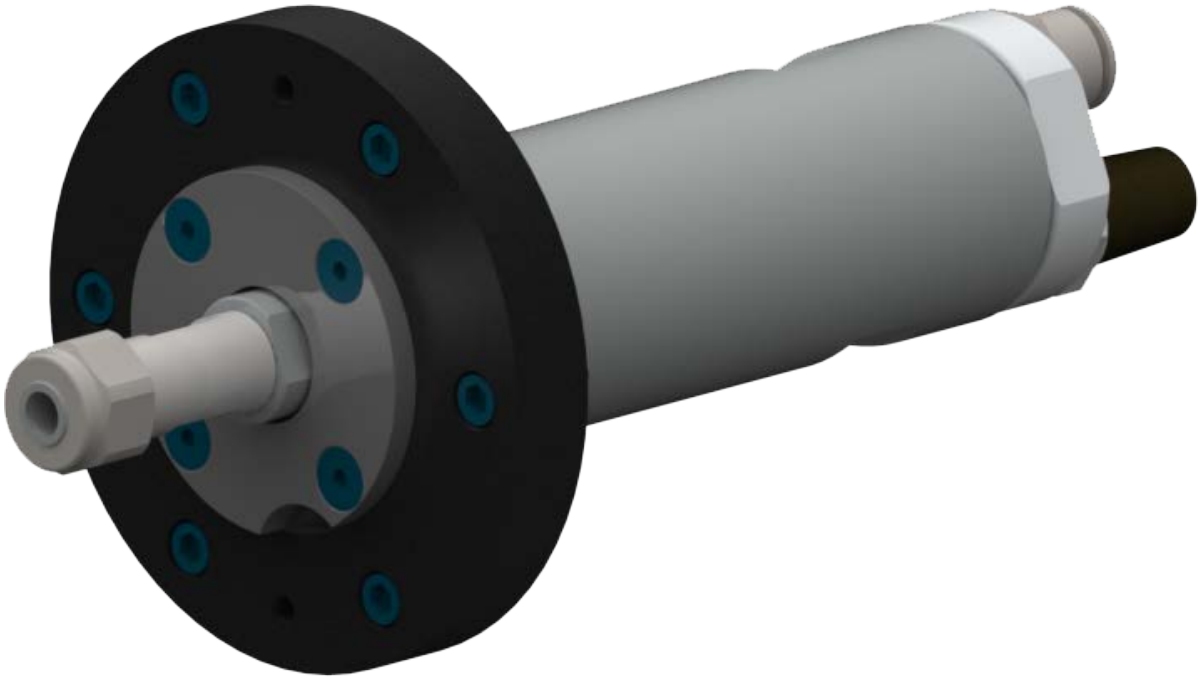
ATI Passive Compliant Force Control (PCFC) Motor Kit

(Model P/N 9005-50-6254 add-on to PCFC)

Product Manual



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Foreword

CAUTION: This manual describes the function, application, and safety considerations of this product. This manual must be read and understood before any attempt is made to install or operate the product, otherwise damage to the product or unsafe conditions may occur.

For additional information or support, please contact an ATI representative:

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Glossary

Term	Definition
Air Filter	A component that removes contamination, also called particulates, from air supply lines.
Coalescing Filter	A component that removes liquid aerosols from the supply air lines.
Compliance	The ability of the device to passively move in response to protrusions on or deviations of the work piece.
Interface Plate	Adapter plate for attaching the tool to robots or work surfaces.
PCFC	Passive Compliant Force Control - A stand-alone device used to add compliance to a rigid tool, gripper, or end-of-arm effector. The PCFC's axial travel range allows the device to compensate for surface irregularities and provide a constant force from the attached tool.
Pneumatic Motor Assembly	The assembly refers both the pneumatic tool plate and pneumatic tool of the PCFC motor kit.
Regulator	A component that sets and controls the supplied air pressure to acceptable levels.
Solenoid Valve	An electrically controlled device for switching the air supply on and off.

1. Safety

The safety section describes general safety guidelines to be followed with this product, explanations of the notifications found in this manual, and safety precautions that apply to the product. Product specific notifications are imbedded within the sections of this manual (where they apply).

1.1 Explanation of Notifications

These notifications are used in all of ATI manuals and are not specific to this product. The user should heed all notifications from the robot manufacturer and/or the manufacturers of other components used in the installation.

DANGER: Notification of information or instructions that if not followed will result in death or serious injury. The notification provides information about the nature of the hazardous situation, the consequences of not avoiding the hazard, and the method for avoiding the situation.

WARNING: Notification of information or instructions that if not followed could result in death or serious injury. The notification provides information about the nature of the hazardous situation, the consequences of not avoiding the hazard, and the method for avoiding the situation.

CAUTION: Notification of information or instructions that if not followed could result in moderate injury or will cause damage to equipment. The notification provides information about the nature of the hazardous situation, the consequences of not avoiding the hazard, and the method for avoiding the situation.

NOTICE: Notification of specific information or instructions about maintaining, operating, installing, or setting up the product that if not followed could result in damage to equipment. The notification can emphasize, but is not limited to: specific grease types, best operating practices, and maintenance tips.

1.2 General Safety Guidelines

The customer should first read and understand the operating procedures and information described in this manual. Never use the PCFC motor kit for any purpose not explicitly described in this manual. Follow installation instructions, electrical connections, and pneumatic connections as described in this manual.

All pneumatic fittings and tubing must be capable of withstanding the repetitive motions of the application without failing. The routing of pneumatic lines must minimize the possibility of stress/strain, kinking, rupture, etc. Failure of critical pneumatic lines to function properly may result in equipment damage.

1.3 Safety Precautions

CAUTION: Do not use serviceable parts other than original ATI serviceable parts. Use of serviceable parts not supplied by ATI can damage equipment and void the warranty. Always use original ATI serviceable parts.

1.4 Safe Working Environment Guidelines

The PCFC motor kit should only be used in an automated cell/chamber.

The work cell must be secured by means of barriers to prohibit personnel from entering the cell. A lockable door should be included as a part of the barrier in order to facilitate access to the cell for authorized personnel only. The barrier could consist partly or fully of polycarbonate to facilitate observation of the manufacturing process.

During system or tool maintenance, make sure the PCFC motor kit and equipment are stopped before entering the cell. Never be present in the cell when the device is running when installing and testing.

Be aware of moving parts. Use eye-protection while working around the device.

2. Product Overview

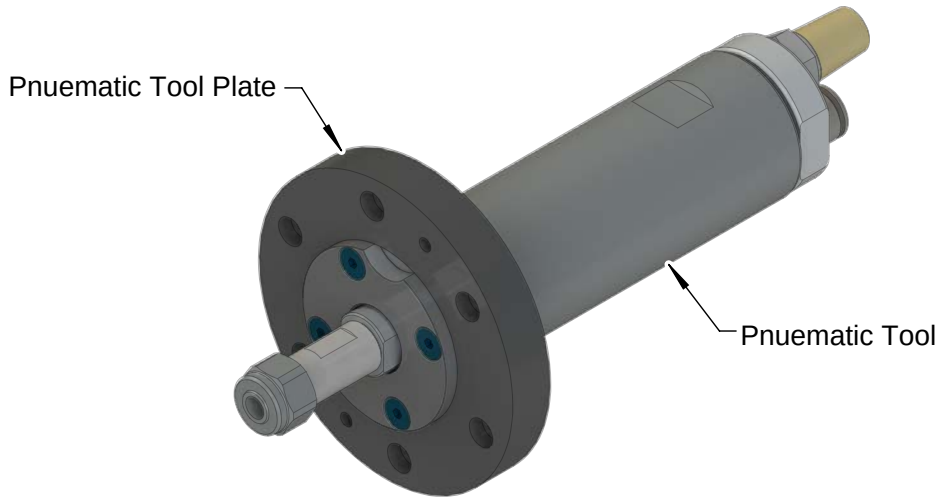
ATI's Passive Compliant Force Control (PCFC) motor kit is an optional accessory for the PCFC device. For more information about the PCFC device, refer to the *product webpage* and the *PCFC product manual*. The PCFC motor kit adds a pneumatic tool motor within the PCFC. The features and benefits of installing the PCFC motor kit include:

- Ideally suited for surface finishing
- Robust vane motor with oiled air
- Built-in compliance reduces robot programming
- Mounts to robot arm via side bolt pattern
- High degree of serviceability
- Great replacement for hand finishing operations
- Position sensing when used with the PCFC

Air supply to the motor spindle must be 6.2 bar (90 psi) to achieve the full rated power. For additional technical specifications, refer to *Section 8—Specifications*.

The standard PCFC motor kit includes an ER-11 collet. Use a 1/2" and 11/16" wrench to loosen or tighten the collet nut when installing new media.

Figure 2.1—PCFC Motor Kit



2.1 Environmental Considerations

When operating or storing the kit, refer to the specifications in the following tables:

Table 2.1—Operation	
Installation position	Mounted to machining center by means various, customer-supplied end-effector.
Temperature range	5° C–35° C 41° F–95° F
Utilities	The device requires the following: • Clean, dry, filtered, and lubricated air (refer to *Section 5.3—Lubrication*) • A coalescing filter and filter elements that are rated 5 micron or better • The 750 W air motor consumes air at a rate of 32 CFM

Table 2.2—Storage	
Temperature range	0° C–45° C 32° F–113° F
Conditions	The device should be stored in its crate and in a dry place. When not in use, keep the unit in its crate; refer to *Section 3.4—Storage and Preventive Maintenance During Storage*.

For additional technical specifications, refer to *Section 8—Specifications*.

3. Installation

The device must be rigidly mounted prior to use. Under no circumstances should the device be used for manual/hand operations. Once securely mounted, the device shall be supplied with clean, lubricated air filtered (5) micron or better. The use of a coalescing filter is recommended to remove trace moisture from the air supply. Air line fittings supplying the PCFC motor kit should be installed with care using a minimum of tape or liquid sealant. To prevent contaminant damage to the device, blow down all air lines to remove debris prior to connecting the PCFC motor kit.

CAUTION: Thread locker applied to fasteners must not be used more than once. Fasteners might become loose and cause equipment damage. Always apply new thread locker when reusing fasteners.

3.1 Protection During Transportation

The PCFC motor kit arrives in packaging that secures and protects the device during transportation. Always use this packaging when transporting the PCFC motor kit in order to minimize the risk of damage.

3.2 Inspection of Condition When Delivered

Upon receipt, the following should be checked:

- Delivery in accordance with freight documents
- Packaging is in good condition

If there is damage to any of the packaging, or if any of the goods have been exposed to abnormal handling, unpack those parts for a closer inspection. Contact ATI for assistance.

3.3 Unpacking and Handling

Always place the PCFC motor kit inside the accompanying packaging, while transporting, storing, and handling.

3.4 Storage and Preventive Maintenance During Storage

For short-term storage, the device should be stored in its accompanying packaging and in a dry place.

For long-term storage, the PCFC motor kit should be thoroughly cleaned of any dust or debris. Remove the motor kit from the PCFC. Place the device inside a sealed, plastic bag and place the bagged device inside the crate.

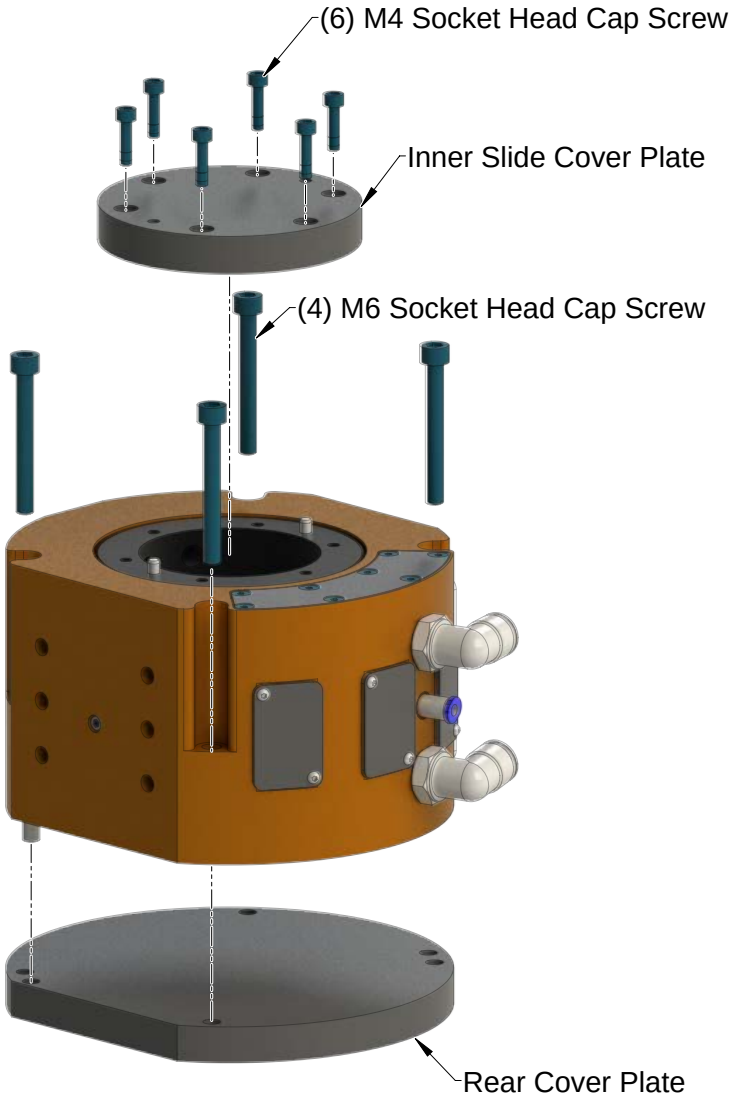
3.5 Installation of the Motor Kit in the PCFC

Supplies required: *Loctite 242*

Tools required: *3 mm hex key, 5 mm hex key, torque wrench*

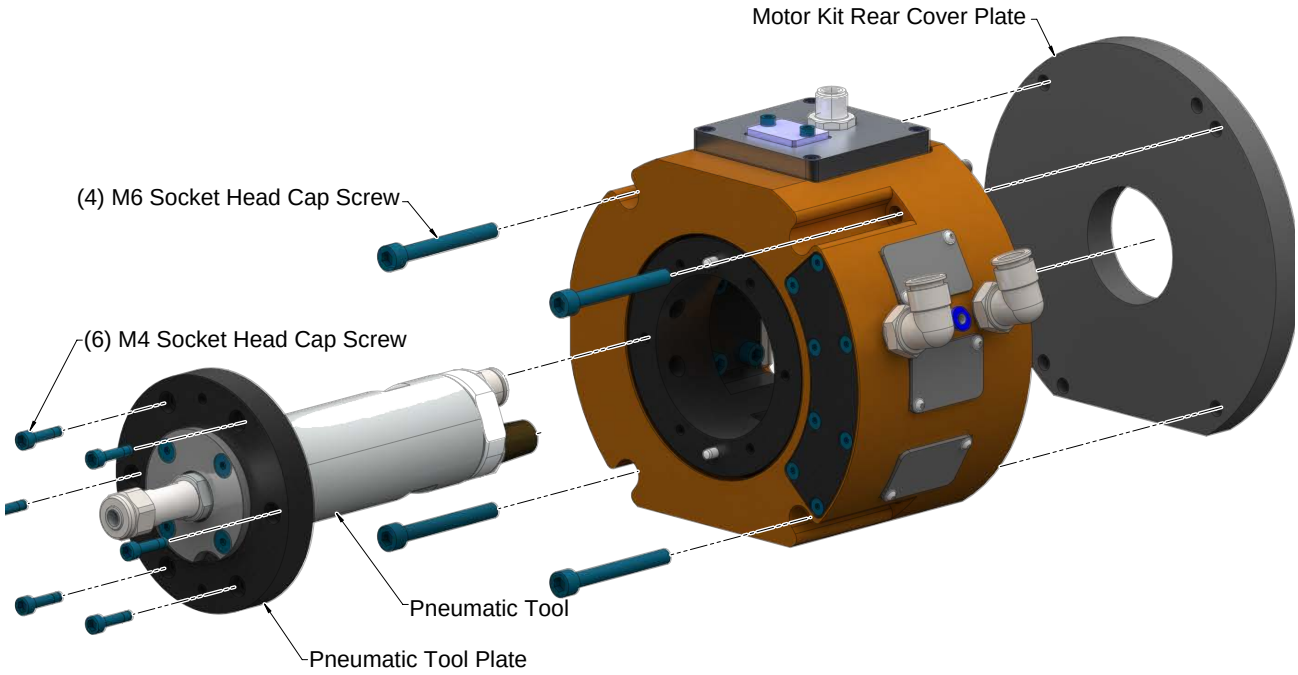
1. Ensure there is no pressure in the air lines to the tool's spindle and compliance connections.
2. Using a 5 mm hex key, remove the (4) M6 socket head cap screws securing the rear cover plate to the PCFC.
3. Remove the rear cover plate.
4. Using a 3 mm hex key, remove the (6) M4 socket head cap screws securing the inner slide cover plate to the PCFC.
5. Remove the inner slide cover plate.

Figure 3.1—Remove the Rear Cover Plate from the PCFC



6. Insert the kit's pneumatic motor assembly through the axial opening of the PCFC.
7. Apply Loctite 242 to the (6) M4 socket head cap screws.
8. Install the (6) M4 fasteners to secure the pneumatic tool assembly on the PCFC. Tighten the screws to 25 in-lb (2.82 Nm) with a 3 mm hex key and torque wrench.

Figure 3.2—Install the Kit's Pneumatic Motor Assembly



9. Apply Loctite 242 to the (4) M6 socket head cap screws of the PCFC.
10. Use the (4) M6 socket head caps screws to secure the motor kit rear cover plate to the PCFC. Tighten the screws to 89 in-lb (10 Nm) with a 5 mm hex key and torque wrench.
11. Mount the PCFC to the robot; refer to the *Installation Section* in the *ATI PCFC manual*.

4. Operation

These operating instructions are intended to help system integrators program, start up, and complete a robotic cell containing the device. The system integrator should be familiar with the task in general and should have extensive knowledge relating to robots and automation incorporating robots.

4.1 Safety Precautions

DANGER: Never use the PCFC motor kit for purposes other than automated processes. If used in any other way, serious injury or damage to equipment may occur.

WARNING: Never use the PCFC motor kit as a hand-held machine. If used in this way, serious injury or damage to equipment will occur.

WARNING: All personnel, who are involved in the operation of the PCFC motor kit product, should have a thorough understanding of the operating procedures. Failure to follow these procedures or neglecting safety precautions can create hazardous situations that may injure personnel or damage the deburring installation and the PCFC motor kit product.

WARNING: Never operate the PCFC motor kit product without wearing hearing protection. High sound levels can occur during cutting. Failure to wear hearing protect can cause hearing impairment. Always use hearing protection while working in proximity of the PCFC motor kit.

WARNING: Never operate the ATI product without wearing eye protection. Flying debris can cause injury. Always use eye protection while working in the proximity of the device.

CAUTION: Do not use replacement parts other than original ATI replacement parts. Use of replacement parts not supplied by ATI can damage equipment and void the warranty. Always use original ATI replacement parts.

CAUTION: Do not use burs that are rated for less than the speed of the PCFC. Using lower speed burs may cause injury or damage equipment. Always use burs rated for at least the speed of the PCFC that is being used.

CAUTION: Never be near the PCFC while it is started or in operation. Flying debris and rotating parts can cause injury. If it is necessary to approach the PCFC while in motion, stand behind appropriate Plexiglas or Lexan windows. Provide a barrier to prohibit people from approaching the PCFC while in operation.

CAUTION: Never use or start the PCFC without first reading and understanding the operating procedures described in this manual. Never use the PCFC for any purposes, or in any way, not explicitly described in this document. Using the deburring tool without fully understanding the installation and operating procedures may cause injury to personnel or damage to equipment. Mount the PCFC and connect the pneumatic control equipment as described in this manual. Operate the PCFC as described in the manual.

4.2 Minimum Requirements for Operation

The following sections describe the minimum requirements for operating the PCFC motor kit.

4.2.1 Air Quality

The air supply should be clean, dry, filtered, and lubricated. A coalescing filter that has elements rated for 5 micron or better is required. The air must be supplied at 6.2 bar (90 psi).

Air quality affects tool performance more than almost any other factor. Particulate can block airflow or impede vane motion. If deburring tool does not receive the proper air pressure, the tool stalls.

4.2.2 Lubrication

Lubricate the air supply with 3-5 drops of an oil-fog lubrication mixture.

It is imperative that the lubricator be located within 5 m (15 feet) of the tool.

4.2.3 Media Selection

Use cup and encapsulated brushes that are under 3 inches in diameter.

Do not use media that requires radial loading. Do not use media rated to below the PCFC motor kit's maximum speed in *Section 8—Specifications.*

The PCFC motor kit deburring tool is designed to use axially loaded media under 3 inches in diameter, and thus, sanding disks and cup brushes may be used. Plunge cuts for countersinking are acceptable as long as the bur angle is 90° or larger so that there is minimal radial load.

Select media and media holders that position the work piece as close to the collet as possible.

The selection of such media is highly dependent upon the work piece material and geometry, and the amount of material to be removed. It is not practical to present all the possibilities in this document.

In most applications, no cooling or lubrication of the part or tool is necessary nor is it desirable. For some materials and situations, the addition of coolants or compressed air may aid the cutting process. Any application of coolant must be exercised with care to prevent fluids from entering the tool or its chuck.

When used with flexible abrasive media, the PCFC motor kit will perform best when the rotating media approaches the burr in a direction that will fold the burr back on itself. This orientation allows the media to remove material rapidly without excessive force and without the creation of a secondary bur. This will decrease the cycle time for the operation while extending the life of the tool and the consumable media. The PCFC motor kit spindle rotates clockwise when viewed from behind.

5. Maintenance

The tool utilizes a vane-type air motor. When subjected to normal use, this robust unit will provide many hours of operation before service or repair is necessary. When subjected to high shock loading or periods of continuous service without interruption, the unit will require service or repair earlier. While simple in design, there are few user-serviceable parts in the assembly. The user is encouraged to return the unit to ATI for service.

For all service, it is recommended that the air supply (before the solenoid valves) be disconnected. Drain any trapped air pressure in the lines. It is suggested that the air supply be “locked out” to prevent accidental operation of the spindle.

CAUTION: For all service, it is recommended that the air supply be disconnected. Drain any trapped air pressure in the lines. It is suggested that the air supply be “locked out” to prevent accidental operation of the device. During maintenance operations, refer to *Section 9—Drawings*.

5.1 Media Replacement

Check media quality regularly to ensure it is not dull or worn. Using worn media causes a poor surface finish and increased wear on the bearings that results in premature tool failure.

When performing maintenance, always remember to tighten all the fasteners. When replacing media always secure it correctly and ensure that the chuck is tightened.

The standard PCFC motor kit includes an ER-11 collet. Use a 1/2" and 11/16" wrench to loosen or tighten the collet nut when installing new media.

When in doubt, the customer should refer to the manufacturer of the media to determine how to properly secure that media to the spindle.

5.2 Utilities

The air tubing and fittings to the unit should routinely be checked for general condition and replaced as required. The lines must be flexible to allow free motion when the unit is mounted to a moving surface or robot. The air to the device must be filtered, dry, and lubricated. The service life of the filter elements depends on the quality of compressed air at the customer’s facility.

5.3 Lubrication

Always lubricate the motor with air tool oil.

6. Troubleshooting Guidance

Symptoms of problems observed while using the PCFC motor kit are listed in the following table. For each symptom, there is a corresponding cause and guidance for fixing the problem.

Table 6.1—Troubleshooting

Symptom	Cause	Resolution
Wear	Too heavy a cut	Decrease width of cut/make multiple passes
	Feed rate is too slow	Increase feed rate
Unequal compliance	Defective regulator	Replace defective regulator
Compliance slide sticking	Compliance slide contaminated	Clean the compliance slide with compressed air and alcohol.
Poor finish	Feed rate is too fast	Reduce feed rate
	Media is worn	Replace media
Secondary Burrs	Incorrect feed rate	Reduce feed rate
	Too heavy a cut	Decrease width of cut/make multiple passes
	Incorrect feed direction	Change path
Spindle stalls	Not enough or no drive air	Check drive air regulator for 90 psi (6.2 bar) and for leaks
	Media is not secure in collet	Properly tighten chuck
	Too much compliance force	Decrease width of cut/make multiple passes
	Compliance exceeded	Examine/correct path

7. Parts/Accessories

For exploded drawings of the components in the PCFC kit, refer to *Section 9—Drawings*.

Table 7.1—Parts/Accessories for the PCFC Motor Kit

Part Number	Description
9005-50-6165	Filter Regulator Lubricator Air Prep Kit with Compliance (High Lubrication Rate)
9005-50-6174	Filter Regulator Lubricator Air Prep Kit with Compliance and Oil Level Switch (High Lubrication Rate)
3490-0001074-01	Replacement Vane Motor, 15k RPM, 1HP
3490-1020007-01	Muffler, G1/4

8. Specifications

Table 8.1—Specifications for the PCFC Motor Kit

Parameter	Rating
Weight	3.7 lbs (1.68 kg)
Pneumatic Connections	Exhaust - 1/4 G-Port (Muffler Installed) Motor - 3/8 (10 mm) Tube
Idle Speed	15,000 RPM
Working Speed	11,000 RPM
Stall Torque	9.5 in-lbs (1.073 Nm)
Spindle Air Pressure	90 psi (6.2 bar)
Air Consumption	32 CFM

9. Drawings

To access drawings applicable to the PCFC motor kit, use the following links:

- For the PCFC motor kit, *https://www.ati-ia.com/app_content/Documents/9630-50-PCFC-750-KIT.auto.pdf*
- For the PCFC device, *https://www.ati-ia.com/app_content/Documents/9630-50-PCFC-12.auto.pdf*
- For a pneumatic diagram, *https://www.ati-ia.com/app_content/Documents/9630-50-PCFC-PNEUMATIC.auto.pdf*

10. Terms and Conditions of Sale

ATI warrants the compliant tool product will be free from defects in design, materials and workmanship for a period of one (1) year from the date of shipment and only when used in compliance with manufacturer's specified normal operating conditions. This warranty does not extend to tool components subject to wear and tear under normal usage; including but not limited to those components requiring replacement at standard service intervals.

The warranty period for repairs made under a RMA shall be for the duration of the original warranty, or ninety (90) days from the date of repaired product shipment, whichever is longer. This warranty is void if the unit is not used in accordance with guidelines presented in this document. ATI will have no liability under this warranty unless: (a) ATI is given written notice of the claimed defect and a description thereof within thirty (30) days after Purchaser discovers the defect and in any event not later than the last day of the warranty period; and (b) the defective item is received by ATI not later ten (10) days after the last day of the warranty period. ATI's entire liability and Purchaser's sole remedy under this warranty is limited to repair or replacement, at ATI's election, of the defective part or item or, at ATI's election, refund of the price paid for the item. The foregoing warranty does not apply to any defect or failure resulting from improper installation, operation, maintenance or repair by anyone other than ATI.

10.1 Motor Life and Service Interval Statement

The air motors that are used in ATI deburring/finishing tools are subject to wear and have a finite life. Motors that fail, during the warranty period, will be repaired or replaced by ATI as long as there is no evidence of abuse or neglect and that the normal operating practices outlined in this manual have been observed.

Components such as motor vanes, bearings, any gear reduction components, and collet nuts/chucks are considered consumable and are not covered by warranty. The customer should expect to service or replace these items at designated service intervals. For any part this is not detailed in this manual, contact ATI for part numbers and pricing.

Premature bearing failure can occur from exposing the deburring tool to coolants and water or impacts from collisions. Other failure modes that are outlined in the manual and relate to improper machining practices and deburring media selection.

10.1.1 Vane Motor Products

Vane type motors have a finite life and require regular service. At that time the customer should expect to replace the bearings and motor vanes. Any gear reduction components should also be inspected and replaced as necessary. Vane type motors perform best and longest when supplied with lubricated air. The service interval will be catastrophically shortened if the tool is ran without lubrication. The expected life of a properly lubricated vane motor in normal operation is entirely application dependent based on a multitude of factors. To maximize the life of a vane type motor products the customer should follow closely the normal operation guide in the product manual. The supplied air must be lubricated, and filtered to remove particulates and moisture. Premature bearing failure can occur from exposing the deburring tool to coolants and water or impacts from collisions. Other failure modes are outlined in the manual and relate to improper machining practices and deburring media selection.