic polyurethane paint.</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>
4.3.14 Optional Certifications	<p>When Certification is specified as an order requirement, ATI will manufacture using materials and specific design criteria.</p>

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.

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 pneumatic system operation and use appropriate personal protection equipment (PPE) to avoid injury from pressure discharge.

Discharge any pressure in the pneumatic system before attempting to remove or repair the actuator or any component of the control system. In particular, ensure that pressure in the lubricator is discharged before attempting any maintenance on a Gas Motor or Gas Motor Actuator.

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.

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. Best practice requires that the actuators be sized so that thrust at maximum pressure does not exceed MAST. For some applications, users may need to manage pressure to an application-specific MAOP (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 MAOP and MAWP as compared to the safe MAST value for connected equipment, and the user is responsible for ensuring that supply pressure is regulated, with pressure 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

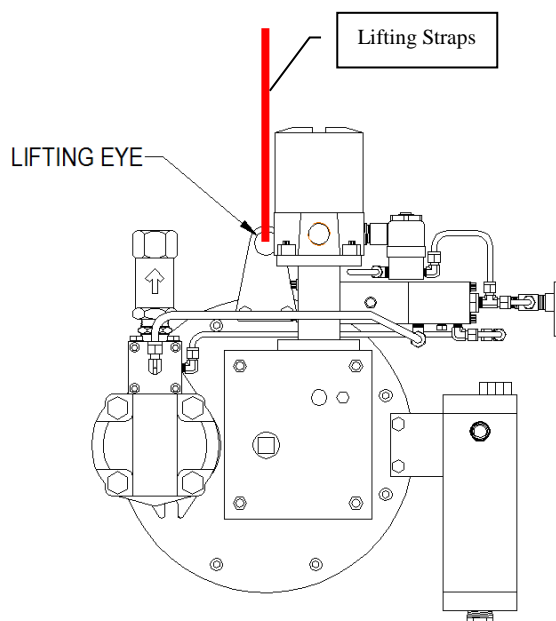
During normal operation of an ATI Gas Motor, all power gas exhausts from the top of the motor at the shuttle exhaust port or through the option Muffler / Mist Extractor. If operated with a combustible line gas, this exhaust may fuel ignition. It is the user's responsibility to define the hazard area, to control all ignition sources, and to pipe away the exhaust if necessary.

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, if wrapping in plastic, ensure that the wrap can breathe, so that it does not trap moisture during extended storage.
- A lifting eye is included with all standard construction. Refer to Section 4.3.7.



- 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.



- 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 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.
- 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 lubricator cannot be filled with oil during storage, it is recommended to use inert, dry gas (such as nitrogen) to purge all oxygen from the motor before sealing with metal plugs.
- It is recommended that the actuator be periodically operated with a lubricated gas at least three (3) cycles every 6 months for covered storage and at least three (3) cycles every 3 months for unprotected outdoor storage. After such operations, carefully plug all the threaded connections of the actuator and controls.

7 Installation Instructions

7.1 Assembly to Valve Operator

The Gas Motor can be assembled onto a gear operator either using the operator's motor flange adapter or using a customized adapter flange or spool piece made by ATI. The drive sleeve of the Gas Motor is connected to the input shaft of the gear operator either directly or with a stem extension made by ATI.

The gear operator is mounted directly to the valve stem and valve topworks. Follow instructions of the gear-operator supplier when installing the gear to the valve.

To assemble the motor onto the gear operator, proceed as follows:

1. Check that the coupling dimensions for the flange and shaft at the input of the gear operator, or of the relevant adapter or shaft extension, meet the actuator coupling dimensions.
2. Lubricate the shafts and couplings with oil or grease in order to make the assembly easier. If an insert bushing or stem extension is supplied separately, assemble it onto the operator shaft.
3. Connect a sling to the support point of the actuator and lift it: make sure the sling is suitable for the actuator weight.
4. Clean the flanges and remove anything that might prevent a tight fit between the Gas Motor and the gear operator. Torque is transmitted through this connection by friction, so remove any trace of grease that might cause this connection to slip in service.
5. Fit the Gas Motor to the gear operator in such a way that the operator shaft enters the Gas Motor drive sleeve. This coupling must take place without excessive force. After the shaft has entered the Gas Motor drive sleeve, check the holes of the flange. If the holes do not align, the drive sleeve must be rotated; using a wrench, actuate the manual override shaft of the Gas Motor until holes are properly positioned.
6. Operate the Gas Motor Actuator to check that it moves the valve smoothly.

7.2 Filling the Lubricator

Each Gas Motor includes a pneumatic lubricator. As high-pressure gas passes through the lubricator, an aerosolized stream of oil is injected into the supply gas line to provide lubrication to internal working parts of the Gas Motor. The lubricant will extend the operational life and improve performance of the Gas Motor by reducing wear on moving parts, in particular by limiting abrasion and twisting of resilient seals.

THE LUBRICATOR MUST BE DEPRESSURIZED BEFORE FILLING OR REFILLING. To do so:

1. Isolate the Gas Motor from the supply gas line.
2. Vent the system by cycling the manual open/closed selector valve until all gas is discharged. Alternatively, if a purge valve has been included in the schematic for the Gas Motor, open the purge valve to depressurize the lubricator.
3. Unscrew the cap on top of the lubricator and fill with a recommended oil. Refer to Section 9.2.1.
4. Replace the lubricator cap, close any purge valve that was opened, and reconnect supply gas.

7.3 Setting the Stroke Limit Cams

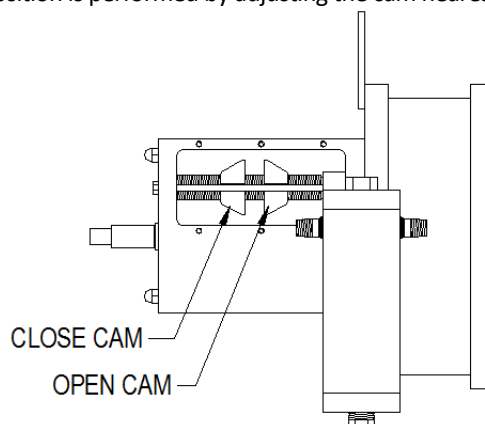
See layout and bill of material GM-6-7 in Appendix C and T-0312 TC2 layout in Appendix D, or the general layout sketch in Appendix E.

It is important that the mechanical stops of the actuator (and not those of the valve) stop the actuator at both ends of travel (fully open and fully closed).

- If the Gas Motor stops before reaching the end position (fully open or closed); the cam (12) must be rotated toward the middle of the cam shaft (toward the opposite limit/pilot valve stem, item 29).
- If the Gas Motor travels past the desired end position (fully open or closed), the cam (12) must be rotated away from the middle of the cam shaft (toward the limit/pilot valve to be set).

The setting of the open valve position is performed by adjusting the cam nearest to the timing gear set (the flange of the Gas Motor).

The setting of the closed valve position is performed by adjusting the cam nearest to the end of the Gas Motor.



To adjust a cam, proceed as follows:

1. Remove the timing box cover plate (9).
2. Loosen and remove the cam locking pin (18).
3. Adjust the cam (12) an appropriate number of turns or partials turns on the cam shaft (10).

Service Note: Cams are difficult to turn if they have been driven into the stems of the pilot valve. Rotate the motor in the opposite direction to separate the cam and stem, then adjust the cam.



4. Re-install and tighten the cam locking pin (18) and operate the motor to confirm cam settings are appropriate. If further adjustment is required, repeat the cam adjustment from step 2.

Service Note: The cam is generally set when gas flow is stopped with no more than two (2) turns of the hand wheel before reaching the valve stops.

5. Add grease to the timing box if necessary (see Section 9.2.2), and replace the timing box cover plate (9).

7.4 Setting the Stroke Time

Stroke time is not adjustable. The operating speed of the Gas Motor is fixed by the motor and gear ratio at time of order. Total time of operations is determined by the number of turns required to reach end of stroke.

8 Preparation for Start-up

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

8.1 Pneumatic Connections

Connect the supply and exhaust lines to the actuator and controls using fittings and/or pipes in accordance to site specifications and any special instructions in order documentation. Connections must be sized appropriately to ensure necessary flow rate of power gas to the actuator. Generally, long lengths of supply line piping (greater than 6 feet) should be 1" pipe or larger. 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 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.

After 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 pneumatic connections. **Cycle test the actuator to full close and full open positions and ensure that gas flow shuts off completely when the motor is stopped.** If gas flow does not shut off, check that cams were correctly adjusted in Section 7.3; the limit/pilot valve may bleed continuously if the motor is allowed to stall against valve stops before the cams fully cut off flow to the limit/pilot valve.

8.2 Electrical Connections

The basic Gas Motor Actuator does not have electrical connections, but common, 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 closes/opens/fails in place, as appropriate, upon loss of supply pressure or loss of control signal.

8.3 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 flow rate of the power gas supply 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 pneumatic connections.
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 Gas Motor Gas Motors (GM) and Gas Motor Actuators, 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.

9.2 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. Check the filter and the strainer in the motor control circuit. Refer to the schematic for the order for details. Each motor typically has a Y-strainer at the supply port at the lubricator to screen large debris from the power gas supply line, and each motor has a 15-micron filter just downstream of the lubricator. If line gas is clean, the



motor will operate for extended periods without a need to clean filters. If supply gas is not clean, these filters/strainers 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 the lubricator and fill with oil as necessary.** Refer to section 9.2.1 for more information.
6. If the Gas Motor includes an optional Muffler / Mist Extractor, the device should be inspected and drained each time the lubricator is checked. Refer to IOMS013 for more details.
7. Check that the external components of the actuator are in good condition. Tighten any loose connections.
8. Check that there are no leaks in the pneumatic connections.
9. In accordance with the applicable protective coating specification(s), repair any protective coating that has been damaged.

9.2.1 Supply Gas Lubricator Maintenance

Refer to diagram GM-HPWS in Appendix E.

An automatic lubricator is included to provide approximately 1 drop of oil for every 40-80 scfm of gas used by the motor (about 20 turns of the Gas Motor at supply gas pressure around 1,000 psig). Proper lubrication ensures that seals throughout the limit/pilot valves remain lubricated and that bearings inside the motor remain lubricated so that the motor turns efficiently. If operated dry, without lubrication, actuator output torque will be reduced.

During the actuator operation the lubricator must be closed (fully pressurized, no relief to atmosphere).

To inspect the lubricator for oil or to fill the lubricator:

1. Isolate and exhaust any power gas from the actuator.
2. Unscrew the fill plug/dipstick.
3. Check that the oil level in the lubricator is in correspondence to the top of the dipstick. Refill if necessary.
4. Screw and tighten the fill plug.

The oil selected for use must be thin enough to atomize in the lubricator. Oils that meet this criteria generally have a viscosity near 32 cSt at 100°F (40°C). For operation in continuous cold conditions, lighter viscosity fluids should be considered to ensure atomization is consistent in cold operation.

The following oils are available through ATI for lubrication of Gas Motors:

MANUFACTURER	EXXONMOBIL	MOBIL
TYPE	VELOCITE OIL NO. 10	UFS AP 0W-20
VISCOSITY @40°C	22 cSt	45 cSt
FLASH POINT	345 °F / 174 °C	468 °F / 242 °C
POUR POINT	-17 °F / -27 °C	-60 °F / -51 °C
ATI PART NUMBER	LUB-V10-QT	LUB-UFS-QT



These additional oils are also suitable for lubrication of the Gas Motor:

MANUFACTURER	GULF WESTERN	MOBIL	EXXONMOBIL
TYPE	AIR TOOL OIL	DTE 24	TERESSTIC 32
VISCOSITY @40°C	32 cSt	31.5 cSt	32 cSt
FLASH POINT	224 °F / 107 °C	428 °F / 220 °C	222 °F / 106 °C
POUR POINT	-17 °F / -27 °C	-17 °F / -27 °C	-22 °F / -30 °C
MANUFACTURER	SHELL	CHEVRON	AMSOIL
TYPE	TURBO T32	GST OIL NO. 32	AWH ISO 32
VISCOSITY @40°C	32 cSt	32 cSt	33 cSt
FLASH POINT	419 °F / 215 °C	222 °F / 106 °C	442 °F / 228 °C
POUR POINT	-27 °F / -33 °C	-33 °F / -36 °C	-51 °F / -60 °C

For special conditions, consult with ATI for alternative lubricating oils. Note that bio oils containing esters are a popular choice for compressor lubrication, but these oils have not been tested in the gas motor.

9.2.2 Gear Lubrication

For normal duty, the gear mechanism of the gas motor actuator is lubricated for the life of the actuator.

In case of high load and high frequency of operation, in the case that contaminants are introduced to the Gas Motor, or in the case that the Gas Motor is making excessive noise, it may be necessary to restore the lubrication. If replacing grease, ensure that supply gas is safely locked out so the motor will not turn unexpectedly, then remove any contaminated grease and dispose according to local regulations. Solvent clean parts if necessary. Apply a generous coating of grease on the contact surfaces of the power gearing and timing gears, in particular to gear teeth and to the threads of the cam shaft. The gear housing and timing box for the motor will hold about 3 pounds of grease.

The following grease is used by ATI for standard working temperature and suggested re lubrication:

MANUFACTURER	JET LUBE
TYPE	ACTUATOR GREASE
COLOR	BEIGE / AMBER
VISCOSITY @40°C	68 cSt
FLASH POINT	507 °F / 264 °C
DROP POINT	536 °F / 280 °C
RECOMMENDED TEMPERATURE	-40°F TO +350°F -40°C TO +177°C

For special conditions, consult with ATI for alternative lubricating greases.

Refer to section 9.2.1 for details on the lubrication of for supply gas.



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.

Common items for Gas Motor maintenance

Item Description	ATI P/N	Quantity
Lubricator oil , Ultimate Full Synthetic, -60°F to +400°F, 1 quart bottle	LUB-UFS-QT	1 quart bottle will fill 1 Gas Motor lubricator 1 time
Lubricator oil , Velocite № 10, -17°F to +300°F, 1 quart bottle	LUB-V10-QT	1 quart bottle will fill 1 Gas Motor lubricator 1 time
Check Valve , TC2 Pilot	XCKB20401	1 valve per TC2, 2 check valves for 2 TC2 repairs in 1 Gas Motor
Crush Washer , TC2 Pilot	XZTCB10908	1 washer per TC2, 2 washers for 2 TC2 repairs in 1 Gas Motor
Seal Kit , TC2 Pilot Valve	SK-TC2V-28165	1 kit per valve, 2 kits for 2 valves in standard Gas Motor controls
Seal Kit , Shuttle Valve Assembly	SK-GMSV-30803	1 kit per shuttle valve, 1 shuttle valve per Gas Motor
TC2-HPW Repair Kit , includes seal kits, check valve and crush washer listed above for 2 TC2 pilots and 1 shuttle valve in 1 Gas Motor	X4TCG10400	1 kit per Gas Motor



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. 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 90% 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 visually and by using a magnet to inspect for ferrous content, as follows:

- Aluminum may be recycled: Majority of material in the Product housing is aluminum, and many optional accessories contain aluminum components. Aluminum is less dense, non-magnetic and lighter in weight than other metals used in the Product.
- Carbon steel may be recycled: Product gears and shafts are carbon steel. 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 rods and pins are made of 17-4 stainless, which is magnetic.
- Copper and bronze may be recycled: Bearings are made of bronze / brass, and bearing shims in the timing gear assembly are made of copper sheet. This material is dark yellow in color with perhaps a green oxide, and it is non-ferrous and will not hold a magnet.
- 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	2/01/2010	Initial Release, Gevalco	T. Hale	T. Hale
B	5/29/2015	Update to ATI standard	D. Rojas	D. Leese
C	8/14/2017	Updated address and phone number.	K. Matetzschk	W. Turner
D	6/12/2018	Update format to align with IOM1003 and others, update information on lubricator oils, grease, and operating temperature. Add Appendix A product configurator, update drawing in App. B. Add option for low temp LUB-UFS-QT.	G. Buley, D. Rojas	D. Leese



APPENDIX A – GAS MOTOR PRODUCT CONFIGURATOR

Base Mode		
GM	Gas Motor	
	Ratio	
	06	Standard 6:1 gear ratio (suitable for most hand wheel replacement)
	10	Special 10:1 gear ratio
	15	Special 15:1 gear ratio
	Turns	
	0135	~10 to 135 turns
	0330	up to 330 turns
	0690	up to 690 turns
	1390	up to 1390 turns
	1800	up to 1800 turns
	TC2 controls	
	M	Local manual
	MR24	Local manual and Remote, 2X 24VDC solenoids
	MR48	Local manual and Remote, 2X 48VDC solenoids
	MR120	Local manual and Remote, 2X 120VAC solenoids
	Options	
	-FD	Filter/Dryer to capture liquids at supply
	-HP###	High pressure pilot for ESD, ### = set pressure
	-LP###	Low pressure pilot for ESD, ### = set pressure
	-LB##	Line break control with rate of drop, # = psi / minute
	-HW##	Hand wheel with motor, ## = diameter in inches (typ. 16 or 24)
	-MC	Mist Extractor, carbon steel
	-MS	Mist Extractor, stainless steel
	-SS	Full stainless controls (strainer, lubricator, internal check)

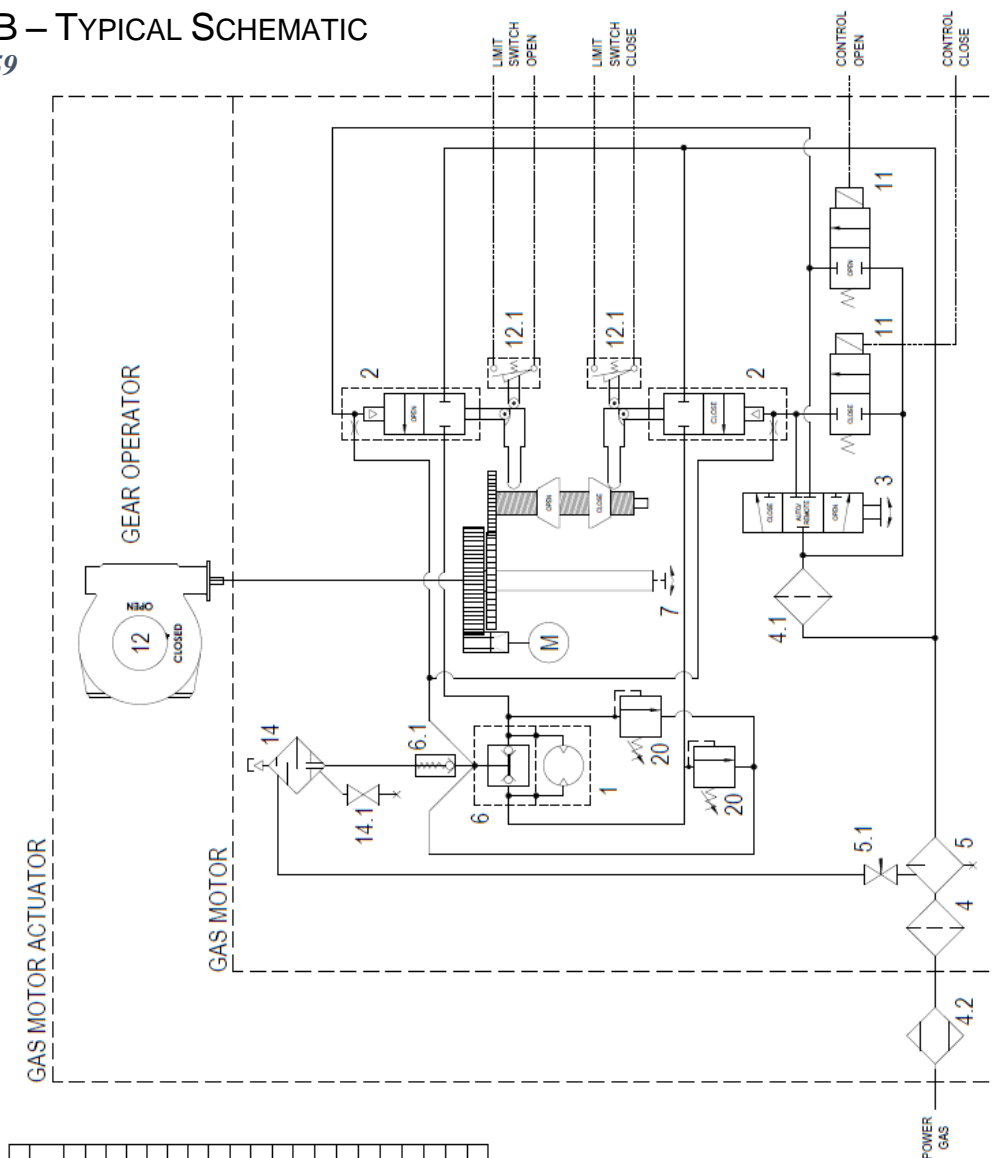
Examples:

GM 06 0330 M	Gas Motor, 6:1 330-turn, local manual controls
GM 06 0330 MR24 -MC	Gas Motor, 6:1 330-turn, local manual and 24VDC remote controls, with mist extractor
GM 06 0135 MR24 -HP1250	Gas Motor, 6:1 135-turn, local manual and 24VDC remote controls, with high pressure pilot set for 1,250 psig
GM 06 0330 M -SS-MS	Gas Motor, 6:1 330-turn, local manual controls, full stainless controls including SS Mist Extractor
GM 06 0135 MR24 -HP1250 -LP0400	Gas Motor, 6:1 135-turn, local manual and 24VDC remote controls, with high pressure pilot set for 1,250 psig and low pressure pilot set for 400 psig



APPENDIX B – TYPICAL SCHEMATIC

Drawing 31059

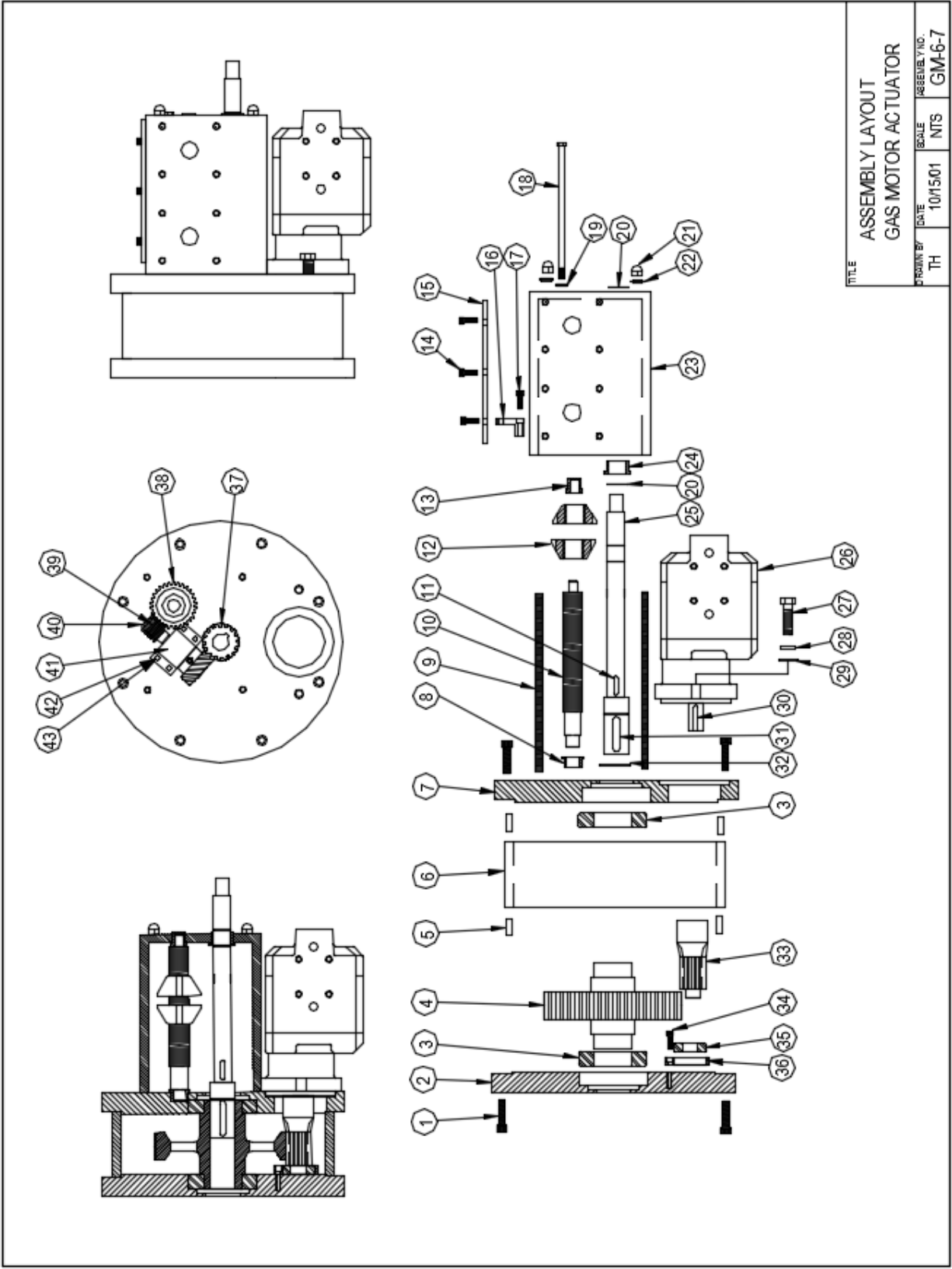


ITEMS		
ITEM No.	QTY	DESCRIPTION
STANDARD ITEMS, ALL GAS MOTOR (ref. IOM1024)		
1	1	GEAR MOTOR, HIGH PRESSURE PNEUMATIC
2	2	LIMIT PILOT VALVES, 2/2 N.C.
3	1	SELECTOR VALVE, 3-POSITION (OPEN, CLOSE, AUTO)
4	1	FILTER, POWER GAS SCREEN
4.1	1	FILTER, PILOT LINE SCREEN
5	1	LUBRICATOR
6	6	SHUTTLE EXHAUST VALVE
6.1	1	CHECK VALVE, EXHAUST
7	1	MANUAL SHAFT FOR WRENCH/HANDWHEEL OVERRIDE
OPTIONAL ITEMS, IF SPECIFIED WITH ORDER		
4.2	1	DESICCANT FILTER/DRYER
5.1	1	ISOLATION VALVE, NEEDLE, N.C. (FOR LUBRICATOR BLOWDOWN)
11	2	SOLENOIDS / PILOTS, 2/2 N.C.
12	1	LIMIT SWITCH / POSITION TRANSMITTER (ON GEAR)
12.1	2	LIMIT SWITCHES (AT CAM NUTS)
14	1	MUFFLER / MIST EXTRACTOR (ref. IOM5013)
14.1	1	ISOLATION VALVE, BALL, N.C. (M/M/E DRAIN)
20	2	PRESSURE RELIEF VALVES (note, if MAX. supply > MAOP, SET PER SALES ORDER)

SCHEMATIC SHOWS DE-ENERGIZED GAS MOTOR
POSITIONED NEAR THE FULL CLOSE MECHANICAL LIMIT.



APPENDIX C – LAYOUT DRAWING AND BOM
Drawing GM-6-7

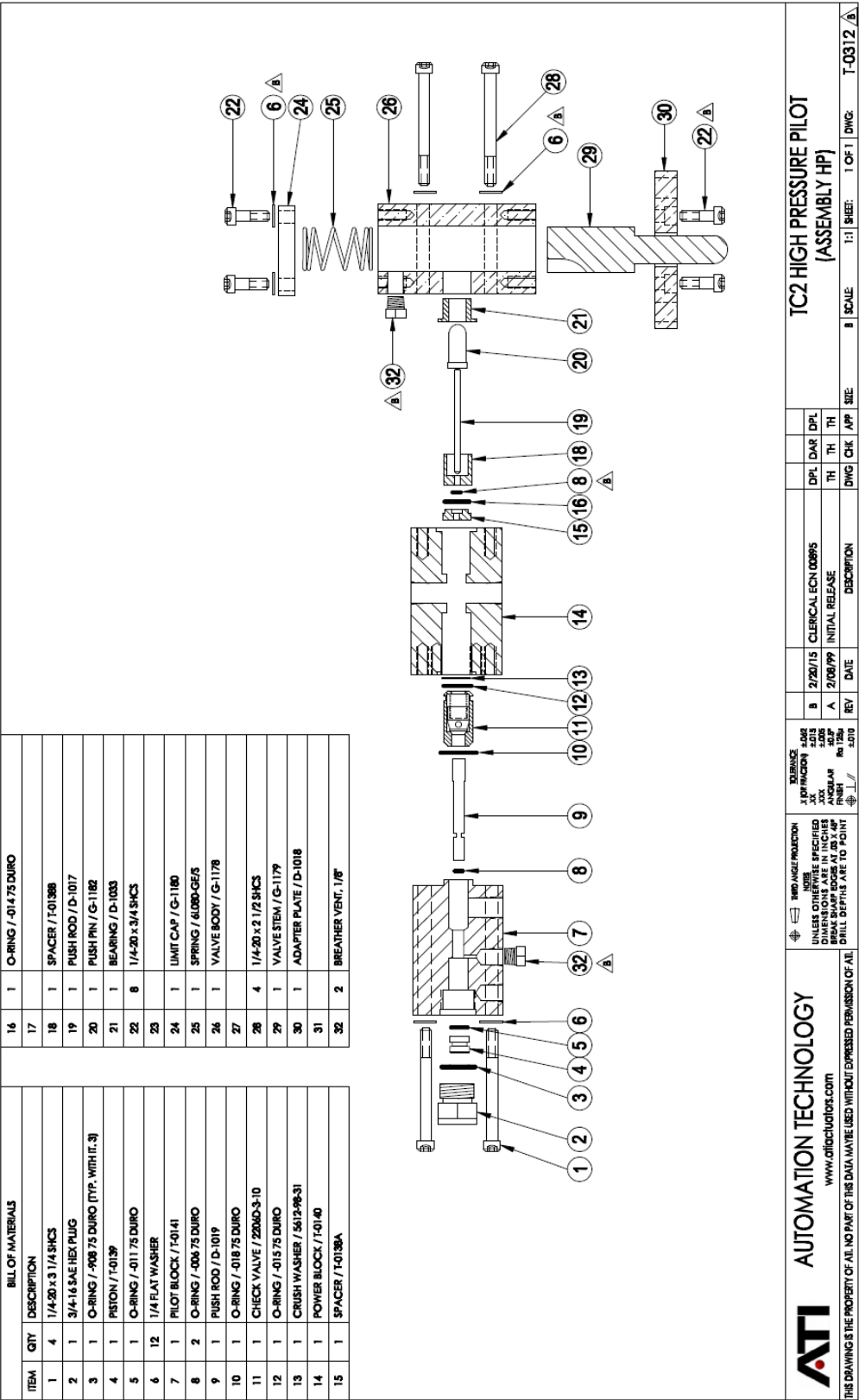


BILL OF MATERIAL FOR GM-6-7

ITEM	QTY.	DESCRIPTION	DWG. NO.
1	16	3/8 - 16 x 1 1/2 SOCKET HEAD CAP SCREW	
2	1	GEAR HOUSING BOTTOM COVER	T-0359
3	2	BEARING	6211-2Z
4	1	SPUR GEAR 77T	T-0337-2
5	4	3/8 x 1 DOWEL PIN	93035
6	1	GEAR HOUSING SPACER	T-0350
7	1	GEAR HOUSING COVER	T-0351-2
8	1	LOWER CAM SHAFT BEARING	T-0540
9	4	3/8 - 16 UNC STUD	
10	1	CAM SHAFT	T-0306A
11	1	KEY - 1/4 SQ. x 1	
12	2	CAM NUT	T-0360
13	1	UPPER CAM SHAFT BEARING	T-0538-1
14	6	1/4 - 20 x 3/4 UNC SOCKET HEAD CAP SCREW	
15	1	TIMING BOX COVER PLATE	T-0354
16	1	CAM LOCKING PIN PLATE	T-0431-1
17	2	1/4 - 20 x 1 1/4 SOCKET HEAD CAP SCREW	
18	1	CAM LOCKING PIN (5/16 - 18 x 7 5/8 HHCS)	
19	1	5/16 THREDSEAL	
20	2	1" RETAINING RING	59525
21	4	3/8 - 16 ACCORN NUT	
22	4	3/8 THREDSEAL	
23	1	TIMING GEAR HOUSING	T-0349-1
24	1	HANDWHEEL SHAFT BEARING	T-0539
25	1	HANDWHEEL SHAFT	T-0303-3
26	1	MOTOR	M5000-2.5
27	2	1/2 - 13 x 1 3/4 HEX HEAD CAP SCREW	
28	2	1/2 LOCKWASHER	
29	2	1/2 AN FLAT WASHER	
30	1	KEY - 1/4 x 3/8 x 1	
31	1	KEY - 3/8 SQ. x 1 3/4	
32	1	1 7/16 RETAINING RING	97339
33	1	PINION GEAR 13T	T-0336
34	3	1/4 - 20 x 5/8 SOCKET HEAD CAP SCREW	
35	1	BEARING	R-14-ZZ
36	1	BEARING HUB	T-0352
37	2	HANDWHEEL GEAR 8DP 16T 2.0PD	HS816R
38	1	WORM GEAR 12DP QUAD 30T 2.5PD	D1601
39	1	WORM 12DP QUAD 1.0PD	DH1607R
40	1	WORM GEAR SHAFT	T-0429
41	1	PILLOW BLOCK	T-0541
42	4	1/4 - 20 x 3/4 SOCKET HEAD CAP SCREW	
43	4	1/4 LOCKWASHER	



APPENDIX D – TC2 LAYOUT DRAWING AND BOM
Drawing T-0312



APPENDIX E – GM LAYOUT DRAWING

Adapted from Drawing GM-HPWS

