ATI Radially-Compliant Robotic Deburring Tools Flexdeburr™

(Model 9150-RC-300 and -340 Series)

Manual

US Patent # 6,974,286 B2

Document #: 9610-50-1019

Engineered Products for Robotic Productivity

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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.

How to Reach Us

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Glossary

Term	Definition
Adapter Plate	Device for attaching the deburring tool to either a robot flange or a stationary mounting surface.
Air Filter	Device for removing contamination from air supply lines. Typically refers to removal of particulates.
Bur	Cutting tool used to remove burrs from the work piece. Alternatively referred to as a rotary file, cutter, or bit.
Burr	Any unwanted, raised protrusion on the work piece.
Climb Milling	Cutting method where the direction of cutter rotation and tool motion are the same.
Coalescing Filter	Device designed to remove liquid aerosols from the supply air lines.
Collet	Gripping device used to hold cutting tools in the spindle.
Compliance	The ability of the spindle to passively move in response to protrusions on or deviations of the work piece.
Conventional Milling	Method of cutting where the direction of tool motion is opposite that of tool rotation.
-E	Euro models.
End-Effector	Tool used by the robot to perform a particular function.
Front Housing	The main cylindrical body of the unit which includes the mounting features.
Regulator	Device used to set and control the supplied air pressure to lower acceptable levels.
Rear Housing	Rear cover to the front housing. The body includes a compliance and spindle air supply fitting.
RC	Radially-Compliant.
Solenoid Valve	Electrically controlled device for switching air supplies on and off.
Spindle	The rotating portion of the deburring tool assembly.
Turbine	Air motor that drives the spindle.

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. More specific notifications are imbedded within the sections of the manual where they apply.

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1.1 Explanation of Notifications

The following notifications are specific to the product(s) covered by this manual. It is expected that the user 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

Prior to purchase, installation, and operation of the Flexdeburr product, the customer should first read and understand the operating procedures and information described in this manual. Never use the deburring tool for any purposes, or in any ways, not explicitly described in this manual. Follow installation instructions 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

WARNING: Never operate the Flexdeburr product without wearing hearing protection. High sound levels can occur during cutting. Failure to wear hearing protection can cause hearing impairment. Always use hearing protection while working in the neighborhood of the deburring tool.

WARNING: Never operate the Flexdeburr product without wearing eye protection. Flying debris can cause injury. Always use eye protection while working in the neighborhood of the deburring tool.

CAUTION: Do not use burs rated for less than the speed of the RC deburring tool being used. Using these too may cause injury or damage equipment. Always use burs rated for at least the speed of the RC deburring tool being used.

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

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

CAUTION: Do not perform maintenance or repair on the Flexdeburr product unless the tool is safely supported or docked in the tool stand and air has been turned off. Injury or equipment damage can occur with tool not docked and air on. Dock the tool safely in the tool stand and turn off the air before performing maintenance or repair on the Flexdeburr product.

NOTICE: Turbine motors are not serviceable at this time. Refer to *Section 10—Terms and Conditions of Sale*. To maximize the life of turbine motor products the customer should follow closely the normal operation procedures outlined in the product manual. The air must be totally lube free and filtered to remove particulates and moisture. Exposing the turbine motors to oil in the air supply results in premature failure.

2. Product Overview

The Radially Compliant (RC) deburring tool, also known as Flexdeburr, is a robust, high-speed and lightweight turbine driven deburring unit for deburring aluminum, plastic, steel, etc. with a robot or CNC machine. The RC deburring tool is especially suited for removal of parting lines and flash from parts. However, its flexible design allows it to be used in a wide variety of applications.

The RC deburring tool's pneumatically controlled, articulated design allows the cutting bit to follow the part profile and compensate for surface irregularities while maintaining a constant, settable force. This allows high feed rates with uniform quality in any orientation. The tool also requires no oil, allowing clean exhaust air to be vented directly into the work environment.

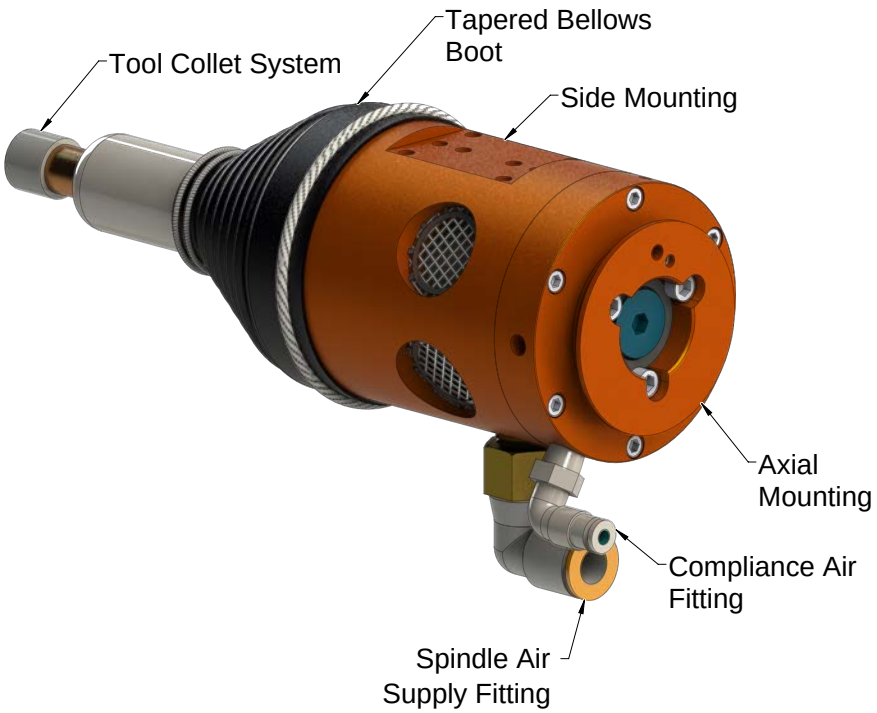
Compliance is supported by air pressure applied to the shaft of the unit and is used to perform consistent deburring on irregular part patterns. The motor's internal governor maintains high spindle speeds for optimum surface finish. The RC deburring tool also utilizes standard industrial tungsten-carbide bits which allows for adaptation to changing assembly lines and part requirements.

The RC-300 and RC-340 series provides for (2) mounting types, a side mounting and an axial mounting. The side mounting provides (2) locating dowel pins and (4) threaded holes. The axial mounting utilizes a tapered flange that requires an adapter plate. Custom adapter plates for both side and axial mounting are available from ATI. Refer to *Section 9—Drawings* for more information.

The RC-300 and RC-340 series is equipped with a 3/8" Push-to Connect fitting to supply the motor air (for -E models ATI supplies an adapter from 3/8" to 8 mm) and a 5/32" (4 mm) Push-to Connect fitting to supply the compliance air.

A tool collet system secures the cutting bur. Many collet sizes and a various selection of tools are available to accommodate a wide variety of applications.

Figure 2.1—RC-300 Series Deburring Tool



2.1 Tool Collet Systems

All Flexdeburr products utilize removable collets to grip customer supplied cutting tools. Different collet diameters may be substituted to retain numerous cutter shank diameters. The collet retaining nut is loosened to open the collet allowing cutting tools to be removed and inserted. Once the tool or bur is set to the desired depth, spanner wrenches are used to tighten the collet nut causing the collet to collapse and secure the cutting tool. The air motor design does not allow the installation of quick-change or drawbar collet systems.

The standard tool holding system for Flexdeburr products is an economical, proprietary, single-angle collet design utilizing multiple gripping fingers. This is suitable for most applications where industry standard shank diameter cutting tools are used and runout tolerances of up to 0.001" (0.025 mm) are acceptable. Special sizes are available upon request but require custom machining.

2.2 Technical Description

The technical overview of the product is provided in the following tables and graphs. For additional technical specifications, refer to *Section 8—Specifications*.

2.2.1 Environmental Limitations

2.2.1.1 Operation

Installation position	Mounted to robot by means of the side mounting pattern or rear adapter flange. Refer to *Section 3.5—Side Mounting Installation* and *Section 3.6—Axial Mounting Installation*. The flange is specific to each type of robot. This optional flange is normally supplied by ATI in a blank form suitable for customer modification. Refer to *Section 9.1—RC-300 Series Geometry and Mounting*.
	Mounted to a table or stand by means of the bench adapter (the robot is carrying the work piece).
Temperature range	5° C–35° C 41° F–95° F
Utilities	The tool requires the following: • Clean, dry, filtered, non-lubricated air. • A coalescing filter and filter elements rated 5 micron or better. • The motor spindle must be supplied air at 6.2 bar (90 psi). • The radial compliance (centering) air must be supplied from a regulated source between 1.0–4.1 bar (15–60 psi).

2.2.1.2 Storage

Temperature range	5° C–35° C 41° F–95° F
Conditions	The tool should be stored in its crate and in a dry place. When not in use, keep the unit in its crate if possible. Consult *Section 3.4—Storage and Preventive Maintenance during Storage* of this manual.

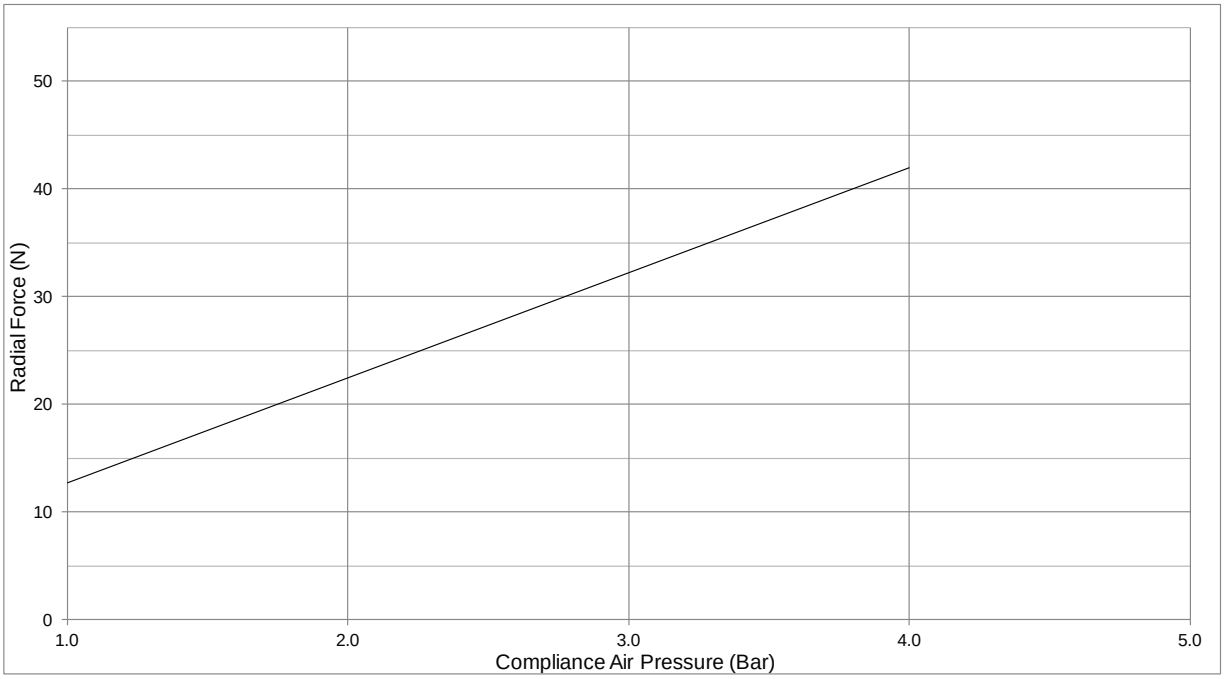
2.2.2 Compliance Unit Performance

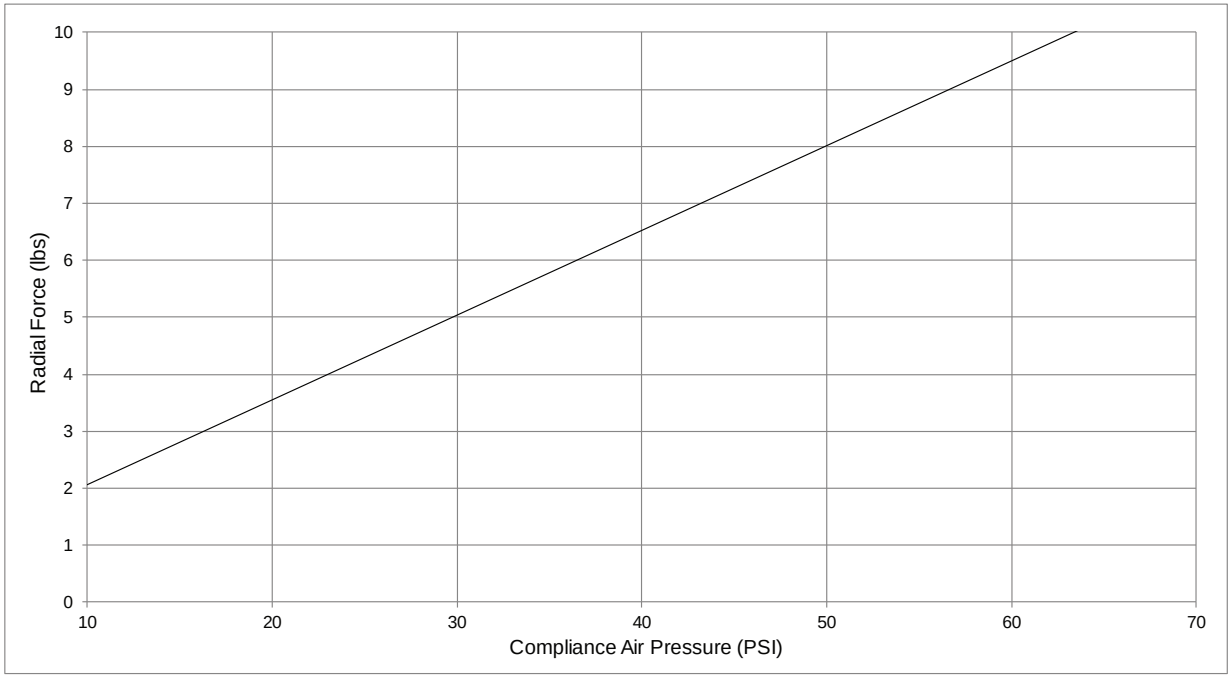
The graphs in *Figure 2.2* illustrate the variation of compliance force with applied air pressure in the vertical orientation with the collet pointed toward the ground. Measurements may vary from one product to another and should only be treated as nominal.

The actual force characteristics are dependent on mounting orientation and condition of the unit. In applications, where the deburring tool is mounted horizontally, additional compliance air pressure is required to overcome the weight of the motor. Compliance pressure is also dependent upon the material of the work piece, type of bur tool, and the amount of material that is removed.

The turbine motor attempts to maintain its full rated speed even under loaded conditions. However, when extremely heavy cuts are taken, the motor may eventually stall. Therefore, multiple, light passes are preferred over slow, heavy cuts.

Figure 2.2—RC-300 and RC-340 Series Compliance Force Curves (Measured at the Spindle Tip)





3. Installation

The RC-300 and RC-340 series Deburring Tools are delivered fully assembled. Optional equipment such as mounting adapter plates, burr tools, additional collets will be separate.

3.1 Transportation and Protection During Transportation

The RC deburring tool is packaged in a crate designed to secure and protect it during transportation. Always use the crate when transporting the deburring tool 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 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 that may have been damaged for a closer inspection. If necessary, notify ATI for assistance in evaluation of the product condition.

3.3 Unpacking and Handling

The deburring tool should always be placed inside the accompanying box (crate) during transportation, storing and handling.

Pneumatic lines and electrical cables are attached, bundled, and must be strain-relieved in a manner that allows for freedom of movement during operation.

3.4 Storage and Preventive Maintenance during Storage

The deburring tool should be stored in its crate when it is not in use. The deburring tool should also be stored in a dry place.

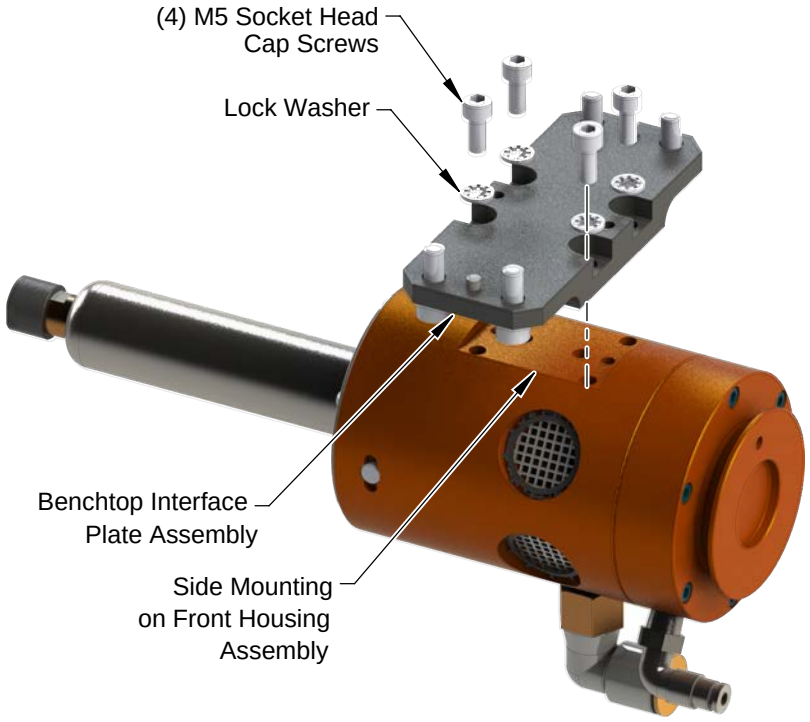
For long-term storage, the deburring tool should be thoroughly cleaned of any burrs or debris. It should not be disassembled. Place the deburring tool inside a sealed, plastic bag inside the crate

3.5 Side Mounting Installation

The side-mounting pattern of the RC deburring tool consists of (2) dowel pin holes and a number of threaded holes as can be seen in the following figure. The maximum fastener length specified must not be exceeded so that the fasteners do not interfere with the compliant motion of the turbine motor spindle. Refer to *Section 9.1—RC-300 Series Geometry and Mounting* for more information.

CAUTION: Lock washers are recommended on all mounting features. Liquid thread lockers should not be used for the mounting hardware as this may damage or remove thread inserts during disassembly.

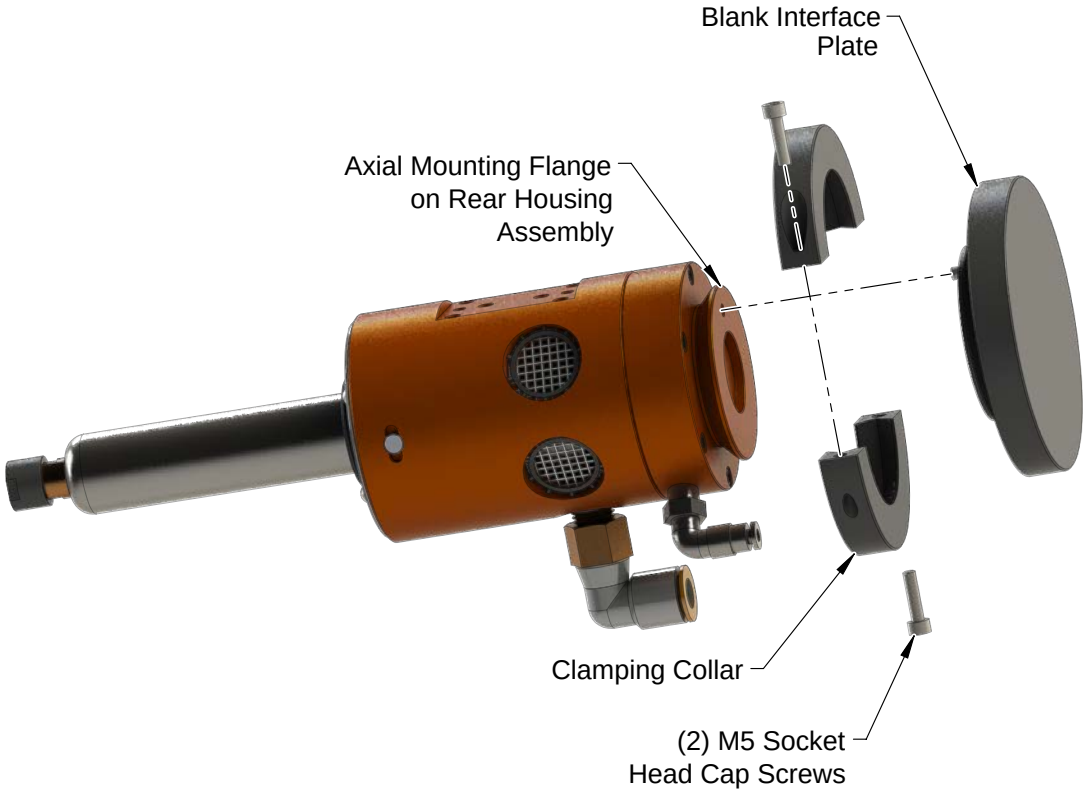
Figure 3.1—Bench (Side) Installation (Model is shown for reference.)



3.6 Axial Mounting Installation

A blank robot adapter plate is also available to allow axial mounting off the rear of the deburring tool housing. This plate may be modified by the system integrator or by the owner/user of the Flexdeburr. ATI can provide custom interface plates and adapters upon request. An optional bench mount adapter plate allows the deburring tool to be permanently attached to a bench or other work surface (see the following figure). If the RC deburring tool is permanently mounted to a work surface, the robot carries the part to be deburred to the deburring tool. Refer to *Section 9.1—RC-300 Series Geometry and Mounting* for more information.

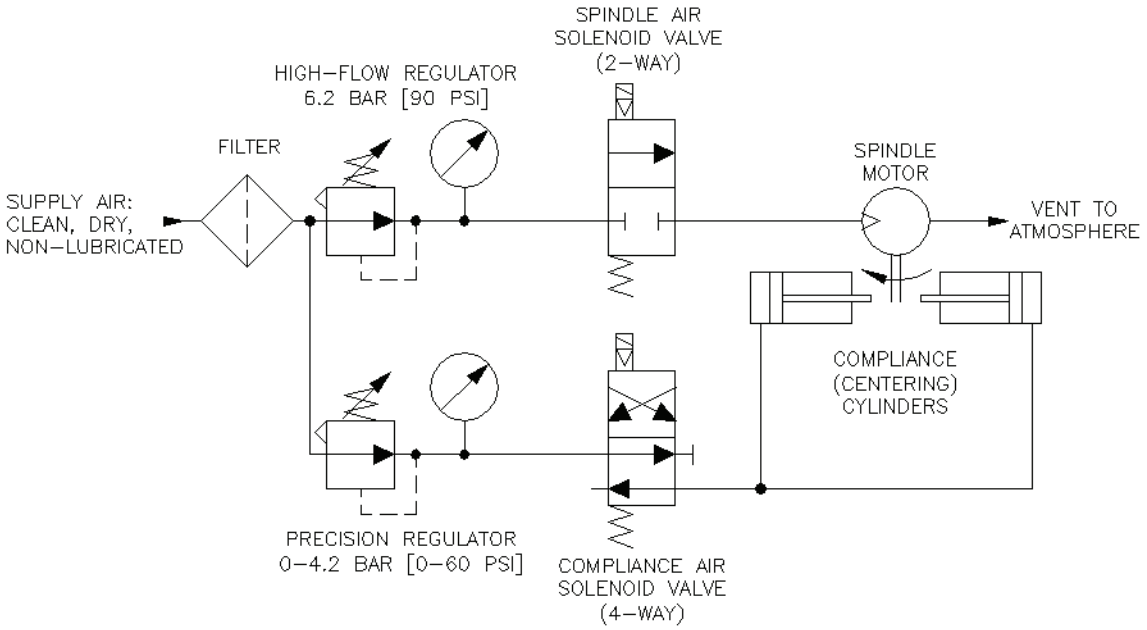
Figure 3.2—Axial Installation (Model shown for reference)



3.7 Pneumatics

Connect the RC deburring tool as shown in the following figure.

Figure 3.3—Pneumatic Connections



WARNING: 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 over stressing, pullout, or kinking the lines. Failure to do so can cause some critical pneumatic lines not to function properly and may result in damage to equipment.

The air supply should be dry, filtered, and free of oil. A coalescing filter with elements rated for 5 micron or better is required.

A high-flow air pressure control regulator is required to supply the spindle motor at 6.2 bar (90 psi). A second, precision, self-relieving regulator supplies air for the compliance or centering force.

The compliance force is applied radially and is adjusted until the desired cut is made. The robot's traversing speed will also be adjusted to achieve the desired finish.

CAUTION: Pneumatic components used for the motor drive circuit must be capable of meeting the air consumption requirements (see *Section 8—Specifications*). Poor performance will result if the correct components are not used.

Conventional, customer-supplied, pneumatic components are used to control the air supply to the deburring tool. ATI recommends that the user install a high-flow pneumatic pressure regulator (ATI Part Number 9150-FFR-90 or equivalent. See *Section 8—Specifications* for the maximum flow requirements) and a high-flow valve to properly supply a stable air supply of 6.2 bar (90 psi) to the spindle motor. The RC deburring tool will not operate properly if supplied air below 6.2 bar (90 psi).

A second, precision, self-relieving regulator (ATI Part Number 9150-PPR-60 or equivalent) and valve are used to supply the compliance (centering) mechanism. This pressure corresponds to the side force on the rotary bur. Because very little airflow is required for the compliance mechanism, a significantly smaller valve can used. (Consult the valve and regulator supplier's literature when selecting these components).

If the complete work piece can be deburred with equal force, a conventional, manual pressure regulator can be used for compliance. If the burrs to be removed vary from place to place on the work piece, and this variation is repeatable for all work pieces of the same type, it may be necessary to adjust the force using an analog pressure regulator controlled from the robot. Then analog output port in the robot or logic controller is needed.

Solenoid valves are actuated from the robot or program logic controller by means of a digital output signal.

Table 3.1—Pneumatic Connections

Function	Connection Type	Pressure
Motor Inlet (9150-RC-300 and 340 Series)	3/8" Quick Connect Tube Alternate: Remove supplied fitting to use 1/8-NPT Port, or use 5/16 (8 mm) Tubing Adapter	6.2 bar (90 psi)
Compliance (Radial) Force Inlet (9150-RC-300 and 340 Series)	5/32” (4 mm) Quick Connect Tube Alternate: Remove Supplied Fitting to use 1/8-NPT Port	1.0–4.1 bar (15–60 psi) (Maximum)
Exhaust	Vented to Atmosphere through the Housing	Not Applicable

It is recommended that flexible plastic tubing be used for the motor air supply and the compliance force air supply. The installed fittings can be removed to expose tapped supply ports thus allowing the use of alternate, customer-supplied components. The turbine motor is extremely quiet and vents dry air to the environment through the screen-covered ports on the side of the housing. No mufflers are required. Information on the sound intensity is provided in *Section 8—Specifications*. To reduce the sound from the cutting operation in neighboring working areas, a customer-supplied barrier surrounding the installation may be installed (Plexiglas® or Lexan® is preferred, see *Section 8—Specifications*).

The compliance force, air supply pressure regulator should have a 0-4.1 bar (0–60 psi) range. When testing for the proper contact force, start with a very low pressure and increase slowly until the desired cut is achieved.

4. Operation

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

4.1 Safety Precautions

DANGER: NEVER use the Flexdeburr for purposes other than robotic deburring. If used in any other way, serious injury or damage to equipment may occur.

WARNING: All personnel, who are involved in operation of the RC deburring tool, 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 RC deburring tool.

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

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

CAUTION: Do not use burs rated for less than the speed of the RC deburring tool being used. Using lower rated burs may cause injury or damage equipment. Always use burs rated for at least the speed of the RC deburring tool being used.

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

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

CAUTION: Never use or start the deburring tool without first reading and understanding the operating procedures described in this manual. Never use the deburring tool for any purposes, or in any ways, 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 deburring tool and connect the pneumatic control equipment as described in this manual. Operate the deburring tool as described in the manual.

4.2 Normal Operation

The following sections describes the normal operating conditions for RC deburring tools.

4.2.1 Air Quality

The air supply should be dry, filtered, and free of oil. A coalescing filter with 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 tools do receive proper air pressure, the tool stalls. Any water in the system damages the housing and blades.

4.2.2 No Lubrication

No lubrication is required.

Turbine motors cannot have any oil in the motor air supply. Oil damages the speed regulator and causes the motor speed to fluctuate out of tolerance.

4.2.3 Bur Selection, Design, and Maintenance

Use a carbide media.

RC tools have higher operating speeds and the media must be rated to RC idle speed at a minimum.

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.

Do not use shank extensions because the large moment loads combined with the high speed can be dangerous.

Brushes are not recommended because the maximum rated speed of the brush is less than the ideal speed of the deburring tool.

Do not use a tool that requires axial loading.

4.2.4 Deburring Tool Approach Path Should be Slow and at an Angle

The deburring tool should approach the workpiece slowly and at an angle.

When beginning a deburring pass, try to minimize the initial impact on the work piece by slowly approaching the tool at an angle while maintaining a slightly parallel path with the surface.

If the tool quickly approaches perpendicularly to the workpiece, the result is gouging and premature wear of the tool bearings and cutting bit. Additionally, collisions could result and create a hazardous situation for both personnel and equipment.

4.2.5 No Axial Loading

Do not apply axial loads that are parallel to the axis of the tool's rotation.

Do not deburr shallow edges where the cutter contacts the parent material below the edge; otherwise, axial loading is applied on the tool and bearings and results in premature failing of the unit.

When deburring holes, interpolate the perimeter. Do not use a countersink tool; otherwise, axial loading occurs and causes premature wear on the bearings.

4.2.6 Program the Robot to Incorporate 50% Compliance Travel of the Tool

Program the robot to have the tool's compliance at 50% travel when on the nominal path.

As the part's edge deviates from the perfect path, the cutting bit can use compliance to follow along high and low spots without losing contact or hitting the positive stop and gouging.

Do not "bottom out" the compliance and hit the positive stop.

Repeated impacts on the positive stop create slop in the compliance and reduce recentering repeatability.

4.3 Flexdeburr Working Environment

As described in previous sections, the RC deburring tool should only be used in conjunction with a robot in a secured work 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 Plexiglas to facilitate observation of the deburring operations.

During system or deburring tool maintenance, make sure the RC deburring tool and robot are stopped before entering the robot cell. When installing and testing, never be present in the cell when the Deburring tool is running.

Be aware of rotating parts. Use eye-protection while working around the deburring tool.

Be aware of high sound levels. While the Flexdeburr air motor is not loud, the cutting action associated with deburring frequently is loud. Always use hearing protection while working in the neighborhood of the deburring cell.

The deburring tool should not be used to deburr materials that are prone to fracture. A fracturing work piece may result in pieces of material damaging surrounding working environment and personnel. Material removed correctly should be in the form of chips.

4.4 Tool Center Point (TCP) Position and Programming

Figure 4.1 shows the RC deburring tool dimensions. The Flexdeburr provides radial compliance and performs best when the cuts taken are not excessively deep. The deburring tool spindle must never be running while programming the robot. During teaching, the compliance air must be on and supplied above a minimum of 0.35 bar (5 psi).

Two programming methods are suggested, but others are possible. In the first method, a dowel pin of suitable diameter is inserted in place of a cutting tool (simulating the cutter shank diameter) when teaching the robot path. For 6 mm collets, this will mean a 6 mm diameter pin of suitable length. The dowel pin should extend sufficiently from the collet to reach the surface on the burr where cutting is desired (see *Figure 4.1*). The diameter of the bur should not exceed that of the dowel pin by more than the compliance of the RC deburring tool.

Another programming method is to teach the path using the center line of the bur as a guide, following the edge of the part, and then manually or automatically adding offsets to the robot path points to achieve the final correct burr path (see *Figure 4.2*). The programming method used will depend on the robot's capabilities and programmer preferences.

Figure 4.1— Flexdeburr Dowel Teaching Tool

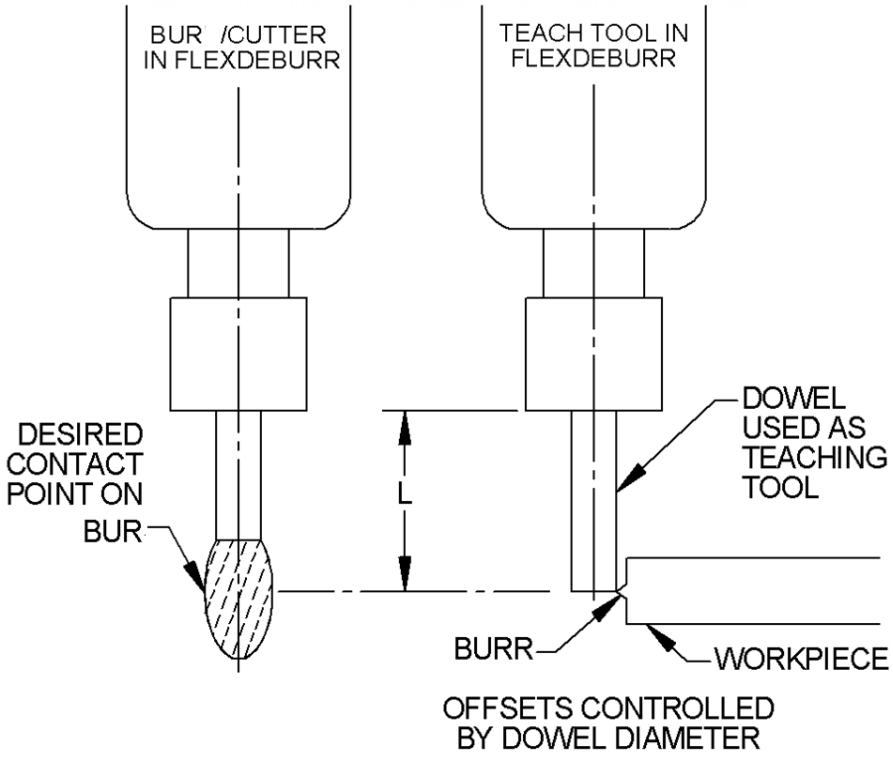
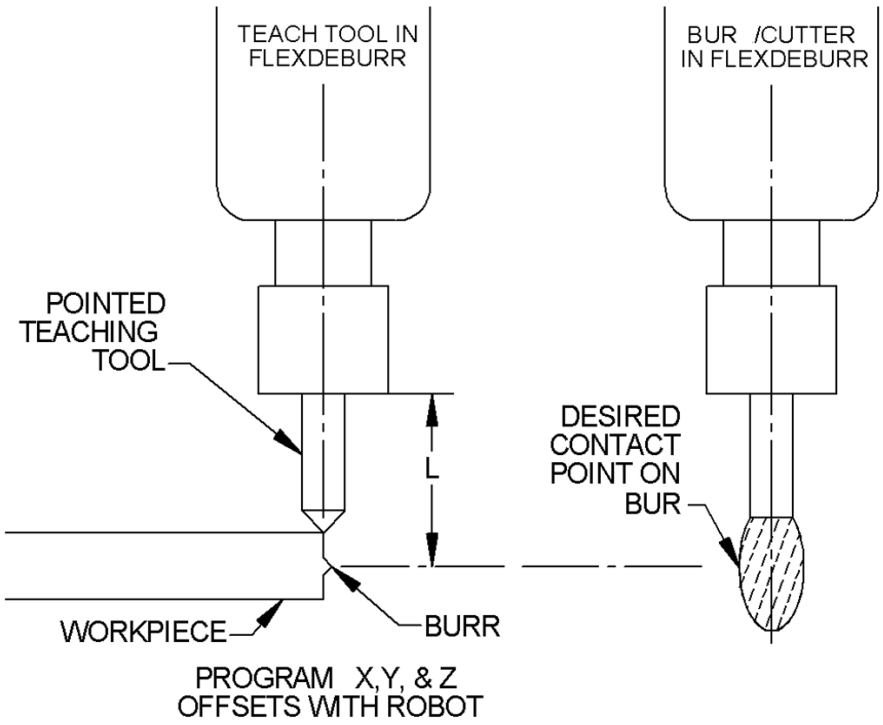


Figure 4.2— Flexdeburr Pointed Teaching Tool



Inside corners represent a complex situation for compliant deburring tools. In general, the bur must not be allowed to simultaneously contact both perpendicular surfaces of an inside corner. The resulting force imbalance in two planes will cause severe tool chatter. The customer is advised to create a tool path, which will prevent the cutter from simultaneously contacting two perpendicular surfaces. A tapered cutter may reach further into such an inside corner if the tool is presented in an inclined orientation and closer to the tip of the tool. (Note: When working near the tip of a tapered cutter the surface cutting speed is reduced.)

When deburring inside radii, a similar situation may arise. The customer is advised that no attempt should be made to deburr an inside radius less than 1.5 times the diameter of the desired cutter (Rmin = 1.5 x Cutter diameter). Depending on the depth of cut, failing to follow these guidelines may result in excessive bur contact that results in excessive tool chatter.

When running the robot program the first time, observe the path with the radial compliance air supply turned down to approximately 0.35 bar (5 psi). When the robot path speed is increased, it is important to notice that robot may deviate from the programmed path. Verify that at operational robot path speed, the bur is deflected but contacts the work surface. Once the robot path has been confirmed, the compliance force of the bur should be adjusted, as described in *Section 3.7—Pneumatics*, in order to achieve a correct depth of cut.

4.5 Cutter Operation and Bur Selection

The RC deburring tool will perform best in “climb milling”. This refers to a bur whose directions of traverse and bur rotation are the same. In the case of the RC deburring tools, the bur rotation is clockwise when viewed from above. Climb milling would therefore involve clockwise motion around the part being deburred. In climb milling, the heaviest cut is made as the tool enters the work piece and the chip becomes narrower as the cut is completed. In “conventional milling”, the bur travels in a direction opposite of burr rotation. This may aid in bur stability for some operations; however, the cutting edge of the bur is subjected to higher friction and cutting forces. Tool wear is accelerated in this mode and surface finish quality will generally be reduced. When “conventional milling”, extra care must be taken around corners. This poses a potential hazard where the cutting force can deflect the bur causing the bur to break as the robot continues along its path.

The selection of a bur is highly dependent upon the part’s material and geometry and the depth of cut. It is not practical to present all the possibilities in this document. Please see *Section 4.5.1—Bur Selection* for a short list of burs and suitable applications. It is worth mentioning here that a specific family of burs is available for working with die cast alloys, aluminum, and plastics. These burs have fewer teeth and increased relief to minimize chip loading.

Plastics represent the most difficult deburring challenge due to the phenomenon of chip re-welding. In this process, if the bur is dull or the feeds and speeds are not correct for the material removed, the chip will melt and weld to the bur or the work piece. This can quickly load a bur and produce unacceptable results. In general, the traverse or feed rate of the deburring tool will be higher for plastics to minimize this behavior. This results in larger cuts, which more effectively remove heat from the bur-tool interface.

4.5.1 Bur Selection

Standard length commercial burs are used with Flexdeburr products. The length of these tools is typically around 2” for 1/4” shank diameter burs (50 mm for 6 mm diameter). Avoid longer shank burs that are available from industrial suppliers and that appear in their catalogs with descriptions such as “long” or “extended” shank. Using extended or long shank burs in the Flexdeburr will place higher loads and vibrations on the motor bearings resulting in reduced motor life. Bearing failure caused by the use of extended shank burs is not covered under warranty.

CAUTION: DO NOT use long or extended shank burs with the Flexdeburr. Long shank tools can lead to premature failure of the air motor and is not covered under warranty.

ATI can provide guidance in bur selection; however, only experimentation will yield the results desired. The following table is presented to assist in burr selection.

This following table is not comprehensive but includes many common bur types and burs recommended for particular applications.

Table 4.1—Bur Selection

	Materials/Application	Features/Benefits:
	**9150-RC-B-24033 - Diamond Cut, 1/4” Bur Diameter, 5/8” Burr Length, 1/4” Shank**	
	• For hardened and tough materials, super alloys, and stainless. steel, alloyed cast steel and fiber reinforced plastics. • Edge and surface working. • Built up Welds of high-tensile strength in mold and die making.	• Higher cutting capacity than standard cuts. • Smoother finish for surface treatments. • Lower axial force than ADC.

Table 4.1—Bur Selection		
	Materials/Application	**Features/Benefits:**
	**9150-RC-B-24061 - Standard Cut, 3/8” Burr Diameter, 3/4” Bur Length, 1/4” Shank**	
	• For steels of high tensile strength die steels, cast steel, built up welds, tough materials, and welds. • For beveling. • For chamfering. • For deburring.	• Without chip breaker, for scratch-free surfaces.
	**9150-RC-B-24063 - Diamond Cut, 3/8” Burr Diameter, 3/4” Bur Length, 1/4” Shank**	
	• For hardened and tough materials, super alloys, and stainless steel, alloyed cast steel and fiber reinforced plastics. • Edge and surface working. • Built up Welds of high-tensile strength in mold and die making. • Higher cutting capacity than standard cuts.	• Smoother finish for surface treatments. • Lower axial force than ADC.
	**9150-RC-B-24065 - Aluminum Cut, 3/8” Burr Diameter, 5/8” Bur Length, 1/4” Shank**	
	• For greasy aluminum alloys, soft non-ferrous metals and thermoplastics. • For deburring. • For use on cast aluminum.	• Easy chip flow through positive rake angle, rounded base of tooth, convex tooth back. • No loading of the flutes, not even while cutting sticky metals. • Smooth operation due to the peeling effect of the teeth.
	**9150-RC-B-24645 - Aluminum Cut, 3/8” Burr Diameter, 5/8” Bur Length, 1/4” Shank**	
	• For greasy aluminum alloys, soft non-ferrous metals and thermoplastics. • For deburring. • For use on cast aluminum.	• Easy chip flow-through positive rake angle, rounded base of tooth, convex tooth back. • No loading of the flutes, not even while cutting sticky metals. • Smooth operation due to the peeling effect of the teeth.

Table 4.1—Bur Selection		
	Materials/Application	**Features/Benefits:**
	**9150-RC-B-26408 - Cut FVK, 1/4” Bur Diameter, 5/8” Bur Length, 1/4” Shank**	
	• For trimming and contour milling of all glass and carbon fiber reinforced plastics.	• Special cut geometry allows high feed rates due to low cutting forces.
	**9150-RC-B-24862 - Alt Diamond Cut, 1/4” Burr Diameter, 3/4” Bur Length, 1/4” Shank**	
	• Universal use, for ferrous and non-ferrous metals, plastics. • Rough finishing of castings. • Surface working. • Weld removal. • Brazed welds.	• Smoother operation, improved tool control. • High cutting action. • Non-clogging. • Smaller chips, reduced slivers. • Even, smooth surfaces.

5. Maintenance

The RC deburring tool is designed to provide reliable service for long periods of operation. 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. *Section 6—Troubleshooting and Service Procedures* is provided to assist the user when they choose to service the unit in the field.

For all service, disconnect the air supply (before the solenoid valves). Drain any trapped air pressure in the lines. The air supply should be "locked out" to prevent accidental operation of the spindle. During maintenance operations, refer to *Section 6—Troubleshooting and Service Procedures* for maintenance instructions. Service and repair parts are identified in *Section 7—Serviceable Parts* and *Section 9—Drawings*.

5.1 Pneumatics

The air lines to the deburring tools should routinely be checked for their general condition and replaced as required. The air to the Flexdeburr must be filtered, dry, and non-lubricated. The air filters should be checked and replaced as required to maintain optimum performance. The life of the filter elements is dependent on the quality of compressed air at the customer's facility and therefore cannot be estimated.

5.2 Lubrication

Lubrication systems are not to be used. The Flexdeburr turbine motor must be supplied with clean, dry, filtered air. Oil in the air stream will cause the turbine motor to fail prematurely. Failure of the motor due to oil in the air stream is not covered under the warranty. See *Section 3.7—Pneumatics* for details on air supply and quality.

CAUTION: DO NOT use lubricated air with the Flexdeburr. Oil in the air stream will result in the premature failure of the air motor and is not covered under warranty. It is recommended that the customer use a coalescing filter and filter elements rated 5 micron or better.

5.3 Bellows Boot Inspection

The bellows boot prevents debris from entering the housing and protects internal components. Inspect the spindle boot regularly for damage and replace if necessary.
Refer to *Section 6.2.5—Tapered Bellows Boot Replacement*.

5.4 Bur Inspection

The bur will wear depending on cut depth, feed rate, and material being deburred. Inspect the bur regularly for wear, and refer to *Section 6—Troubleshooting and Service Procedures* for symptoms of a worn bur.

5.5 Spindle Motion Inspection

The pivot bearing allows articulation of the motor assembly. The pivot bearing is subject to wear and should be replaced when excessive spindle motion is observed. Contact between the motor air supply fitting and the main housing indicates pivot bearing wear which should be corrected.
Refer to *Section 6.2.2—Rear Housing and Pivot Bearing Replacement*.

6. Troubleshooting and Service Procedures

The RC deburring tool is designed to provide reliable service for long periods of operation. 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. *Section 6.1—Troubleshooting Procedures* is provided to assist the user when they choose to service the unit in the field.

For all service, disconnect the air supply (before the solenoid valves). Drain any trapped air pressure in the lines. It is suggested that the air supply be "locked out" to prevent accidental operation of the air motor spindle. During maintenance operations, refer to *Section 6.2—Service Procedures* for maintenance instructions. Service and repair parts are identified in *Section 7—Serviceable Parts* and *Section 9—Drawings*.

6.1 Troubleshooting Procedures

Deburring process development is an iterative, learning task. The following table is presented to assist in solving deburring problems.

Table 6.1—Troubleshooting

Symptom	Cause	Resolution
Bur Wear.	Hard work material.	Use a better grade burr material add coating (TiAlN).
	Too heavy a cut.	Decrease width of cut/make multiple passes.
	Feed rate is too slow.	Increase feed rate.
Bur Breakage.	Too heavy a cut.	Decrease width of cut/make multiple passes.
	Deflection at corner.	Climb mill; do not begin path at a sharp corner.
	Impacting part.	Decrease feed rate at contact; enter part at an angle.
Unequal compliance.	Worn ring cylinder.	Replace ring cylinder; refer to *Section 6.2.4—Ring Cylinder Assembly Replacement*.
	Pivot bearing worn.	Replace pivot bearing. Refer to *Section 6.2.2.2—Pivot Bearing and Keying Dowel Replacement*.
	Pivot bearing components (axial, radial, preload set screw) not set correctly.	Reinstall the axial and preload set screw, and verify the preload set screw is correctly adjusted. Refer to *Section 6.2.2.2—Pivot Bearing and Keying Dowel Replacement*.
Poor finish on work piece.	Feed rate is too fast.	Reduce feed rate.
	Bur is worn.	Inspect bur; if worn, replace. Refer to *Section 6.2.1—Bur and Collet Replacement*.
	Turbine bearings are worn.	Inspect spindle shaft, if shaft feels loose or has play, replace the turbine motor. Refer to *Section 6.2.3—Turbine Motor Replacement.*
Bur is chattering during a cut.	Feed rate is too fast.	Reduce feed rate.
	Lack of rigidity.	Increase radial compliance pressure.
	Too heavy a cut.	Decrease width of cut; make multiple passes.
	Improper bur selection.	Choose bur designed for work material. Refer to *Section 4.5.1—Bur Selection*.
	Bur is worn.	Inspect bur if worn, replace. Refer to *Section 6.2.1—Bur and Collet Replacement*.
	Turbine motor bearings are worn	Inspect spindle shaft. If spindle shaft feels loose or has play, replace the turbine motor. Refer to *Section 6.2.3—Turbine Motor Replacement.*

Table 6.1—Troubleshooting		
Symptom	**Cause**	**Resolution**
Secondary burrs are created on work piece after cut.	Incorrect feed rate.	Reduce feed rate.
	Too heavy a cut.	Decrease width of cut; make multiple passes.
	Improper Bur selection.	Choose bur designed for work material. Refer to *Section 4.5.1—Bur Selection*.
	Bur is worn.	Inspect bur. If worn, replace. Refer to *Section 6.2.1—Bur and Collet Replacement*.
	Motor bearings are worn.	Inspect turbine motor spindle shaft. If spindle feels loose or has play, replace the turbine motor. Refer to *Section 6.2.3—Turbine Motor Replacement.*
Chip Packing of Burr.	Too heavy a cut.	Decrease width of cut; make multiple passes.
	Not enough chip clearance.	Use a bur with fewer flutes.
Bur stalls.	Not enough or no drive air.	Check drive air regulator has 6.2 bar (90 psi) of air, and inspect for leaks.
	Bur is not secure in collet.	Properly tighten burr in collet; refer to *Section 6.2.1—Bur and Collet Replacement*.
	Too much side load.	Decrease width of cut/make multiple passes.
	The turbine motor needs to be replaced	Replace air motor; refer to *Section 6.2.3—Turbine Motor Replacement*.
Sticking Turbine Motor Spindle.	The turbine motor bearings are worn.	Replace turbine motor; refer to *Section 6.2.3—Turbine Motor Replacement*.

6.2 Service Procedures

The following service procedures provide instructions for component replacement and adjustment.

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.

6.2.1 Bur and Collet Replacement

In normal operation the bur will become worn. If improper feeds and speeds are used, the cutter may become “loaded” with material. In both instances, the bur must be replaced. During initial production, the bur and the work piece should be examined often in order to determine at what interval the bur should be replaced. Replacing the collet is not required, when the bur is replaced, but a different collet may be required, when a different sized tool is used.

The following steps detail replacing the bur and or collet:

Refer to *Figure 6.1*.

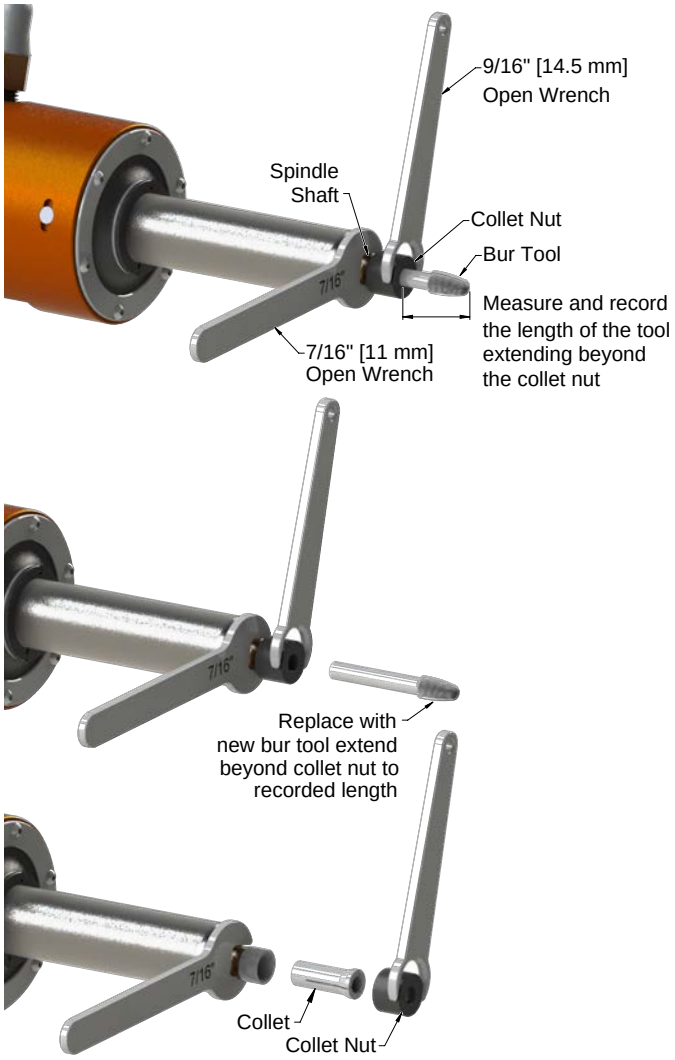
Parts required: *Refer to Section 7—Serviceable Parts.*

Tools required: *7/16” (11 mm) and 9/16” (14.5 mm) open-end wrench*

1. Lock out the spindle motor air supply for safety. (De-energize all energized circuits such as air and power).
2. If applicable, disconnect the air hose from the compliance and spindle supply air fitting and remove the deburring tool from the robot or work piece.

3. If the bur is to be replaced with an identical type, measure and record the tool length extending beyond the collet lock nut.
   Alternatively, the optional ATI 9150-RC-T-4230 bur setting tool accessory can be used to duplicate tool exposure length. Refer to the *Supplemental Documentation for Deburring Tools - Bur Setting Fixture Instructions Document#9640-50-1005*.
4. Use the 7/16” (11 mm) open-end wrench to hold the spindle just behind the collet nut.
5. Use the 9/16” (14.5 mm) collet wrench to turn the collet locknut counterclockwise (when viewed from the bur tip) to loosen the collet.

Figure 6.1— Bur and Collet Replacement



> **CAUTION:** During operation of the deburring tool, the bur reaches high temperatures. Failure to wear proper personal protection equipment or not allowing the bur to cool could result in serious injury to the user. Be aware that during operation, the bur becomes very hot, and when removing the bur, take necessary safety precautions to avoid injury.

6. To remove a worn bur, pull the bur out of the loosened collet.
7. If the collet is being replaced, completely remove the nut and extract the old collet. Insert the new collet and refit the nut leaving it loose.
8. If an identical new bur is replacing a worn bur, measure and adjust the length of its exposed portion according to the measurement taken in Step *3*.

9. Use the 7/16” (11 mm) open-end wrench to hold the spindle just behind the collet nut.
10. Use the 9/16” (14.5 mm) collet wrench to turn the collet locknut clockwise (when viewed from the bur tip) to tighten the collet.
11. If applicable, install the deburring tool to the robot or work location.
12. If applicable, replace hose connections to the compliance and spindle supply air fitting.
13. When the replacement procedure is complete, all circuits (for example: power and air) may be placed into normal operation.

6.2.2 Rear Housing and Pivot Bearing Replacement

To minimize possible downtime, the pivot bearing should be replaced any time the turbine motor is replaced. Early Flexdeburr units can be identified by their lack of radial and axial tapped holes for the pivot bearing keying dowel (refer to *Figure 6.3*). During maintenance of these units the customer should replace the entire rear housing assembly to upgrade the deburring tool. The early style of pivot bearing and rear housing are not currently supported.

The pivot bearing may be replaced in one of two ways. For quick repairs with minimal downtime, the user is encouraged to replace the entire rear housing assembly. Refer to *Section 6.2.2.1—Rear Housing Replacement*. When a spare unit can be placed into service or downtime is not an issue, a new pivot bearing can be installed in an existing rear housing assembly. Refer to *Section 6.2.2.2—Pivot Bearing and Keying Dowel Replacement*.

6.2.2.1 Rear Housing Replacement

Refer to *Figure 6.2*.

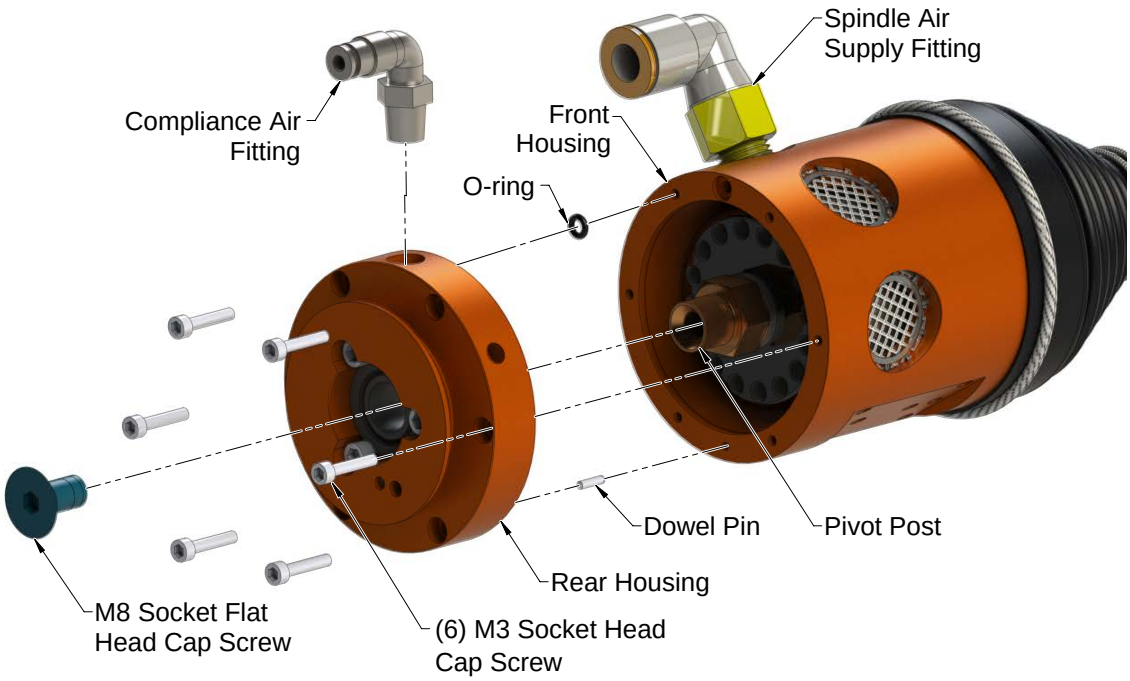
Parts required: *Refer to Section 7—Serviceable Parts.*

Tools required: *2.5 and 6 mm Allen® wrench, torque wrench*

Supplies required: *Magnalube, Loctite® primer 7649, Loctite 222 and 569, Clean lint free rag*

1. Remove and/or lock out the spindle motor air supply for safety. (De-energize all energized circuits such as air and power).
2. Disconnect the air hoses from the compliance and spindle supply air fitting.
3. Remove the deburring tool from the robot or work location.
4. Clean the debris from the deburring tool using compressed air and a clean rag to wipe any grease from the outer surfaces.
5. Using a 6 mm Allen wrench, remove the M8 socket flat head cap screw from the center of the deburring unit’s rear housing. Refer to *Figure 6.2*.
6. Using a 2.5 mm Allen wrench, remove the (6) M3 socket head cap screws that secure the rear housing to the front housing.
7. Remove the rear housing cover complete with the pivot bearing. Retain the small O-ring and dowel pin between the cover and housing for reuse if desired. (A new rear housing assembly is provided with new fasteners and a new O-ring.)
8. Remove the compliance air fitting from the rear housing assembly. Discard the old rear housing assembly.
9. With a clean lint free rag, wipe debris and fluid from the threads of the compliance air fitting.
10. Apply Loctite 569 to the threads of the compliance air fitting and thread into the new rear housing assembly. Tighten the air fitting hand tight plus an additional half turn.

Figure 6.2— Rear Housing Assembly Replacement



11. Apply Magnalube to the small O-ring and dowel pin.
12. Set the O-ring and dowel pin in place on the front housing.
13. Apply Loctite 7649 primer and Loctite 222 to the threads of the (6) M3 socket head cap screws.
14. Using a 2.5 mm Allen wrench, secure the rear housing cover to the front housing with the (6) M3 socket head cap screws. Tighten to 12 in-lbs (1.4 Nm).
15. Insert the M8 socket flat head cap screw into the pivot post; do not fully tighten the screw.
16. Position the air motor to ensure that the spindle air supply fitting is centered in the front housing hole.
17. Using a 6 mm Allen wrench, tighten the M8 socket head cap screw 110 in-lbs (12.4 Nm).
18. Install the deburring tool to the robot or work location.
19. Replace the air hoses to the compliance and spindle supply air fitting.
20. When the replacement procedure is complete, all circuits (for example: air and power) may be placed into normal operation.

6.2.2.2 Pivot Bearing and Keying Dowel Replacement

Refer to *Figure 6.3* through *Figure 6.6*.

Parts required: *Refer to Section 7—Serviceable Parts.*

Tools required: *2.5 mm and 3 mm Allen wrench, torque wrench, small diameter magnet*

Supplies required: *Magnalube, Loctite 7649 primer, Loctite 222, clean lint free rag*

1. Remove and/or lock-out the spindle motor air supply for safety. (De-energize all energized circuits such as air and power).
2. Disconnect the air hose from the compliance and spindle supply air fitting.
3. Remove the deburring tool from the robot or work location.
4. Clean the debris from the deburring tool using compressed air and a clean rag to wipe any grease from the outer surfaces.
5. Remove the rear housing cover from the front housing.
   Refer to *Section 6.2.2.1—Rear Housing Replacement*, steps *5* through *7*.
6. With a clean lint free rag, clean any debris and lubrication from the alignment pin and O-ring as well as the rear and front housing assemblies.
7. Using a 3 mm Allen wrench, remove the (3) M4 socket head cap screws securing the clamping washer and pivot bearing in the center of the rear housing. Refer to *Figure 6.3*.
8. Remove the large clamping washer, which rests on top of the pivot bearing.
9. Locate and loosen, with a 3 mm Allen wrench, the radially tapped bearing preload M5 set screw in the rear housing.
10. Locate the (2) M4 set screws securing the pivot bearing keying dowel in the rear housing. One will be radially tapped in the rear housing, and the second will be axially tapped on the rear mounting surface. Remove both screws, using a 2.5 mm Allen wrench.
11. Use a small diameter magnet or a powerful magnet attached to the side of a hex key to reach inside the keying dowel pin hole. Remove the keying dowel pin from the rear housing.
12. With the dowel pin removed, the old pivot bearing can be pressed from the rear housing using a press tool.

Figure 6.3—Remove the Pivot Bearing and Keying Dowel

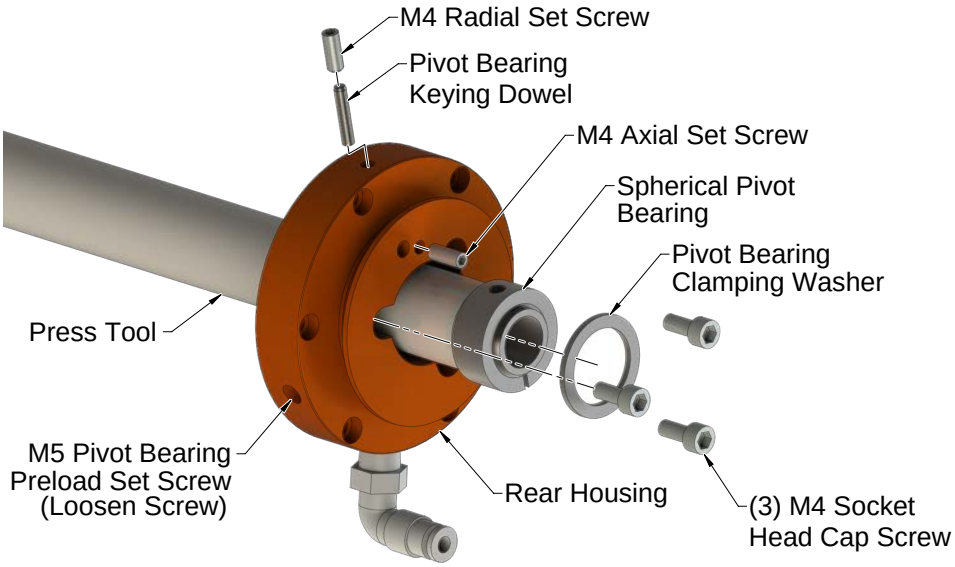
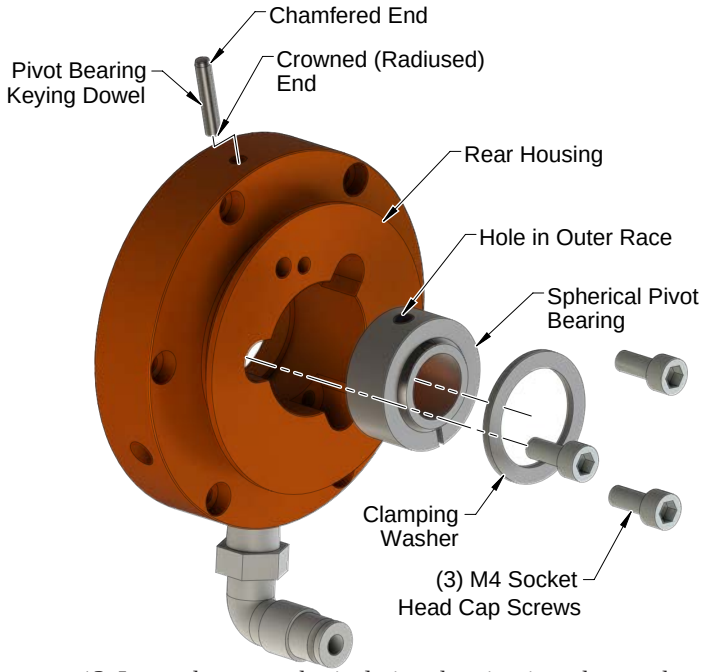


Figure 6.4—Install the Pivot Bearing and Keying Dowel



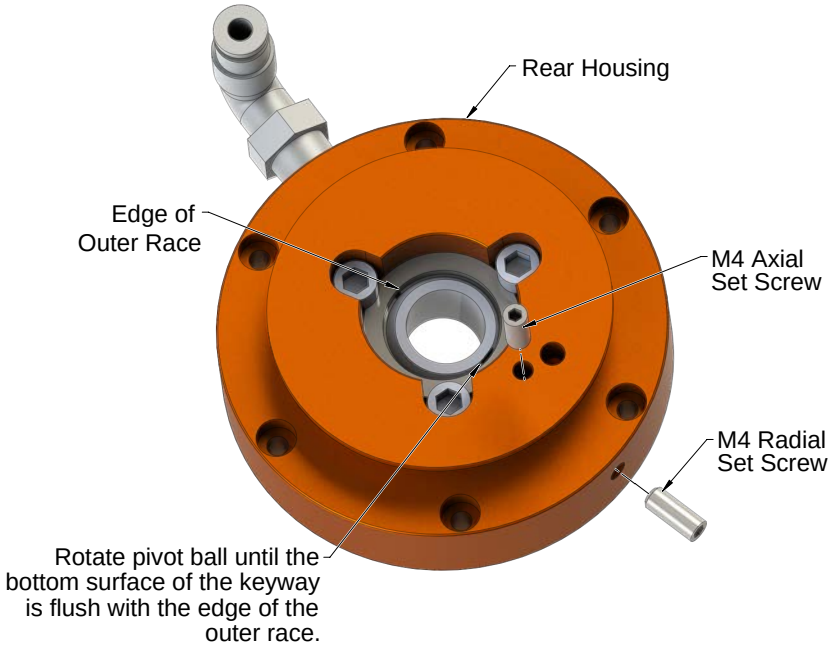
13. Insert the new spherical pivot bearing into the rear housing, making sure the hole in the outer race of the new pivot bearing lines up with the keying dowel pin hole in the rear housing.

14. Always use a new keying dowel pin. Insert the keying dowel pin with its crowned (radiused) end first so that it rests in the slot machined in the pivot bearing's ball (visible from the end of the pivot bearing).

15. Apply Loctite 7649 primer and then Loctite 222 to the threads of the (3) M4 socket head cap screws that are used to secure the clamping washer.

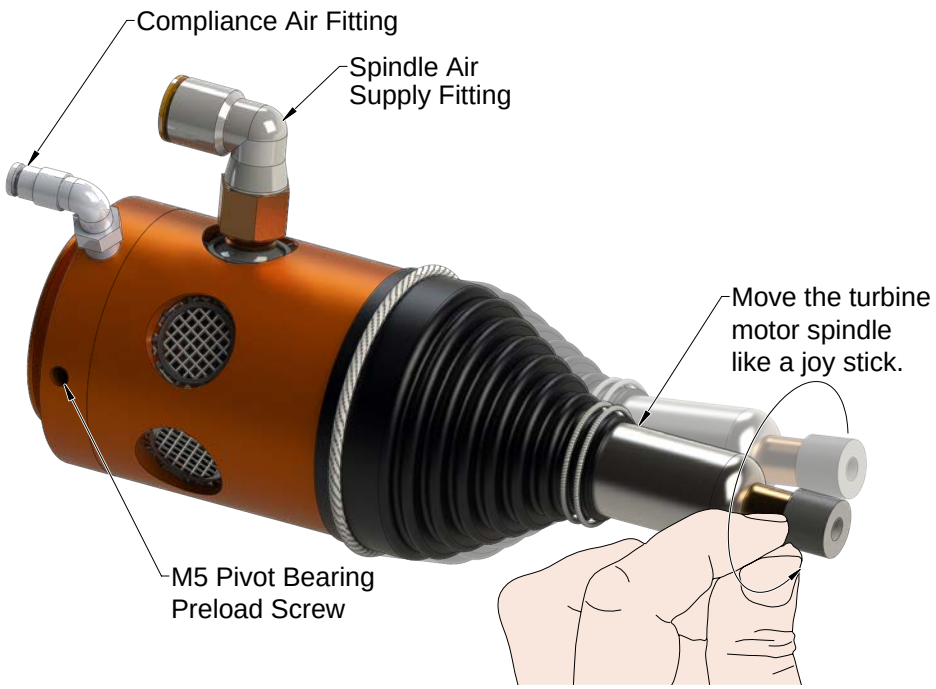
16. With a 3 mm Allen wrench, refit both the washer and (3) M4 socket head cap screws to the rear housing. Tighten the screws to 12 in-lbs (1.4 Nm).

Figure 6.5—Pivot Bearing Set Screw Installation



17. Rotate the pivot ball until the bottom surface of the keyway is flush with the edge of the outer race.
18. Apply Loctite 7649 and Loctite 222 to the (2) keying dowel pin M4 set screws.
19. While holding the pivot ball in the rotated position, use a 2.5 mm Allen wrench to thread the M4 radial set screw securing the keying dowel pin in the rear housing until the screw just contacts the end of the pin.
20. Still holding the pivot ball in the rotated position, use a 2.5 mm Allen wrench to insert the axial M4 set screw into the rear housing so that keying dowel pin is securely in place. Tighten the axial M4 set screw to 12 in-lb (1.4 Nm).
21. Install the rear housing cover onto the front housing cover.
    Refer to *Section 6.2.2.1—Rear Housing Replacement* steps *11* through *17*.
22. Install the deburring tool on the robot or work location.
23. Replace the hose connection to the compliance air fitting and supply 0.69 bar (10 psi). Move the turbine motor spindle like a joystick and loosen or tighten the M5 bearing preload set screw with a 3 mm Allen wrench until a slight resistance to the applied motion can be felt. Refer to *Figure 6.6*.

Figure 6.6— Pivot Bearing Adjustment



24. Replace hose connection to the spindle supply air fitting.
25. When replacement procedure is complete, all circuits (for example: air and power) may be placed into normal operation.

6.2.3 Turbine Motor Replacement

If the turbine motor is operated using oil-laden or dirty air, it will fail and require replacement. Failure of the motor due to contamination in the spindle air is not covered under warranty. The motor may also require replacement after an extended operating life or following a severe collision. To minimize possible downtime, the pivot bearing should be replaced any time the turbine motor is replaced; refer to *Section 6.2.2—Rear Housing and Pivot Bearing Replacement*. There are no user serviceable parts in the turbine motor. Flexdeburr units with defective motors should be returned to ATI during the warranty period. Motors are sold as complete, modular assemblies to simplify and speed user installation. Should the customer wish to replace the motor after the warranty period, perform the following steps.

Refer to *Figure 6.7* through *Figure 6.10*.

Parts required: *Refer to Section 7—Serviceable Parts.*

Tools required: *Small screwdriver, 2 mm, 2.5 mm, and 6 mm Allen wrenches, torque wrench, needle-nose pliers, crescent wrench*

Supplies required: *Clean lint free rag, Magnalube, Loctite Primer 7649, Loctite 222 and 569*

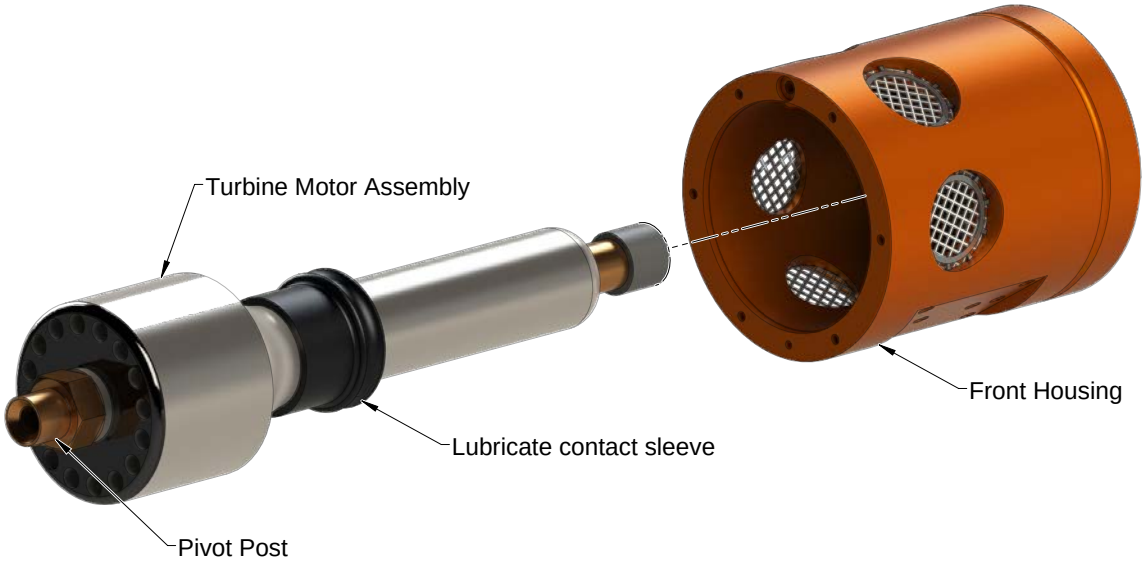
1. Remove and/or lock out the spindle motor air supply for safety. (De-energize all energized circuits such as air and power).
2. Disconnect the air hoses from the spindle and compliance air fittings.
3. Remove the deburring tool from the robot or work location.
4. Remove the cutting bur, refer to *Section 6.2.1—Bur and Collet Replacement* steps *3* through *7*.
5. Using compressed air and a clean rag, remove debris and grease from the outer surfaces of the deburring tool.
6. Using a small screw driver, pry the retaining ring around the spindle air fitting from the housing.

7. Lift the retaining ring and rubber boot out of the housing. ATI recommends replacing the retaining ring and rubber disk when the turbine motor is replaced.
8. Remove the spindle air supply fitting from the side of the main housing by using a crescent wrench and rotating the fitting counter-clockwise.
9. If applicable, remove the tapered bellows boot and (3) garter springs.
   Refer to *Section 6.2.5—Tapered Bellows Boot Replacement* steps *3* and *4*.
10. Ease the garter spring off the front spindle boot.

Figure 6.7— Spindle Air Supply Fitting Assembly and Disk Boot Garter Spring

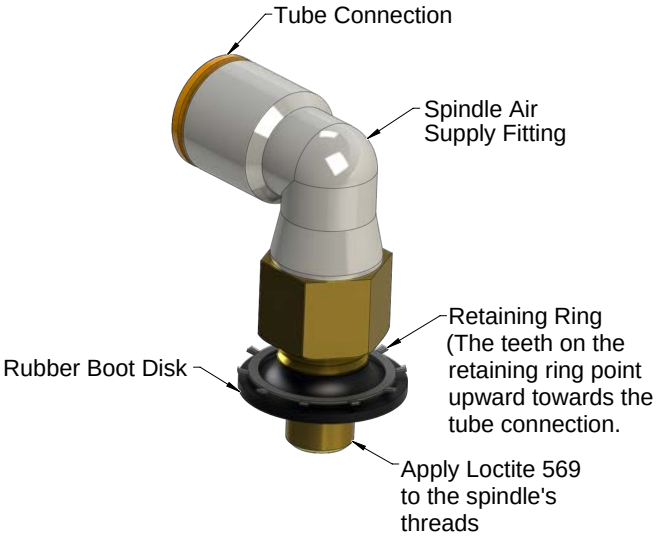
11. Remove the rear housing assembly.
    Refer to *Section 6.2.2.1—Rear Housing Replacement* steps *5* through *7*.
12. Withdraw the turbine motor complete as an assembly. Refer to *Figure 6.8*.

Figure 6.8— Remove the Turbine Motor Assembly



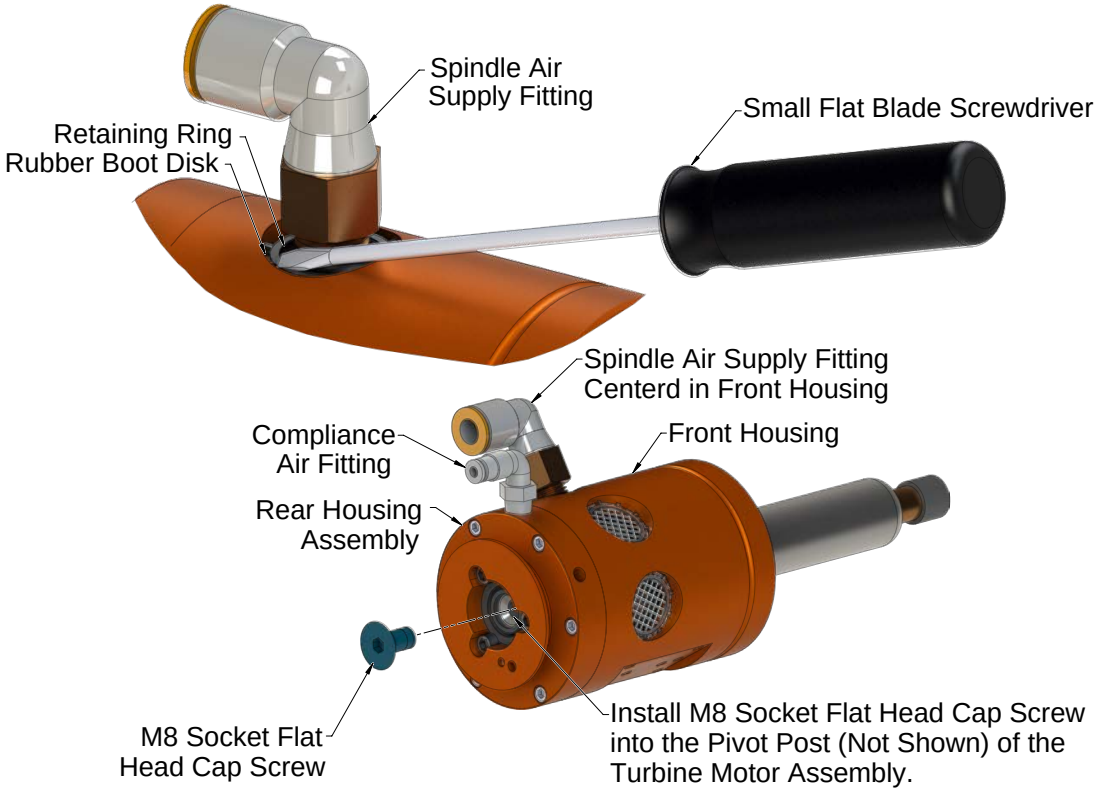
13. Apply a thin coating of Magnalube or equivalent to the outer surface of the new turbine motor contact sleeve.
14. Gently insert the new turbine motor assembly into the rear end of the front housing assembly and through the ring cylinder. Make sure the turbine motor is oriented so that the air port in the turbine motor lines up with the opening in the front housing assembly.
15. Install the rear housing assembly.
    Refer to *Section 6.2.2.1—Rear Housing Replacement* steps *11* through *14*.
16. Slip the retaining ring over the fitting followed by the rubber disk boot. The points on the retaining ring should point towards the air spindle fitting's tube. Refer to *Figure 6.7*.
17. Apply Loctite 569 to the threads of the spindle air supply fitting.

Figure 6.9—Assemble Spindle Air Supply Fitting, Retaining Ring, and Rubber Boot Disk



18. Install the spindle air supply fitting in the turbine motor. The spindle air supply fitting should be hand tight and an additional one half to three quarters of a turn.
19. Use a small flat blade screw driver to seat the (spindle supply fitting) rubber disk and retaining ring into the bottom of the counterbore in the front housing assembly. Refer to *Figure 6.10*.

Figure 6.10—Installation of Turbine Motor Assembly, Spindle Air Supply Fitting, and Rear Cover



20. Insert the M8 socket flat head cap screw into the pivot post; do not fully tighten the screw.
21. Position the turbine motor to ensure that the spindle air supply fitting is centered in the front housing hole.
22. While holding the motor to keep the air fitting centered in the hole, use a 6 mm Allen wrench to tighten the M8 socket flat head cap screw to 110 in-lbs (12.4 Nm).
23. Install the garter spring on the front spindle boot. Refer to *Figure 6.7*.
24. If applicable, install the tapered bellows boot over the motor shaft.
    Refer to *Section 6.2.5—Tapered Bellows Boot Replacement* steps *5* and *6*.
25. Install the cutting bur, refer to *Section 6.2.1—Bur and Collet Replacement* step *7* through *10*.
26. Install the deburring tool to the robot or work location.
27. Connect the air hoses to the spindle and compliance air fittings.
28. When replacement procedure is complete, all circuits (for example: air and power) may be placed into normal operation.

6.2.4 Ring Cylinder Assembly Replacement

The compliant motion of the turbine motor spindle is accomplished using a circular array of pistons (ring cylinder) at the front of the housing. After extended operation, this component may need replacing to ensure free motion of the pistons. The unit may be replaced as an assembly, but its subcomponents are not user serviceable. To replace the ring cylinder assembly, perform the following steps. The ring cylinder is available as a complete assembly with new O-ring seals.

Refer to *Figure 6.11* through *Figure 6.14*.

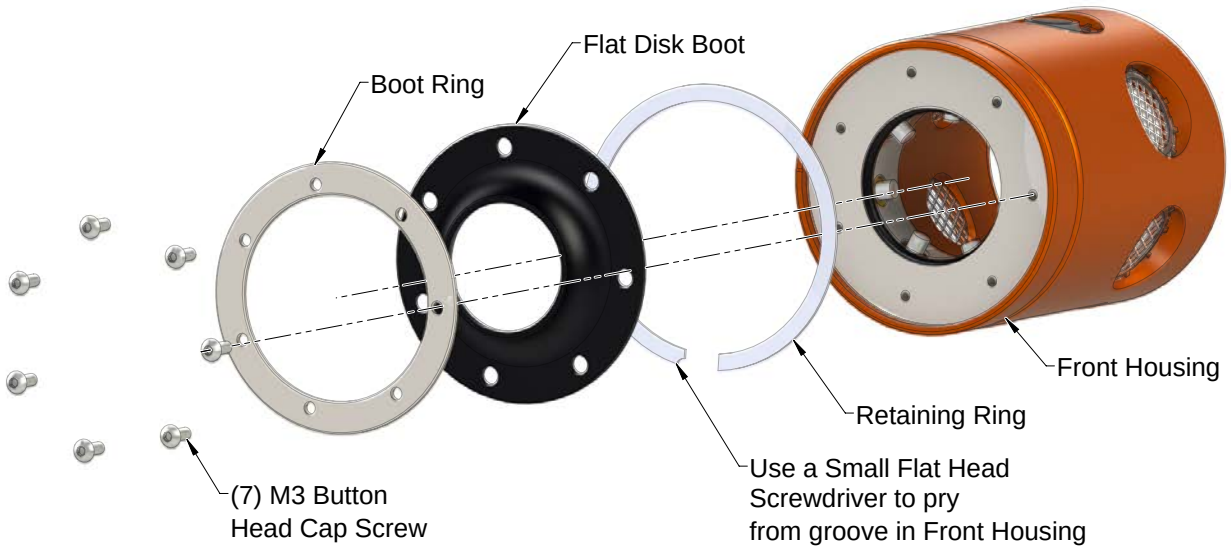
Parts required: *Refer to Section 7—Serviceable Parts.*

Tools required: *2 mm Allen wrench, torque wrench, small flat blade screwdriver, non-metallic drift or arbor press, clean rag, flat plate*

Supplies required: *Clean rag, Magnalube, Loctite 222*

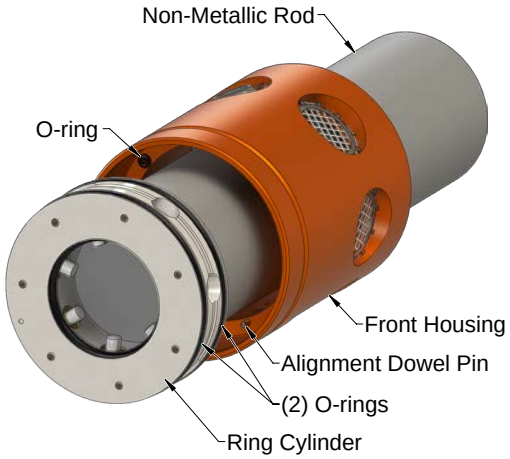
1. Remove and/or lock out the spindle motor air supply for safety. (De-energize all energized circuits such as air and power).
2. Disconnect the air hose from the compliance and spindle supply air fitting.
3. Remove the deburring tool from the robot or work location.
4. Remove the turbine motor assembly.
   Refer to *Section 6.2.3—Turbine Motor Replacement* steps *5* through *12*.
5. Use a 2 mm Allen wrench to remove the (7) M3 button head cap screws securing the boot ring and flat disk boot to the front housing.
6. Using a small flat blade screwdriver, pry the ring cylinder retaining ring free and remove from the front housing.

Figure 6.11—Boot Ring, Flat Disk Boot, and Retaining Ring



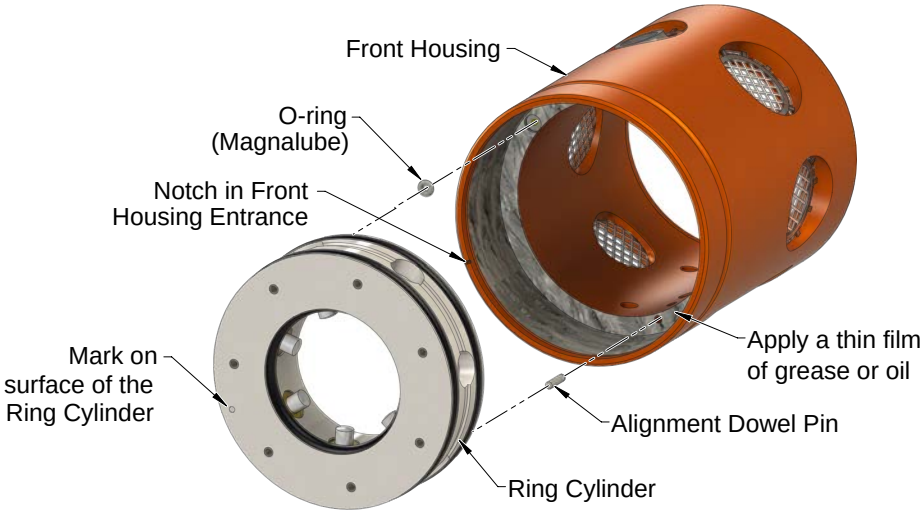
7. From inside the housing, use a non-metallic drift (plastic or wooden rod) to press the ring cylinder out of the housing. Refer to *Figure 6.12*.
   Note: After prolonged periods of use, the O-ring seals may make removal of the compliance unit difficult. If this occurs, support the front housing on a suitable plate with a clearance hole for the ring cylinder. Use an arbor press for extraction. Retain the small O-ring and dowel pin for reuse.

Figure 6.12— Remove Ring Cylinder with a Non-Metallic Drift (plastic or wooden rod)



8. Using a clean lint free rag, remove any debris and lubrication from the alignment dowel pin, O-ring, and front housing (including the bore inside the housing).
9. Apply a thin film of Magnalube to the housing bore where the ring cylinder seats.
10. Apply a thin film of Magnalube to the small O-ring and fit into the spotface of the front housing.
11. Apply a thin film of Magnalube to the dowel pin and insert into the slip fit hole of the front housing.
12. Align the alignment notch on the front housing entrance and the alignment mark on the flat surface of the ring cylinder assembly prior to pressing the ring cylinder in the bore.
13. Using hand pressure and a flat plate, press the ring cylinder assembly beyond the retaining ring groove and into the seat of the bore in the front housing. The alignment dowel pin helps to ensure proper orientation of the ring cylinder. Make sure the small O-ring is in place.

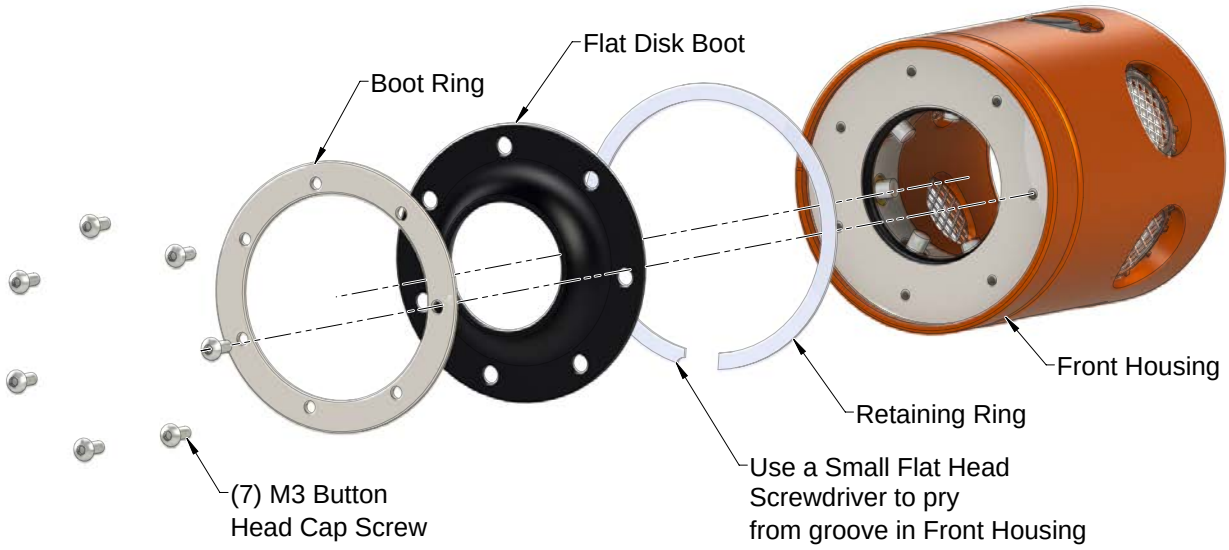
Figure 6.13— Ring Cylinder Replacement



14. Install the retaining ring into the groove of the front housing so that the ring cylinder is secure. Refer to *Figure 6.14*.
15. Place the front boot disk on the entrance of the housing. Twist and slide the boot so that the holes around the boot's outer perimeter align with the tapped hoes in the ring cylinder.
16. Place the boot ring over the rubber boot and align to the holes of the ring and boot.

17. Apply Locite 222 to the (7) M3 button head cap screws.
18. Using a 2 mm Allen wrench, install the (7) M3 button head cap screws into the boot ring, flat disk boot, and ring cylinder.

Figure 6.14—Installation of the Retaining Ring, Flat Disk Boot, and Boot Ring



19. Install the turbine motor. Refer to *Section 6.2.3—Turbine Motor Replacement* steps *13* through *24*.
20. Install the cutting bur, refer to *Section 6.2.1—Bur and Collet Replacement* steps *7* through *10*.
21. Install the deburring tool on the robot or work location.
22. Connect the air hose to the spindle and compliance air fittings.
23. When the replacement procedure is complete, all circuits (for example: air and power) may be placed into normal operation.

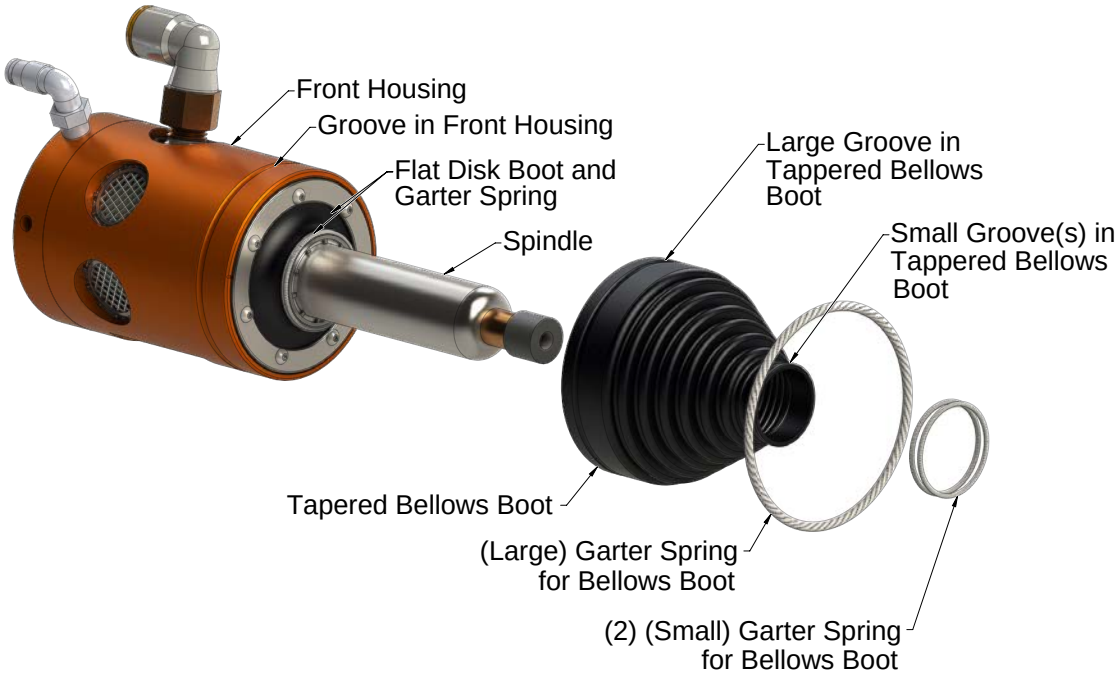
6.2.5 Tapered Bellows Boot Replacement

The tapered bellows boot prevents debris from entering the housing and protects internal components. Replace the tapered bellows boot if damaged.

Parts required: *Refer to Section 7—Serviceable Parts.*

1. Turn off all energized circuits (for example: air and power).
2. If necessary, remove the deburring tool from the robot or work location:
   a. Disconnect the air hoses from the spindle and compliance air fittings.
   b. Remove the deburring tool from the robot or work location.
   c. If necessary, remove the cutting bur.
   Refer to *Section 6.2.1—Bur and Collet Replacement* steps *3* through *7*.
3. Remove the (3) garter springs retaining the tapered bellows boot to the spindle and front housing.
4. Remove the tapered bellows boot.
5. Slide the new tapered bellows boot over the spindle and onto the front housing.
6. Secure the flexible boot using the (3) garter springs. Make sure the garter springs fit tightly in the grooves of the front housing and bellows boot. Refer to *Figure 6.15*.
7. If applicable, install the deburring tool to the robot or work location:
   a. If applicable, install the cutting bur.
   Refer to *Section 6.2.1—Bur and Collet Replacement* steps *7* through *10*.
   b. Install the deburring tool to the robot or work location.
   c. Connect the air hoses from the spindle and compliance air fittings.
8. After repair is complete, return all circuits (for example: air and power) to normal operation.

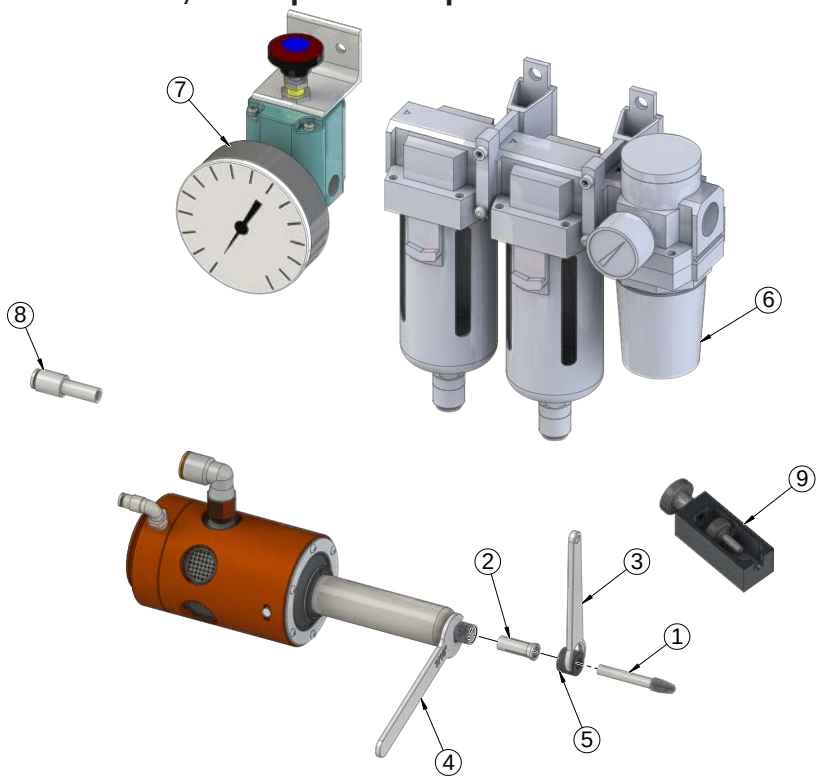
Figure 6.15—Tapered Bellows Boot Replacement



7. Serviceable Parts

For repair and spare parts please contact ATI. Refer to *Section 9.2—RC-300 Series Serviceable Parts* for exploded drawings showing all the user replaceable components of the Flexdeburr. Available accessories, tools, and optional replacement parts are listed in *Section 7.1—Accessories Tools, and Optional Replacement Parts.* All other repairs must be performed by ATI.

7.1 Accessories Tools, and Optional Replacement Parts



NOTICE: Individual parts may have a slightly different appearance from what is shown in the figure above.

Table 7.1—Available Accessories, Tools, and Optional Replacement Parts

Item No.	Part Number	Description
1	9150-RC-B-XXXXX	Refer to *Table 4.1* for bur part numbers and descriptions
2	9150-RC-C-12442	Ø 3 mm Collet
	9150-RC-C-12443	Ø 1/8” Collet
	9150-RC-C-12444	Ø 3/16” Collet
	9150-RC-C-12445	Ø 6 mm Collet (Standard on Metric Models)
	9150-RC-C-12446	Ø 1/4” Collet (Standard on Inch Models)
3	9150-RC-T-12479	9/16” (14.5 mm) Collet Wrench
4	9150-RC-T-12475	7/16” (11mm) Collet Wrench
5	3700-50-3081	Collet Nut, RC-300/340 Motor (.450 x .318 Hole)
	3700-50-3082	Collet Nut, RC-300/340 Motor (.450 x .254 Hole)
6	9150-FFR-90	High-Flow Filter/Regulator Assembly
7	9150-PPR-60	Precision Regulator
8	3405-1210010-01	Spindle Tubing Adapter, 3/8" to 5/16" (8 mm)
9	9150-RC-T-4230	Bur Setting Fixture, RC/RS Tools

8. Specifications

The following table lists specifications. For an additional technical description of the product, refer to *Section 2.2—Technical Description*.

Table 8.1—RC-300 and RC340 Series Specifications

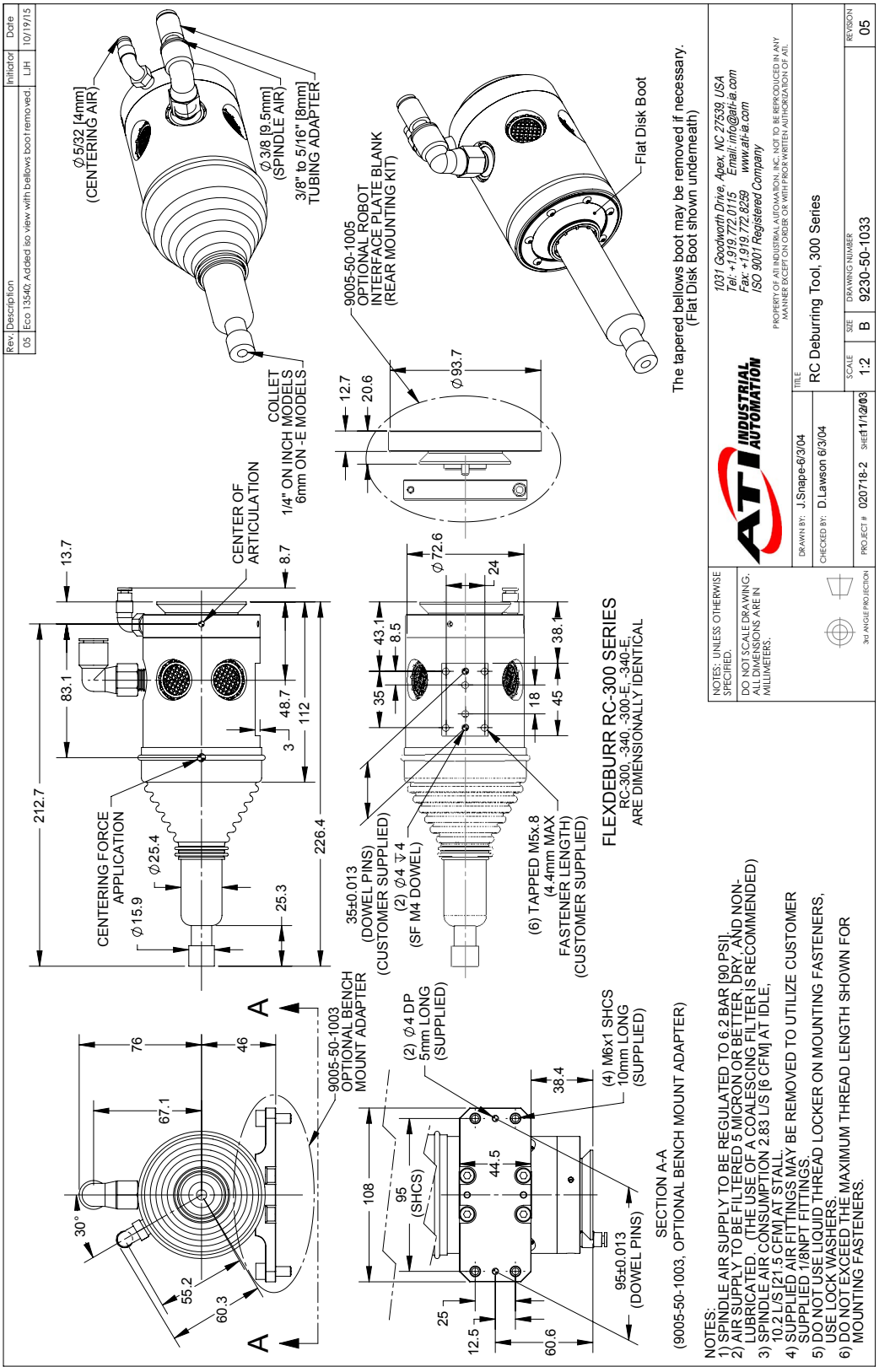
Parameter	Rating	
	RC-300 Series	RC-340 Series
Motor Type	Turbine	
Motor Part Number	3490-0001023-02	3490-0001020-02
Motor Series	525JSL	
Idle Speed (RPM)	30,000	40,000
Torque (Max.)	0.09 N-m (0.8 lb-in)	0.08 N-m (0.7 lb-in)
Power	300 W (0.40 hp) @ 30,000 RPM	340 W (0.46 hp) @ 40,000 RPM
Weight (without Adapters)	1.2 kg (2.6 lbs)	
Compensation (Radial)	+/- 7.5 mm max., +/- 3 mm recommended	
Compliance Force (Measured at Collet)	12.7-42 N (2.8–9.5 lb) @ 1.0-4.1 bar (15–60 psi)	
Bur Surface Speed	Dependent on Cutter Geometry and Motor Speed	
Spindle Air Pressure	6.2 Bar (90 psi)	
Air Consumption (Idle)	5.6 l/s (12 CFM)	
Air Consumption (Stall)	10.2 l/s (21.5 CFM)	
Air Connection (Spindle)	3/8” Tube	
Air Connection (Compliance)	5/32” Tube	
Sound Pressure Level[1]	78 dBa	
Collet Size, Standard[2]	1/4" (All Modules) 6 mm on Euro Models	
Rotary Burs [3]	Commercial Units Rated 40,000 RPM or Higher	
Special Tools	Open End Wrenches (1 Pair Supplied) 9/16” (14.5 mm) 7/16” (11 m)	

Notes:

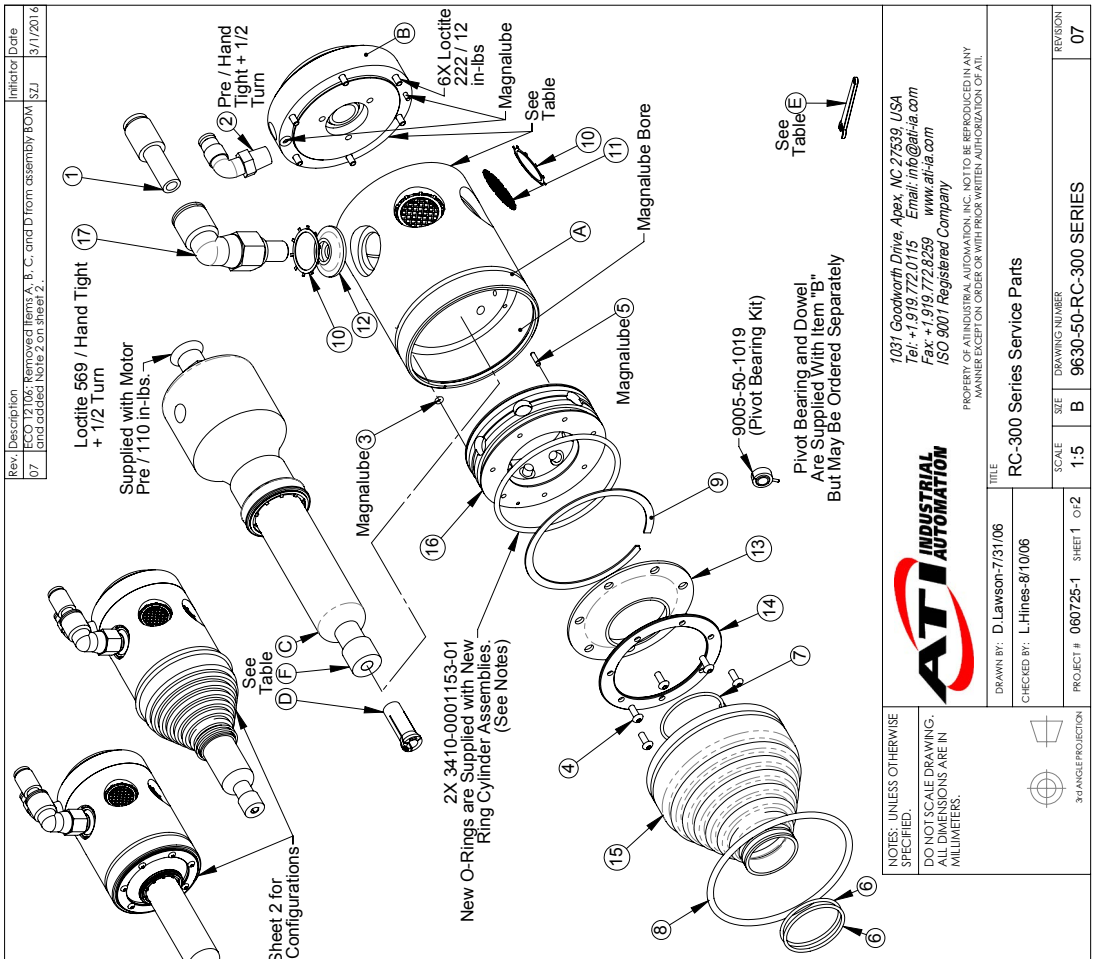
1. All noise emission measurements were taken under no load idle conditions without a cutting tool. Because the working environment is unknown, it is impossible to predict the noise that will occur during a deburring operation.
2. Optional Sizes Available, See *Section 7—Serviceable Parts*
3. ATI Can Supply Burs, See *Section 4.5.1—Bur Selection*.

9. Drawings

9.1 RC-300 Series Geometry and Mounting



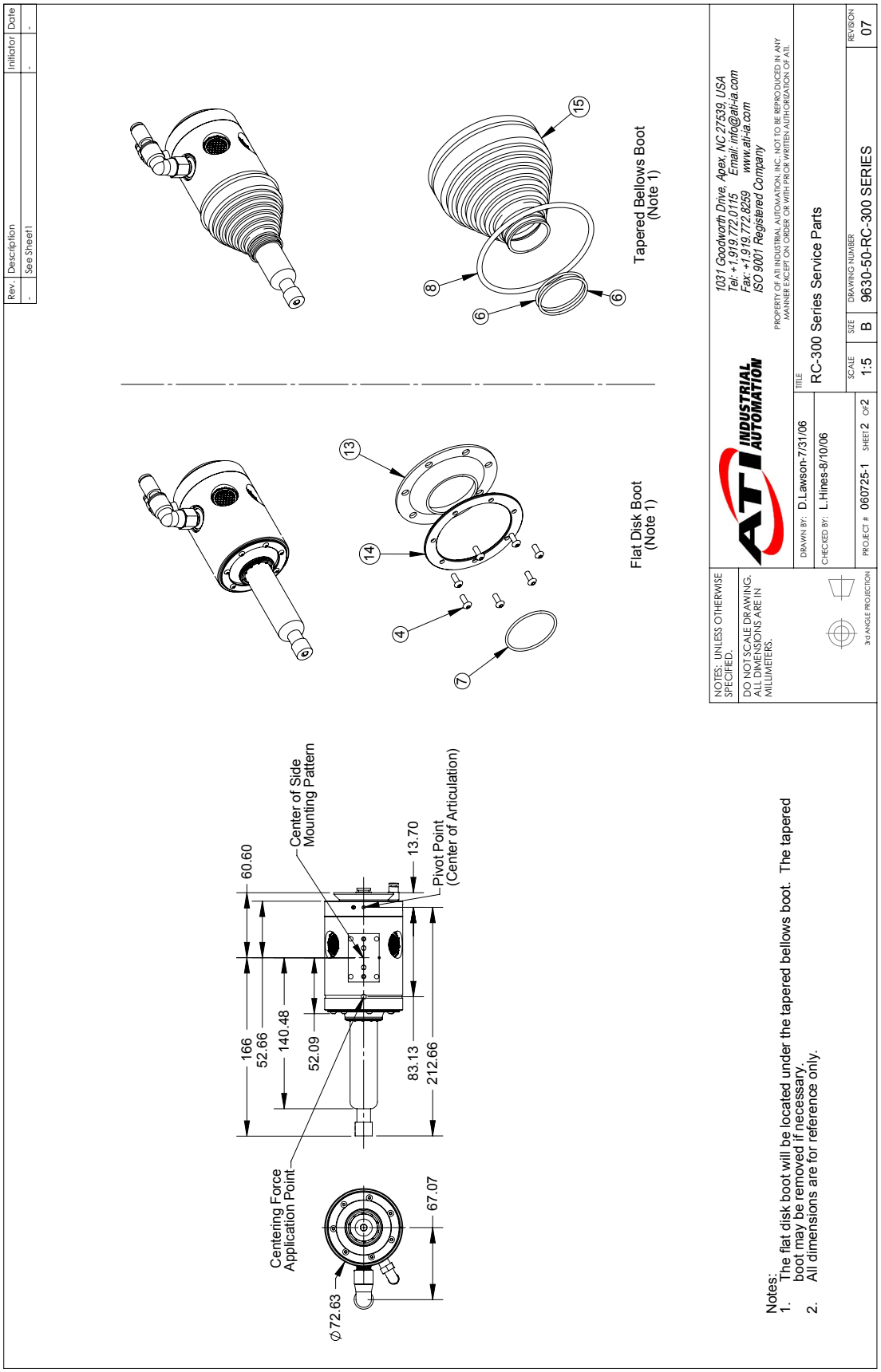
9.2 RC-300 Series Serviceable Parts



ITEM NO.	QTY.	PART NUMBER	DESCRIPTION
1	1	3405-1210010-01-01	ADAPTER, 3/8x5/16[8mm], McM#51495K308
2	1	3405-2210001-01	1/8NPT Swivel Elbow, 5/32 (4mm) PL Tubing
3	1	3410-0001151-01	O-RING, 1/16 x 1/16
4	7	3500-1158008-21	M3 X 8 BHCS, SS
5	1	3540-0102008-11	Dia 2mm x 8mm Dowel Pin
6	2	3610-0235001-21	GARTER SPRING, RC 150
7	1	3610-0340001-21	GARTER SPRING, RC 340
8	1	3610-0494000-20	GARTER SPRING, SR-081 Boot
9	1	3690-1200001-11	RET.INT. 2.76", UR-268
10	5	3690-7500003-11	RET.,INT. 1" 5005-100
11	4	3700-50-3005	DISK, FILTER, FLEXDEBURR
12	1	3700-50-3006	SUPPLY BOOT, FLEXDEBURR 340
13	1	3700-50-3007	BOOT, FLEXDEBURR 340
14	1	3700-50-3008	RING, BOOT, FLEXDEBURR 340
15	1	3700-50-3079	BOOT, RC-300/340, VITON
16	1	9005-50-1000	RING CYLINDER, FLEXDEBURR 340
17	1	9005-50-1002	ELBOW FITTING ASSY., FLEXDEBURR

NOTES:
If the Old Ring-Cylinder Will Be Re-installed, New O-Rings are Recommended.

A	RC-300 & 340	1	3700-50-3000	Front Housing, Orange	
	RC-300-E & 340-E	1	3700-50-3019	Front Housing, Black	
B	RC-300 & 340	1	9005-50-1017	Rear Housing Assembly, Orange	
	RC-300-E & 340-E	1	9005-50-1018	Rear Housing Assembly, Black	
C	RC-300 & 300-E	1	9005-50-1066	300 W, 30k RPM Motor Assembly	
	RC-340 & 340-E	1	9005-50-1065	340 W, 40k RPM Motor Assembly	
D		OPT.	9150-RC-C-12442	3mm Collet	
		OPT.	9150-RC-C-12443	1/8" Collet	
	All	OPT.	9150-RC-C-12444	3/16" Collet	
		OPT.	9150-RC-C-12445	6mm Collet (Standard on Metric Models)	
		OPT.	9150-RC-C-12446	1/4" Collet (Standard on Inch Models)	
E		OPT.	9150-RC-T-12475	7/16" Collet Wrench	
	All	OPT.	9150-RC-T-12479	9/16" Collet Wrench	
F		1	3700-50-3081	Collet Nut (.450 x .318 Hole)	
	All	1	3700-50-3082	Collet Nut (.450 x .254 Hole)	


Rev
Description
Initiator
Date
-
See Sheet1
-
-
Tapered Bellows Boot
(Note 1)
Flat Disk Boot
(Note 1)
Center of Side
Mounting Pattern
Pivot Point
(Center of Articulation)
Centering Force
Application Point
60.60
13.70
166
52.66
140.48
52.09
83.13
212.66
67.07
ϕ72.63
Notes:
1. The flat disk boot will be located under the tapered bellows boot. The tapered boot may be removed if necessary.
2. All dimensions are for reference only.
NOTES: UNLESS OTHERWISE SPECIFIED.
DO NOT SCALE DRAWING. ALL DIMENSIONS ARE IN MILLIMETERS.
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INDUSTRIAL AUTOMATION
DRAWN BY: D.Lawson-7/31/06
CHECKED BY: L.Hines-8/10/06
TITLE
RC-300 Series Service Parts
SCALE
1:5
SIZE
B
DRAWING NUMBER
9630-50-RC-300 SERIES
REVISION
07
PROJECT # 060725-1
SHEET 2 OF 2
3rd ANGLE PROJECTION

10. Terms and Conditions of Sale

The following Terms and Conditions are a supplement to and include a portion of ATI's Standard Terms and Conditions, which are on file at ATI and available upon request.

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 the 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 that require 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 that are 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.

ATI will in no event be liable for incidental, consequential or special damages of any kind, even if ATI has been advised of the possibility of such damages. ATI's aggregate liability will in no event exceed the amount paid by purchaser for the item which is the subject of claim or dispute. ATI will have no liability of any kind for failure of any equipment or other items not supplied by ATI.

No action against ATI, regardless of form, arising out of or in any way connected with products or services supplied hereunder may be brought more than one (1) year after the cause of action occurred.

No representation or agreement varying or extending the warranty and limitation of remedy provisions contained herein is authorized by ATI, and may not be relied upon as having been authorized by ATI, unless in writing and signed by an executive officer of ATI.

Unless otherwise agreed in writing by ATI, all designs, drawings, data, inventions, software and other technology made or developed by ATI in the course of providing products and services hereunder, and all rights therein under any patent, copyright or other law protecting intellectual property, shall be and remain ATI's property. The sale of products or services hereunder does not convey any express or implied license under any patent, copyright or other intellectual property right owned or controlled by ATI, whether relating to the products sold or any other matter, except for the license expressly granted below.

In the course of supplying products and services hereunder, ATI may provide or disclose to Purchaser confidential and proprietary information of ATI relating to the design, operation or other aspects of ATI's products. As between ATI and Purchaser, ownership of such information, including without limitation any computer software provided to Purchaser by ATI, shall remain in ATI and such information is licensed to Purchaser only for Purchaser's use in operating the products supplied by ATI hereunder in Purchaser's internal business operations.

Without ATI's prior written permission, Purchaser will not use such information for any other purpose or provide or otherwise make such information available to any third party. Purchaser agrees to take all reasonable precautions to prevent any unauthorized use or disclosure of such information.

Purchaser will not be liable hereunder with respect to disclosure or use of information which: (a) is in the public domain when received from ATI; (b) is thereafter published or otherwise enters the public domain through no fault of Purchaser; (c) is in Purchaser's possession prior to receipt from ATI; (d) is lawfully obtained by Purchaser from a third party entitled to disclose it; or (f) is required to be disclosed by judicial order or other governmental authority, provided that, with respect to such required disclosures, Purchaser gives ATI prior notice thereof and uses all legally available means to maintain the confidentiality of such information

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 lon 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 that 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 Turbine Motor Products (Flexdeburr (RC) models)

Turbine motors are not serviceable at this time. The expected life of a turbine motor in normal operation is entirely application dependent based on a multitude of factors To maximize the life of turbine motor products, the customer should follow closely the normal operation guide in the product manual. The supplied air must be totally lube free and filtered to remove particulates and moisture. Exposing the turbine motors to oil in the air supply results in premature failure. 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.