ATI Radially-Compliant Robotic Deburring Tools
Flexdeburr™ RC-1000 Series
(Models 9150-RC-900-ER, 9150-RC-900-ER-E, 9150-RC-1040-ER, and 9150-RC-1040-ER-E)

Product Manual

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Engineered Products for Robotic Productivity
Pinnacle Park • 1031 Goodworth Drive • Apex, NC 27539 • Tel: +1 919-772-0115 • Fax: +1 919-772-8259 • www.ati-ia.com

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 this product. Failure to do so may result in personnel injury and/or damage to equipment.

How to reach us:

Sale, Service and Information about ATI products:

ATI Industrial Automation
1031 Goodworth Drive
Apex, NC 27539 USA
www.ati-ia.com
Tel: +1 919-772-0115
Fax: +1 919-772-8259

Application Engineering
Tel: +1 919-772-0115
Fax: +1 919-772-8259
E-mail: *ATI-MRapplications@novanta.com*

24/7 Support: +1 855 ATI-IA 00 (+1 855-284-4200)

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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.
Burr	Any unwanted, raised protrusion on the work piece.
Bur	Cutting tool used to remove burrs from the work piece. Alternatively referred to as a rotary file, cutter, or bit.
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.
Deburr	To remove the burrs from (a piece of machined work)
End-Effector	Tool used by the robot to perform a particular function
Flexdeburr	Product family name for ATI's line of Radially-Compliant (RC) deburring tools.
Main Housing	The main cylindrical body of the unit which includes the mounting features.
RC	Radially-Compliant.
Rear Housing	Rear cover to the main housing. This body includes a connection port for the compliance air supply.
Regulator	Device used to set and control the supplied air pressure to lower acceptable levels.
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.
-E	Euro models.

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

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.

CAUTION: Do not perform maintenance or repair on the Flexdeburr product unless the tool is safely supported or placed in the tool stand and air has been turned off. Injury or equipment damage can occur with tool not placed in a tool stand and air remaining on. Place 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 9—Terms and Conditions*. 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 units 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 bur to follow the part profile and compensate for surface irregularities while maintaining and setting a constant force. As a result, high feed rates with uniform quality in any orientation is achievable. The tool also requires no oil, allowing clean exhaust air to be vented directly into the work environment.

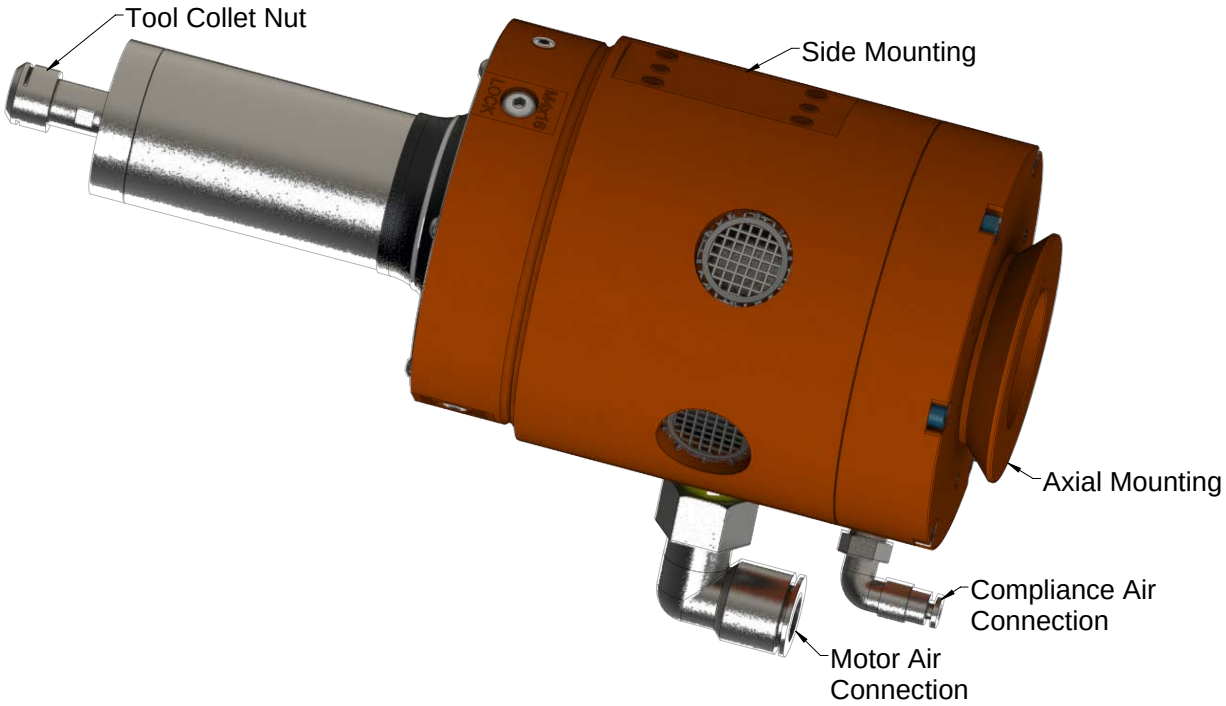
Compliance is supported by air pressure applied to the shaft of the unit and is used to perform consistent deburring on irregular part patterns. The motor's internal governor maintains high spindle speeds for optimum surface finish. The RC deburring tool also utilizes standard industrial tungsten-carbide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

The RC deburring tool provides for (2) mounting methods, 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. For more information, refer to the *ATI customer drawing*.

Table 2.1—Deburring Tools

Model	Description	Motor Air Tube Size for the Push-To-Connect Fitting	Compliance Air Tube Size for the Push-to-Connect Fitting
9150-RC-900-ER	900 Watt, radially compliant tool	1/2"	5/32"
9150-RC-900-ER-E	900 Watt, radially compliant tool, Euro	12 mm	4 mm
9150-RC-1040-ER	1040 Watt, radially compliant tool	1/2"	5/32"
9150-RC-1040-ER-E	1040 Watt, radially compliant tool, Euro	12 mm	4 mm

Figure 2.1—Deburring Tool



2.1 Collet System

A collet system secures the bur and many collet sizes are available to accommodate a wide variety of applications.

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 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 turbine motor design does not allow the installation of spindle brakes or Tool Changer (drawbar) collet systems.

The ATI RC-1000 deburring tools use an ER-11 collet system to hold cutting tools. The ER collet is a commercial, double-angle design offering greater tool gripping force, less tool runout and an extended grip range. The collets are available from many sources in many different gripping diameters. ER-11 collets can achieve runout tolerances below 0.0005” [0.013 mm] and provide a gripping range up to 0.040” [1 mm]. These tolerances and gripping range allow a standard 1/4 inch ER-11 collet to safely and accurately hold a metric 6 mm diameter bur. Euro (or -E) versions are provided with a 6 mm metric collet.

2.2 Technical Description

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

2.2.1 Environmental Limitations

2.2.1.1 Operation

Table 2.2—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.
	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

Table 2.3—Storage	
Temperature range	0° C–45° C 32° F–113° 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.

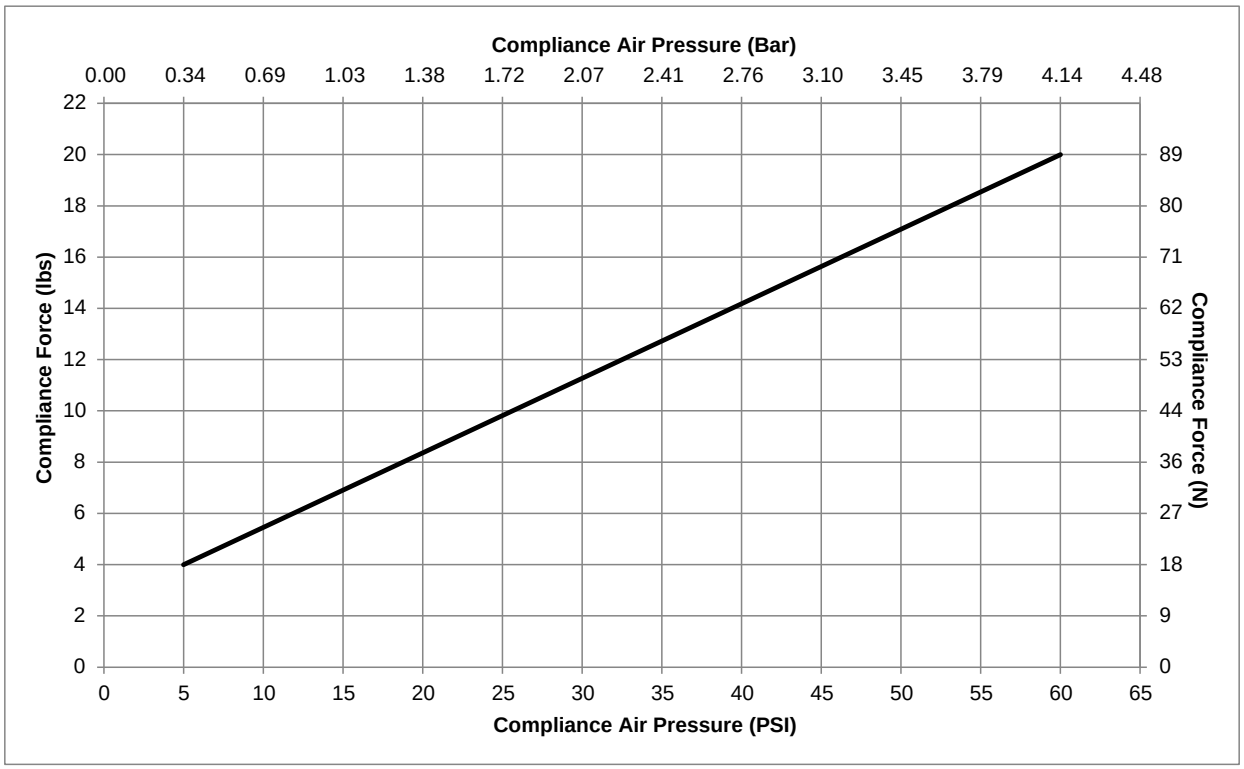
2.2.2 Compliance Unit Performance

The graph in *Figure 2.2* illustrates 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-1000 Series Radial Compliance Force (Measured at the Spindle Tip)



3. Installation

The deburring tool is delivered fully assembled. Optional equipment such as mounting adapter plates, burs, and 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.

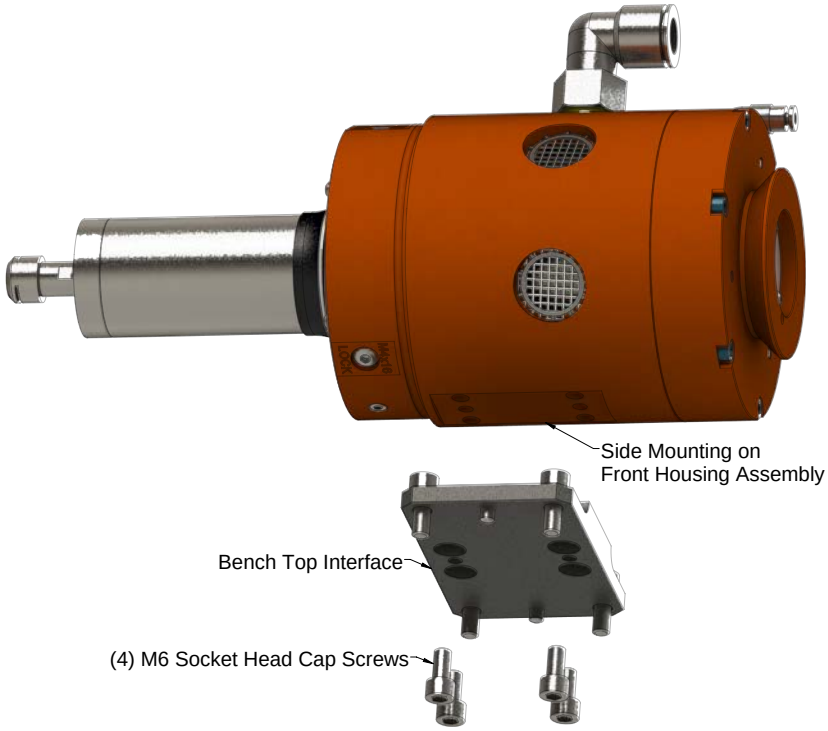
3.5 Side Mounting Installation

CAUTION: The length of the fasteners should not interfere with the compliant motion of the turbine motor spindle. For the maximum fastener length, refer to the *ATI customer drawing*. Do not use fasteners that exceed the maximum length; otherwise, damage will occur.

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

The side mounting pattern of the RC deburring tool consists of (2) dowel pin holes and (4) of threaded holes as shown in *Figure 3.1*. If the RC deburring tool is permanently mounted to a work surface, the robot carries the part to be deburred to the deburring tool.

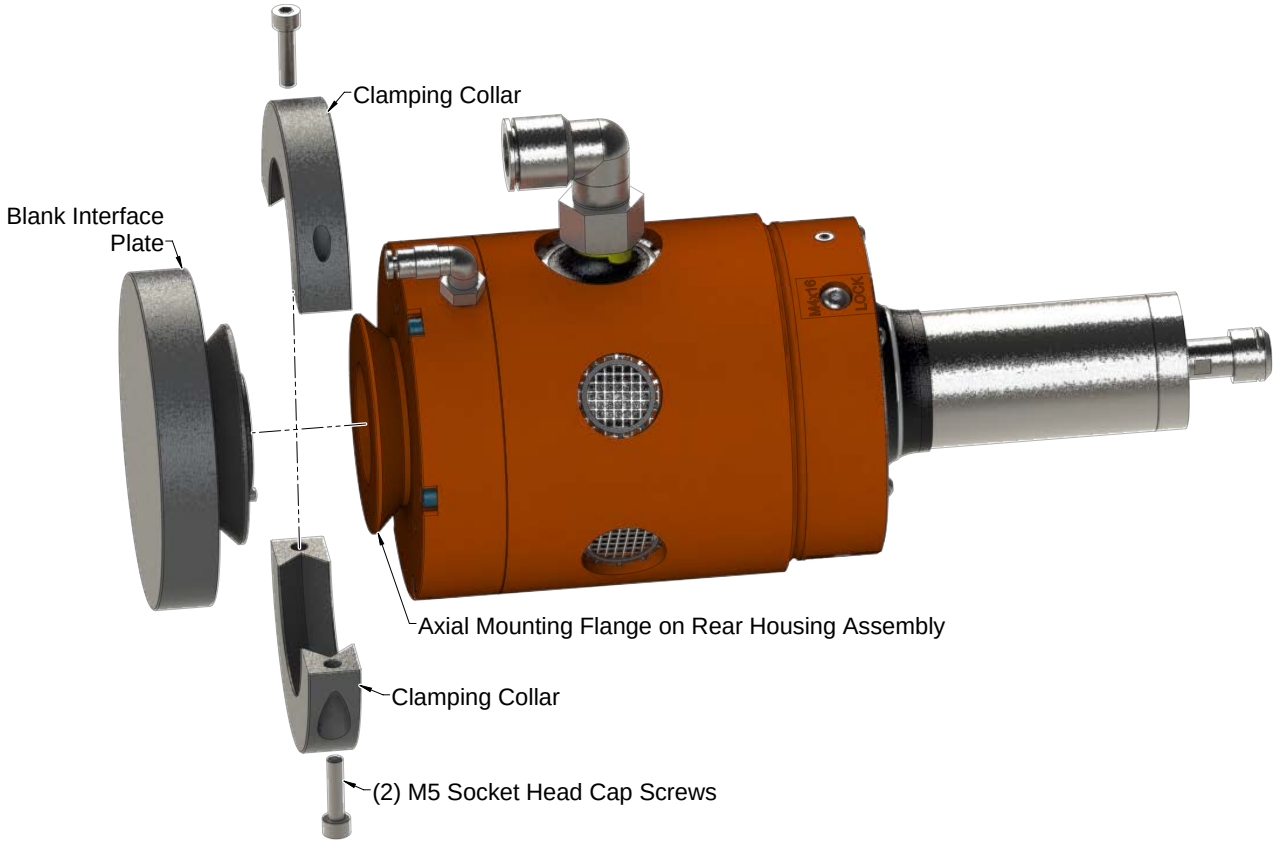
Figure 3.1—Bench (Side) Installation



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 *Figure 3.2*).

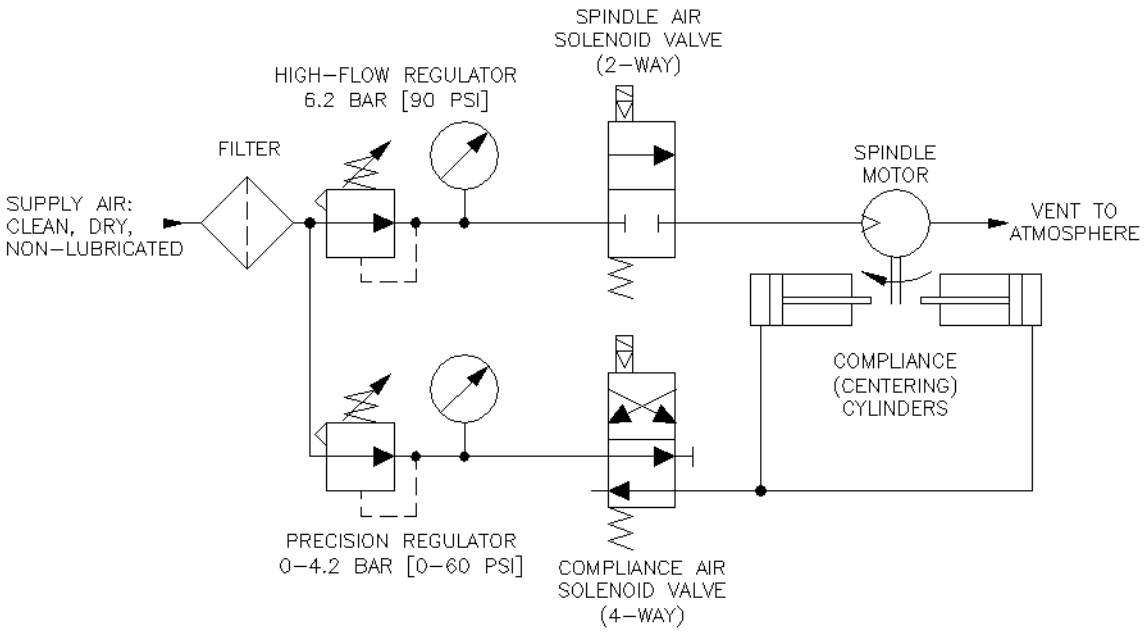
Figure 3.2—Axial Installation



3.7 Pneumatics

Connect the RC deburring tool as shown in *Figure 3.3*.

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 will supply air for the compliance or centering force.

The compliance force is applied radially and is adjusted until the desired cut is made. The robot 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 P/N 9005-50-6166, 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 P/N 9005-50-6164, or equivalent) is used to supply the compliance (centering) mechanism. This pressure corresponds to the side force on the rotary bur. Because very little air flow is required for the compliance mechanism, a significantly smaller valve can be 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. An analog output port in the robot or logic controller will be 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-900-ER and 9150-RC-1040-ER	1/2" Quick Connect Tube (U.S. Model) Alternates: Remove the ATI Supplied Fitting and use the 3/8-NPT Port in the Motor Body	6.2 bar 90 psi
9150-RC-900-ER-E and 9150-RC-1040-ER-E	12 mm Quick Connect Tube (-E Euro Model) Alternates: Remove the ATI Supplied Fitting and use the 3/8-NPT Port in the Motor Body	
Compliance (Radial) Force Inlet		
9150-RC-900-ER, 9150-RC-900-ER-E, 9150-RC-1040-ER, and 9150-RC-1040-ER-E	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 about 1 bar [15 psi] of pressure and increase the pressure 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 and have extensive knowledge about automation applications that incorporate 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 describe 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 not receive proper air pressure, the tool stalls. Any water in the system damages the housing and blades.

4.2.2 No Lubrication

Lubrication of any kind is strictly prohibited.

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 at least the RC idle speed.

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 operating speed of the deburring tool. Operating the brush above its maximum rated speed can be unsafe due to unbalanced loading. Additionally, even balanced brushes can result in an excessive load on the motor and reduced motor life.

Do not use a tool that results in axial loading on the RC tool.

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 RCT-151 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 RCT-151 maintenance, make sure the RCT-151 and robot are stopped before entering the robot cell. When installing and testing, never be present in the cell when the RCT-151 is running.

Be aware of rotating parts. Use eye-protection while working around the RCT-151.

Be aware of high sound levels. While the RCT-151 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 RCT-151 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 Locking the Tool to Single Axis Compliance

The deburring tool can be locked to be compliant in single axis. Included are (4) M4 x 16 button head socket cap screws to lock the tool.

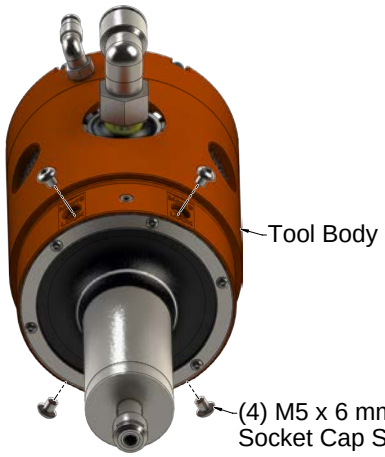
> **CAUTION:** Do not use improper length screws for locking the tool axis. Improper length screws can cause damage to equipment and/or personnel. Use only M4 x 16 mm button head socket cap screws to lock axis.

Tools required: *2.5 mm and 3 mm hex key, torque wrench*

Supplies required: *Loctite 7649 primer and Loctite 222*

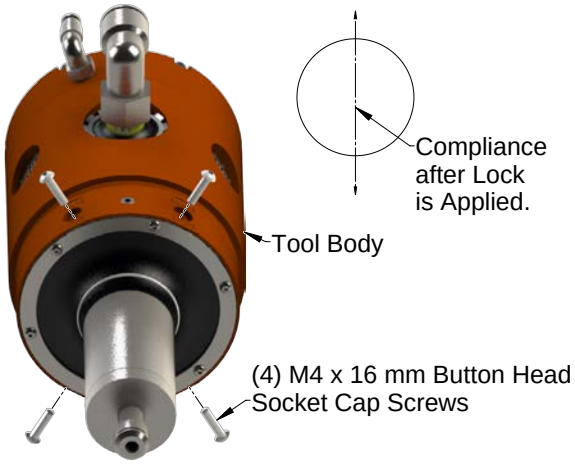
1. Remove and/or lock-out the spindle motor air supply for safety.
2. Using a 3 mm hex key, remove the (4) M5 x 6 mm button head socket cap screws from around the center of the tool body.

Figure 4.1—Remove M5 Button Head Socket Cap Screws



3. Apply Loctite 7649 primer and Loctite 222 to the (4) M4 x 16 mm button head socket cap screws.
4. Using a 2.5 mm hex key, install the (4) M4 x 16 mm button head socket cap screws into the screw holes that the (4) M5 x 6 mm button head socket cap screws were removed from. Tighten to 25 in-lbs (2.82 Nm).

Figure 4.2—Install M4 Button Head Socket Cap Screws



5. Restore the air supply.

4.5 Tool Center Point (TCP) Position and Programming

Figure 4.3 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 bur (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 bur where cutting is desired (see *Figure 4.3*). 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 centerline 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 bur path (see *Figure 4.4*). The programming method used will depend on the robot's capabilities and programmer preferences.

Figure 4.3—Flexdeburr Dowel Teaching Tool

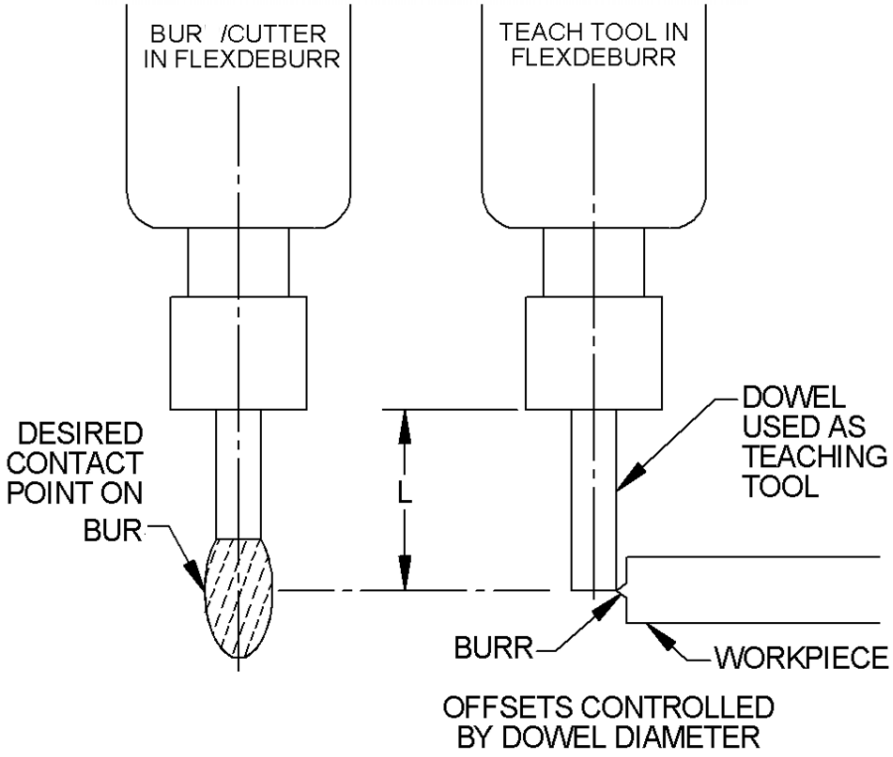
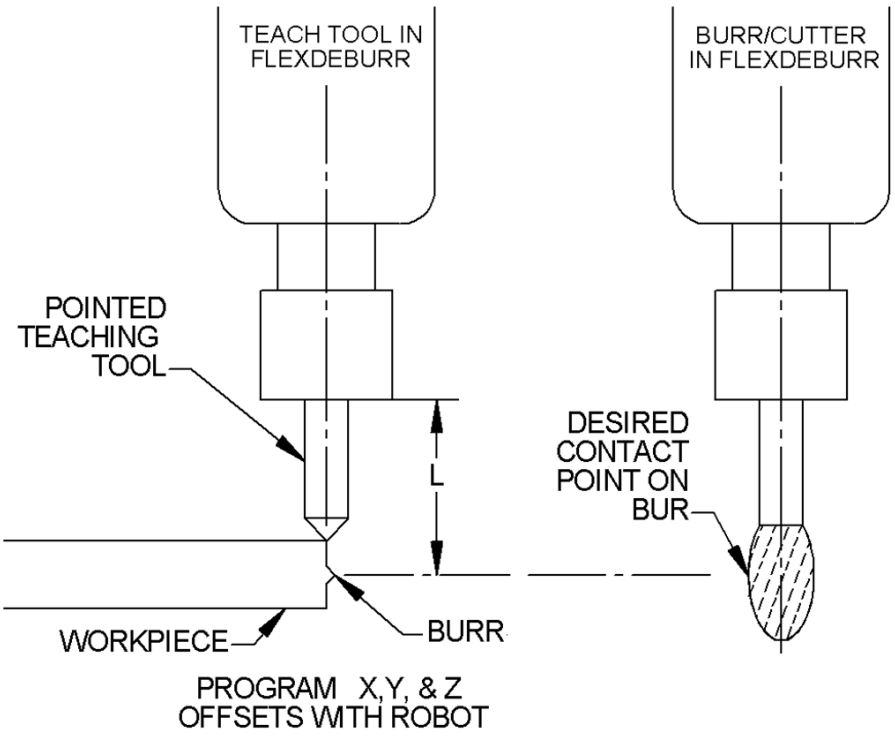


Figure 4.4—Flexdeburr Pointed Teaching Tool



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 that will prevent the bur from simultaneously contacting two perpendicular surfaces. A tapered bur 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 bur the surface cutting speed is reduced.)

When deburring inside radii, a similar situation may arise. Do not attempt to deburr an inside radius less than 1.5 times the diameter of the desired bur (Rmin = 1.5 x Cutter diameter). Depending on the depth of cut, failing to follow these guidelines may result in excessive cutter contact resulting 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 the 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.

4.6 Cutter Operation and Bur Selection

The RC deburring tool performs best in “climb milling”, which is when the cutter directions of traverse and 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 cutter directions of traverse and rotation are opposite. Conventional milling may aid in cutter stability for some operations; however, the cutting edge of the tool is subjected to higher friction and cutting forces. Tool wear is accelerated in this mode and surface finish quality is generally reduced. When conventional milling, take extra care around corners. A corner poses a potential hazard where the cutting force can deflect the bur and cause the bur to break as the robot continues along its path.

The selection of a cutting tool is highly dependent upon the part material and geometry, and the depth of cut. It is not practical to present all the possibilities in this document. Please see *Section 4.6.1—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 welding can quickly load a bur and produce unacceptable results. The traverse or feed rate of the deburring tool is higher for plastics to minimize melting and welding. A higher feed rate causes larger cuts that more effectively remove heat from the cutter-tool interface.

4.6.1 Bur Selection

Standard length commercial burs are used with Flexdeburr products. The length of these tools is typically around 2 inches for 1/4” shank diameter burs [50 mm for 6 mm diameter]. Avoid longer shank burs that are available from industrial suppliers and 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 turbine motor and is not covered under warranty. Use standard length commercial burs with the Flexdeburr.

ATI can provide guidance in bur selection; however, only experimentation will yield the results desired. The following table is presented to assist in bur 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" 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-24061 - Standard Cut, 3/8" Bur 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" Bur 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" Bur Diameter, 5/8" Bur Length, 1/4" Shank**	
	• For greasy aluminum alloys, soft non-ferrous metals and thermoplastics • 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-24645 - Aluminum Cut, 3/8” Bur Diameter, 5/8” Bur Length, 1/4” Shank**	
	• For greasy aluminum alloys, soft non-ferrous metals and thermoplastics • 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
	**3710-50-1492 - Bur for Composites, 1/4” Burr Diameter, 3/4” Burr 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” Bur 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. Preventive 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 chose to service the unit in the field.

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 Spindle Boot Inspection

The spindle boot prevents debris from entering the housing and protects internal components. Inspect the spindle boot regularly for damage. Refer to *Section 6—Troubleshooting and Service Procedures* for symptoms of a worn bur. If necessary, replace the bur. Refer to *Section 6.2.4—Spindle 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 6.1—Troubleshooting* for symptoms of a worn bur. If necessary, replace the bur *Section 6.2.1—Bur and Collet Replacement*.

6. Troubleshooting and Service Procedures

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.

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* is provided to assist the user when they choose to service the unit in the field.

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 motor spindle. During maintenance operations, refer to *Section 6.2—Service Procedures* for instructions. Service and repair parts are identified in *Section 7—Serviceable Parts* and the *ATI customer drawing*.

6.1 Troubleshooting

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 better grade bur 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 a corner	Climb mill/Do not begin path at sharp corner
	Impacting part	Decrease feed rate at contact/ enter part at an angle
Unequal compliance	Regulator is defective	Replace regulator
	Worn ring cylinder	Replace ring cylinder, refer to *Section 6.2.3—Ring Cylinder Assembly Replacement*.
	Pivot pins in gimbal ring are worn.	Replace pivot pins, refer to *Section 6.2.2—Turbine Motor Replacement*.
	Pivot rings in gimbal ring are not correctly installed.	Reinstall set screws and verify pivot pins are correctly installed in gimbal ring. Refer to *Section 6.2.2—Turbine Motor Replacement*.
	Gimbal ring is not correctly installed in front housing.	Reinstall gimbal ring in front housing. Refer to *Section 6.2.2—Turbine Motor 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—Service Procedures*.
	Motor bearings are worn	Inspect spindle shaft, if shaft feels loose or has play, replace. Refer to *Section 6.2.2—Turbine Motor Replacement.*
Bur is chattering during 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
	Bur is worn	Inspect bur if worn, replace. Refer to *Section 6.2—Service Procedures*.
	Motor bearings are worn	Inspect spindle shaft; if the shaft feels loose or has play, replace the motor. Refer to *Section 6.2.2—Turbine Motor Replacement.*
Secondary burrs are created on work piece after a cut	Incorrect feed rate	Reduce feed rate
	Too heavy a cut	Decrease width of cut/make multiple passes
	Improper Bur selection	Choose a bur designed for work material
	Bur is worn	Inspect bur; if worn, replace. Refer to *Section 6.2—Service Procedures*.
	Motor bearings are worn	Inspect spindle shaft, if shaft feels loose or has play, replace. Refer to *Section 6.2.2—Turbine Motor Replacement.*
Chip packing of bur	Too heavy a cut	Decrease width of cut/make multiple passes
	Not enough chip clearance	Use a bur with fewer flutes

Table 6.1—Troubleshooting		
Symptom	**Cause**	**Resolution**
Bur stalls	Not enough or no drive air	Verify drive air regulator is operating at 90 PSI [6.2 Bar] and check for leaks
	Bur is not secure in collet	Properly tighten bur in collet
	Too much side load	Decrease width of cut/make multiple passes
	Motor must be replaced.	Replace turbine motor, refer to *Section 6.2.2—Turbine Motor Replacement*.
Motor spindle is sticking	Motor bearings are worn	Replace turbine motor, refer to *Section 6.2.2—Turbine Motor Replacement*.

6.2 Service Procedures

Component replacement and adjustment procedures are provided in the following section:

6.2.1 Bur and Collet Replacement

In normal operation the bur will become worn. If improper feeds and speeds are used, the bur may become “loaded” with material. In both instances, replace the bur. 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 will not be required when the same size of bur is replaced, but a new collet is installed when a different sized bur is required.

Refer to the following procedure for replacing the bur and collet.

Refer to *Figure 6.1*.

Tools required: *7/16” open-end wrench, 10 mm collet wrench*

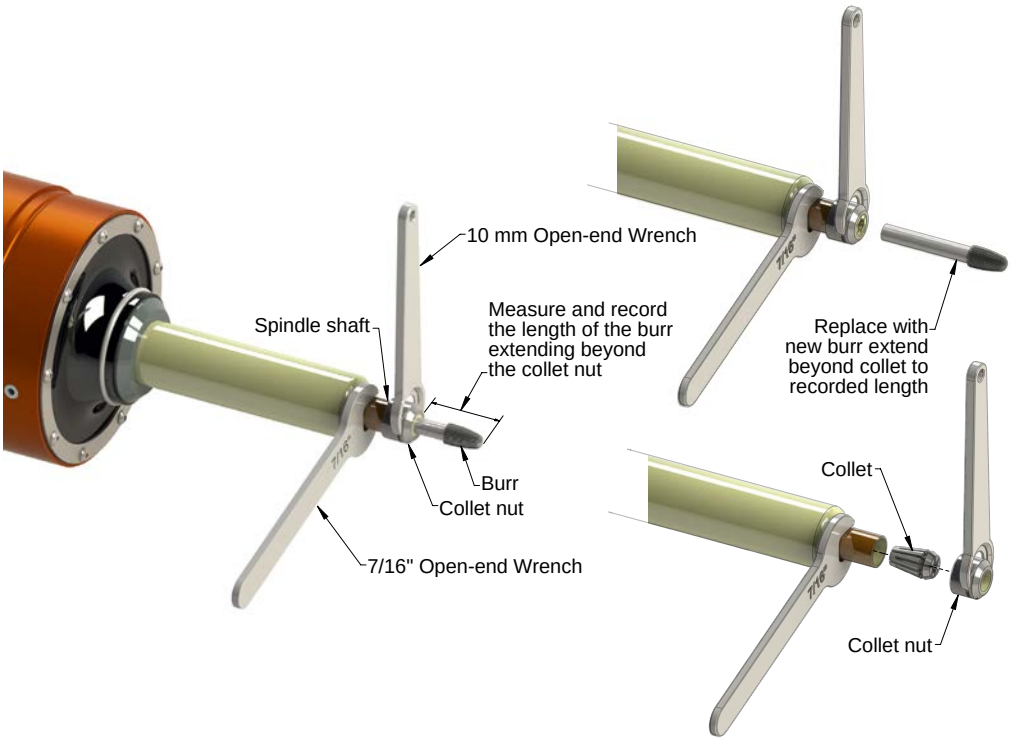
1. Remove and/or lock-out the spindle motor air supply for safety (De-energize all energized circuits such as air and power).
2. If the bur is to be replaced with one of an identical type, measure and record the bur length extending beyond the collet lock nut. Alternatively, the optional ATI 9150-RC-T-4230 bur setting tool accessory can be used to duplicate tool exposure length.
3. Use the 7/16” open-end wrench to hold the spindle just behind the collet nut.
4. Use the 10 mm collet wrench to turn the collet locknut counterclockwise (when viewed from the bur tip) to loosen the collet.

> **CAUTION:** During operation of the deburing 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.

5. To remove a worn bur, pull the bur out of the loosened collet.

6. 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.
7. If an identical new bur is replacing a worn one, insert the new bur and measure and adjust the length of its exposed portion according to the measurement taken in step *2*.
8. Use the 7/16” open-end wrench to hold the spindle just behind the collet nut.
9. Use the 10 mm collet wrench to turn the collet locknut clockwise (when viewed from the bur tip) to tighten the collet.
10. When the replacement procedure is complete, all circuits (for example: power and air) may be placed in normal operation.

Figure 6.1—Bur and Collet Replacement



6.2.2 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. 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 replace the motor, after the warranty period, perform the following procedure:

Refer to *Figure 6.2* through *Figure 6.11*.

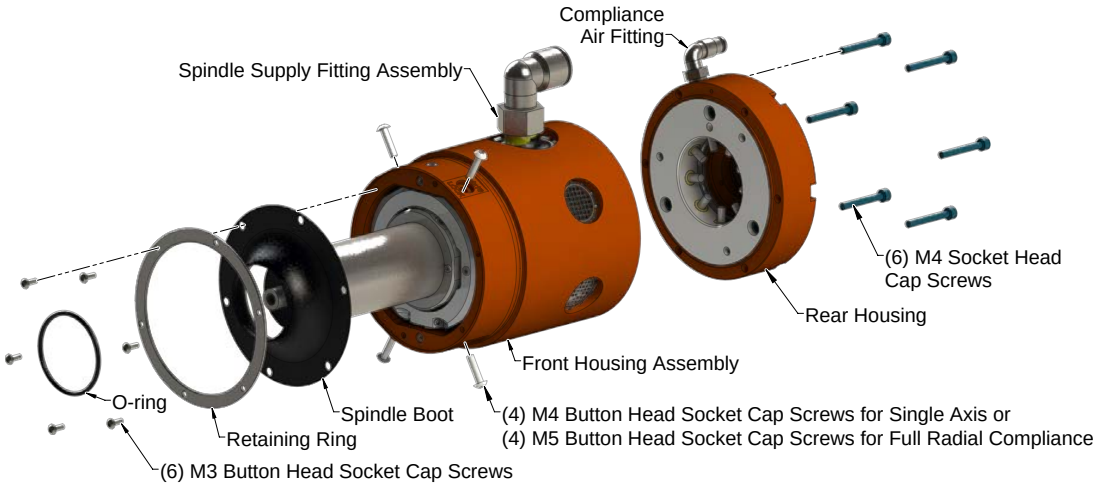
Parts required: *Refer to the ATI customer drawing*

Tools required: *Small screwdriver, 1.3 mm, 2 mm, 2.5 mm, and 3 mm hex key, torque wrench*

Supplies required: *Clean rag, Loctite primer 7649 and 222, 10W to 30W oil*

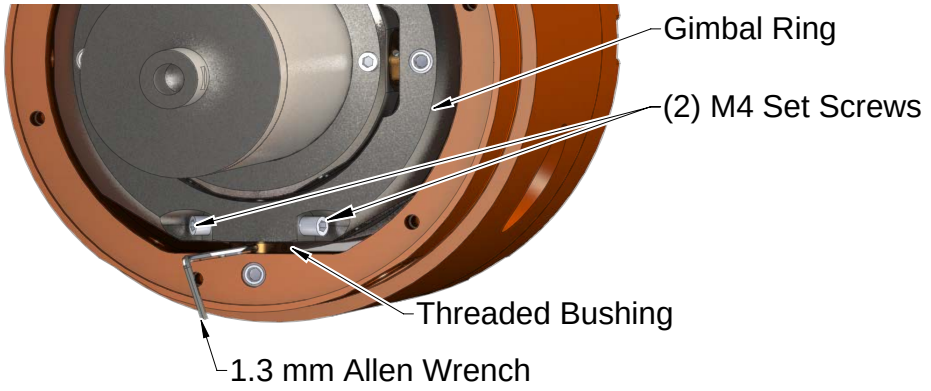
1. Remove and/or lock-out the spindle motor air supply for safety (De-energize all energized circuits such as air and power).
2. Disconnect the air hoses from the spindle supply fitting and the compliance air fitting.
3. Remove the deburring tool from the robot or work location.
4. Clean the debris from the deburring tool using compressed air and a clean rag to wipe any grease from the outer surfaces.
5. Remove the spindle air supply fitting from the side of the main housing by rotating the fitting counter-clockwise.
6. Using a small screw driver, remove the internal retaining ring and rubber boot. ATI recommends replacing the internal retaining ring and rubber disk at the spindle supply fitting when the motor is replaced.
7. Ease the O-ring off the front spindle boot.
8. Using a 2 mm hex key, remove the (6) M3 button head socket cap screws that hold the boot retainer ring and disk boot to the front housing assembly.
9. Remove the boot retainer ring and disk boot.
10. Using a 3 mm hex key, remove the (6) M4 socket head cap screws that secure the rear housing.
11. Remove the rear housing.
12. If the tool is locked to single axis compliance, use a 2.5 mm hex key to remove the (4) M4 x 16 mm button head socket cap screws.

Figure 6.2—Spindle Boot and Rear Housing



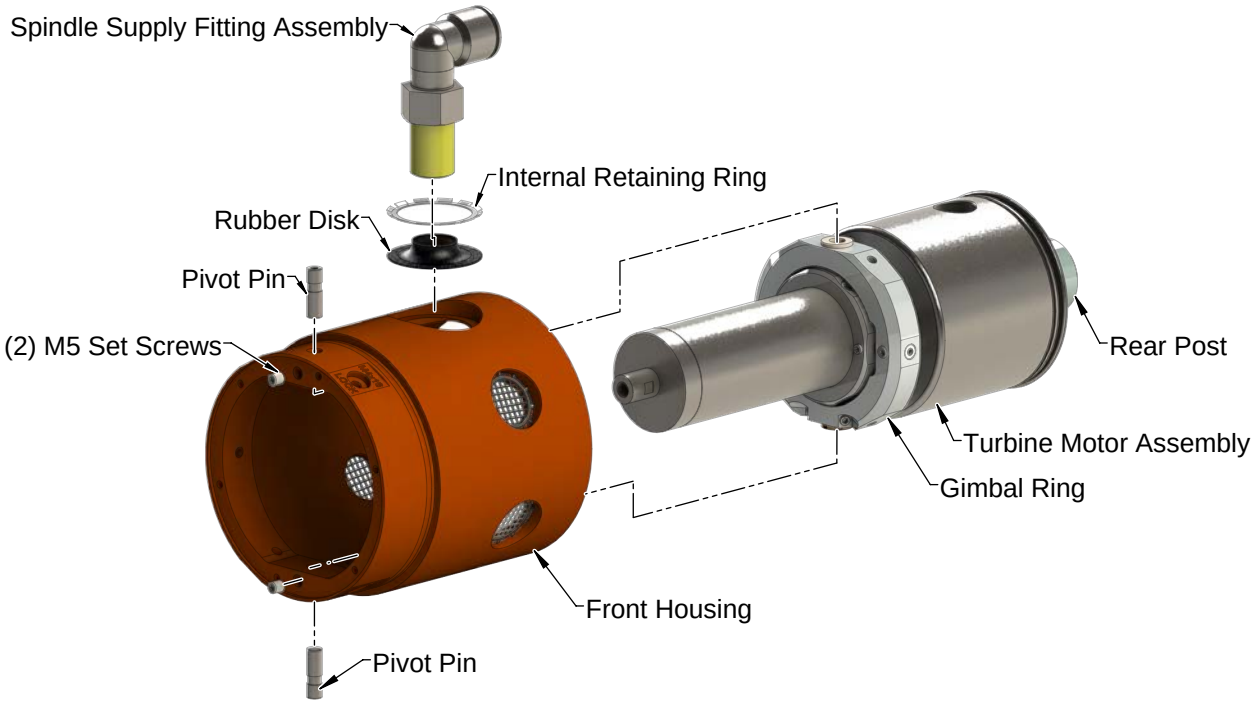
13. Using a 2 mm hex key, loosen the (2) M4 set screws at the bottom of the gimbal ring.
14. Using a 1.3 mm hex key inserted into the side hole of the threaded bushing, turn the bushing in toward the gimbal ring.

Figure 6.3—Gimbal Ring Bushing Adjustment



15. Thread M3 fasteners into the pivot pins.
16. At the front of the front housing assembly, loosen the (2) M5 set screws that secure the motor pivot pins until they extend out of the front housing about 1/8".
17. Pull the M3 fasteners screwed into the pivot pins to extract the pins.
18. Withdraw the turbine motor complete as an assembly by pulling it backward out of the main housing.

Figure 6.4—Turbine Motor Replacement

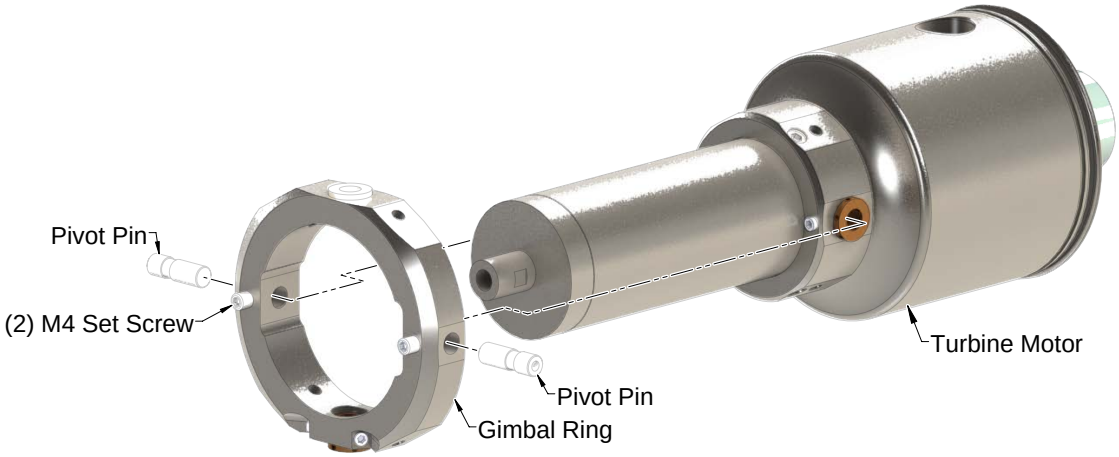


19. Thread M3 fasteners into the pivot pins of the gimbal ring assembly.
20. At the front of the gimbal ring assembly, use a 2.5 mm hex key to loosen the (2) M5 set screws securing the motor pivot pins until they extend out of the front housing about 1/8".
21. Using a 2 mm hex key, loosen the M4 set screws at the bottom of the motor ring.
22. Using a 1.3 mm hex key inserted into the side hole of the threaded bushing, turn the bushing in toward the motor ring.

Figure 6.5—Motor Ring Bushing Adjustment

23. Pull the M3 fasteners screwed into the pivot pins to extract the pins.
24. Remove the gimbal ring.

Figure 6.6—Gimbal Ring and Turbine Motor

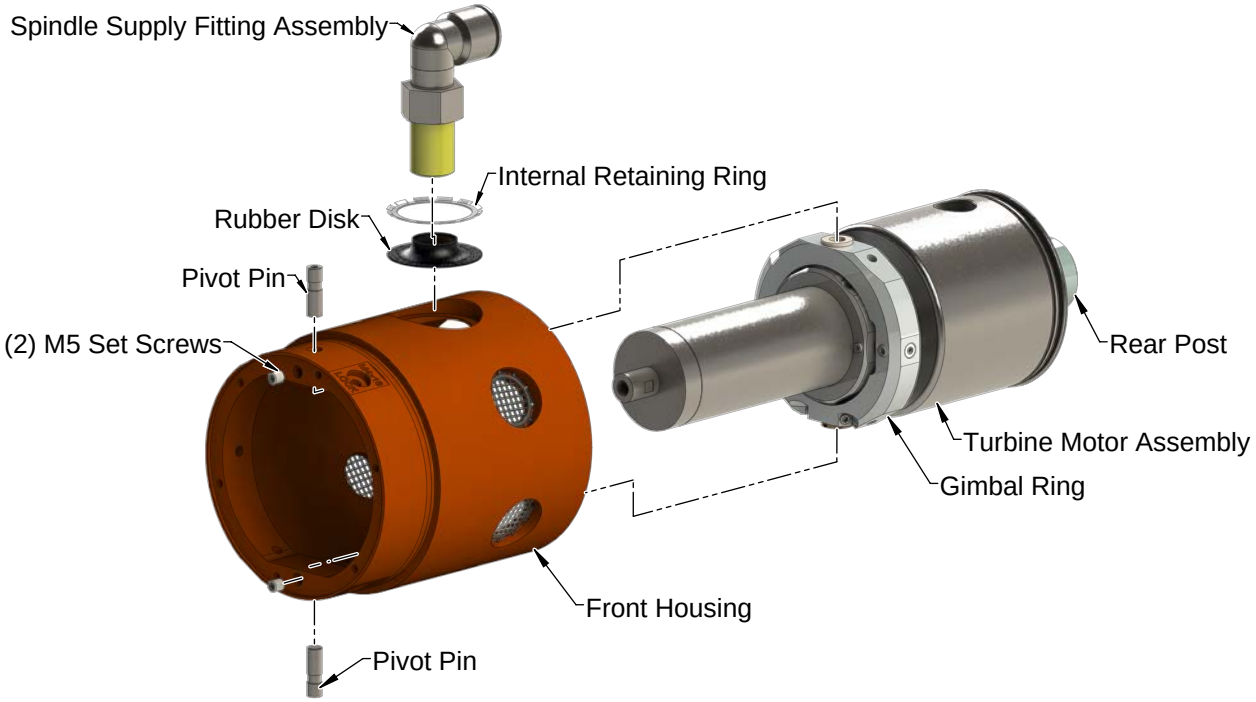


25. Install the gimbal ring on the new turbine motor assembly.
26. Insert the pivot pins flush with the gimbal ring to secure it in place.
27. Using a 2.5 mm hex key, install the (2) M5 set screw into the gimbal ring to secure the pivot pins. Tighten to 25 in-lbs (2.82 Nm).
28. Using a 1.3 mm hex key inserted into the side hole of the threaded bushing, turn the bushing out toward the gimbal ring until contact and then back in 1/6 of a turn (one through hole). Refer to *Figure 6.5*.
29. Using a 2 mm hex key, tighten the M4 set screw at the bottom of the motor ring to 6 in-lbs (0.68 Nm).

Figure 6.7—Motor Ring Bushing Adjustment

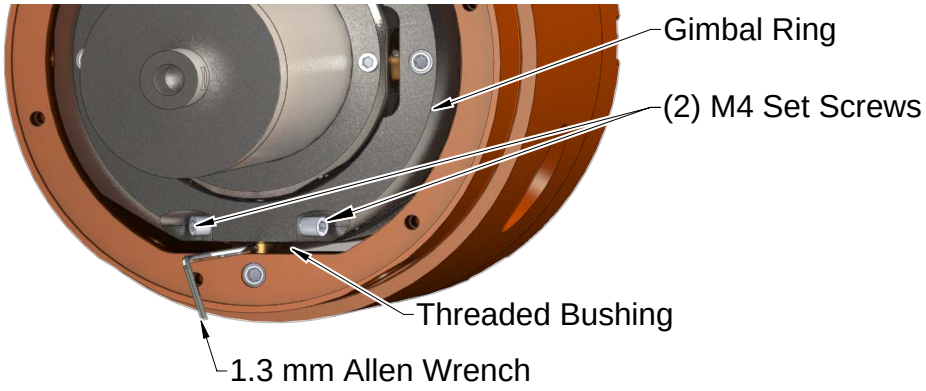
30. Insert the new turbine motor and gimbal assembly into the front housing assembly making sure the motor's air supply port aligns with the hole in the front housing.
31. Insert the pivot pins flush with the front housing to secure the turbine motor in place.

Figure 6.8—Turbine Motor Replacement



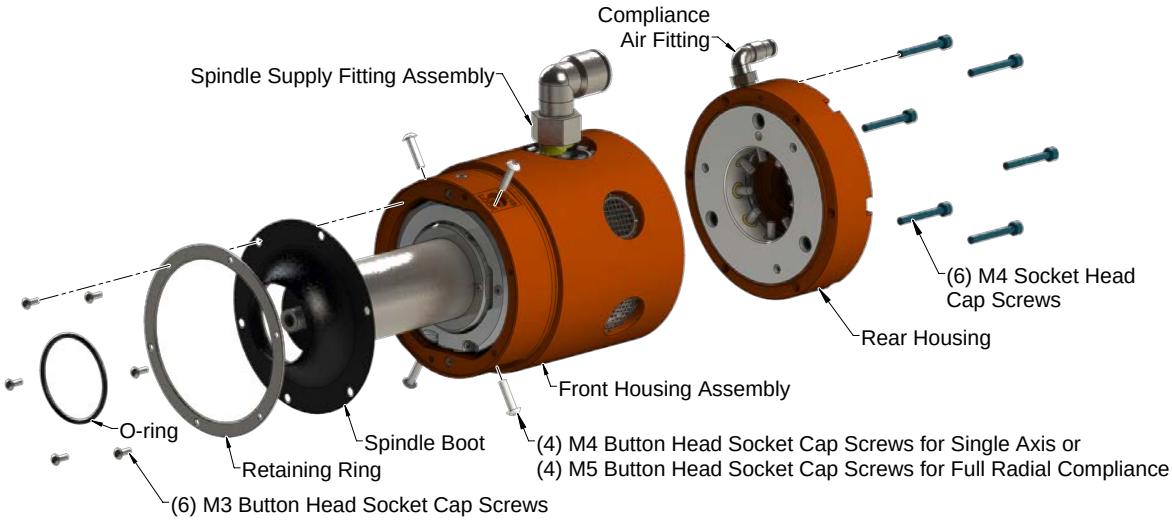
32. Using a 2.5 mm hex key, install the (2) M5 set screws into the front housing assembly to secure the pivot pins. Tighten to 25 in-lbs (2.82 Nm).
33. Using a 1.3 mm hex key, which is inserted into the side hole of the threaded bushing, turn the bushing out toward the housing until contact and then back in 1/6 of a turn (one through hole). Refer to *Figure 6.3*.
34. Using a 2 mm hex key, tighten the (2) M4 set screws at the bottom of the gimbal ring to 6 in-lbs (0.68 Nm).

Figure 6.9—Gimbal Ring Bushing Adjustment



35. Apply a coating of Magnalube on the rear post of the turbine motor assembly. Refer to *Figure 6.4*.
36. Apply Loctite 222 to the (6) M4 socket head cap screws.
37. Align the rear housing to the front housing assembly and secure with the (6) M4 socket head cap screws. Tighten to 25 in-lbs (2.82 Nm).
38. Apply (1) drop of 10W to 30W oil to each bushing in the gimbal ring.
39. Slide the disk boot over the motor spindle and align to the front housing assembly.
40. Apply Loctite 222 to the (6) M3 button head socket cap screws.
41. Fit the boot retaining ring over disk boot and secure with (6) M3 button head socket cap screws using a 2 mm hex key. Tighten to contact and an additional 1/2 turn.

Figure 6.10—Spindle Boot and Rear Housing



42. Assemble the O-ring over the disk boot.

43. Assemble the new internal retaining ring and rubber disk to the spindle supply fitting as shown in *Figure 6.11*.
44. Apply non-hardening thread sealant to the threads of the spindle supply fitting. Do not use thread sealant tape.
45. Thread the spindle supply fitting into the turbine motor assembly until it is finger tight then tighten an additional 1/2 turn.
46. Slide the rubber disk into the counter bore in the front housing.
47. Push the internal retaining ring into the counter bore to secure the rubber disk.

Figure 6.11—Spindle Supply Fitting and O-Ring Installation

48. If the tool was locked to single axis compliance before air motor replacement, apply Loctite primer 7649 and 222 to and install the (4) M4 x 16 mm button head socket cap screws. Tighten to 25 in-lbs (2.82 Nm).
49. Install the deburring tool to the robot or work location.
50. Connect the air hose to the spindle supply fitting and the compliance air fitting.
51. Apply and/or unlock the spindle motor air supply.

6.2.3 Ring Cylinder Assembly Replacement

The compliant motion of the turbine motor spindle is accomplished using an array of pistons (ring cylinder) installed inside the rear housing. After extended operation, this component may need replacing to insure 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 procedure: The ring cylinder is available as a complete assembly with new O-ring seals.

Refer to *Figure 6.12*.

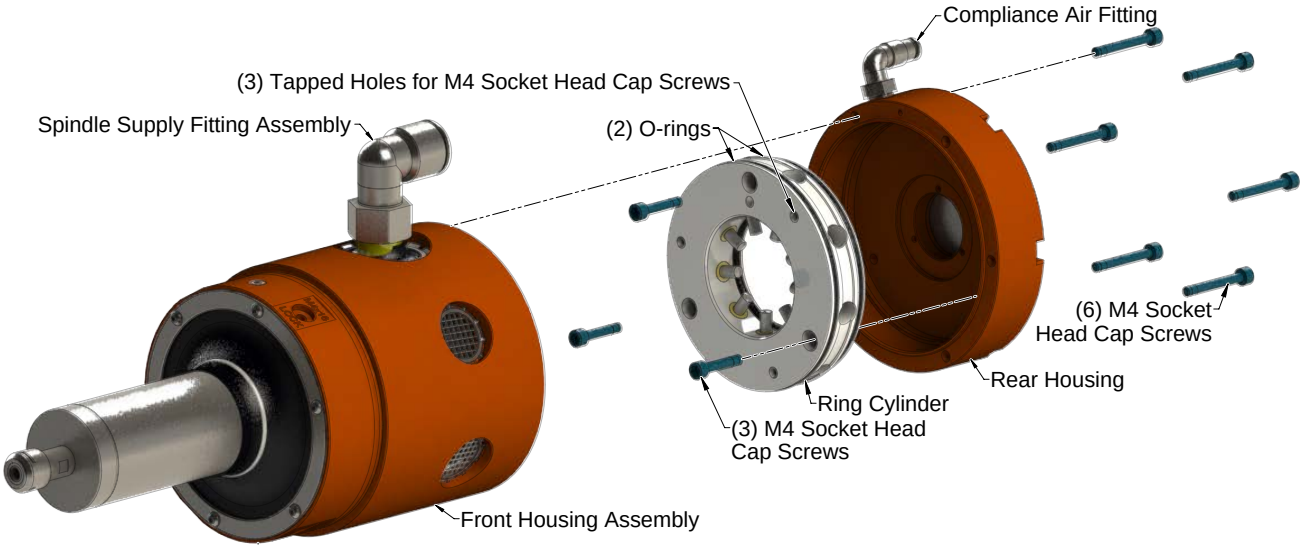
Parts required: *Refer to the ATI customer drawing*

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

Supplies required: *Clean rag, Loctite 222*

1. Remove and/or lock-out the spindle motor air supply for safety.
2. Disconnect the air hoses from the spindle supply fitting and the compliance 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 3 mm hex key, remove the (6) M4 socket head cap screws securing the rear housing to the front housing.
6. Remove the rear housing.
7. Using a 3 mm hex key, remove the (3) M4 socket head cap screws securing the ring cylinder assembly to the rear housing.
8. Place the removed M4 screws in the tapped holes in the ring cylinder body and tighten them slowly and equally, so they push the ring cylinder assembly out of the rear housing.

Figure 6.12—Ring Cylinder Replacement



9. Apply a thin film of grease or oil to the housing bore where the ring cylinder seats prior to installation.
10. Insert the new ring cylinder assembly into the rear housing. Align the ring cylinder assembly using the mounting screws prior to pressing the ring cylinder in the bore.
11. Apply Loctite 222 to the (3) M4 socket head cap screws.

12. Place the M4 screws in the through holes in the ring cylinder body and tighten them slowly and equally using a 3 mm hex key, so they pull the ring cylinder assembly into of the rear housing. Note: Be sure the O-rings stay seated in their grooves. Tighten to 25 in-lbs (2.82 Nm).
13. Assemble the rear housing to the front housing.
14. Apply Loctite 222 to the (6) M4 socket head cap screws. Secure the rear housing using the (6) M4 socket head cap screws using a 3 mm hex key. Tighten to 25 in-lbs (2.82 Nm).
15. Install the deburring tool to the robot or work location.
16. Connect the air hose to the spindle supply fitting and the compliance air fitting.
17. Apply and/or unlock the spindle motor air supply.

6.2.4 Spindle Boot Replacement

The spindle boot prevent debris from entering the housing and protects internal components. Replace the spindle boot if damaged.

Refer to *Figure 6.13*.

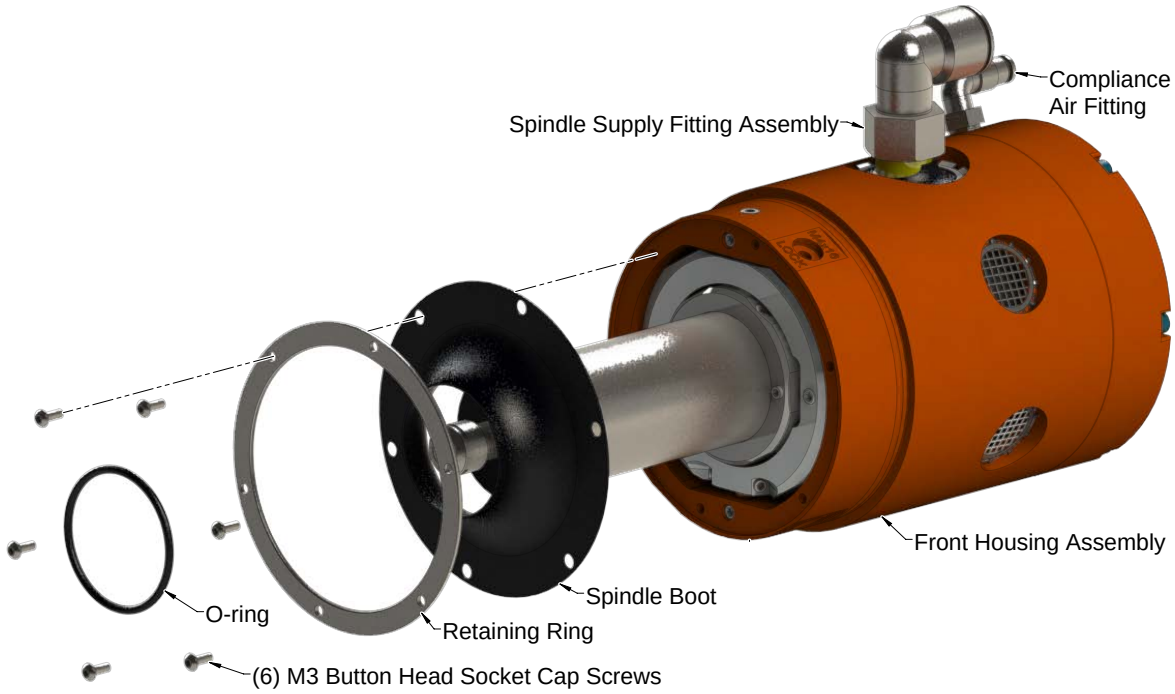
Parts required: *Refer to the ATI customer drawing*

Tools required: *2 mm hex key, torque wrench*

Supplies required: *Clean rag, Loctite 222*

1. Remove and/or lock-out the spindle motor air supply for safety.
2. Disconnect the air hose from the spindle supply fitting and the compliance 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. Ease the O-ring off the front spindle boot.
6. Using a 2 mm hex key, remove the (6) M3 button head socket cap screws securing the retaining ring to the front housing assembly.
7. Remove the retaining ring and spindle boot.

Figure 6.13—Retaining Ring, Spindle Boot, and O-ring Replacement



8. Apply (1) drop of 10W to 30W oil to each bushing in the gimbal ring.
9. Align the spindle boot and the retaining ring with the holes in the ring cylinder and slide the boot onto the air motor and align the edge of the boot to the edge of the contact sleeve.
10. Apply Loctite 222 to the threads of the (6) M3 button head socket cap screws.
11. Secure the spindle boot and retaining ring to the front housing using the (6) M3 button head socket cap screws using a 2 mm hex key. Tighten to contact plus one additional flat.
12. Stretch the O-ring over the boot.
13. Install the deburring tool to the robot or work location.
14. Connect the air hose to the spindle supply fitting and the compliance air fitting.
15. Apply and/or unlock the spindle motor air supply.

7. Serviceable Parts

For repair and spare parts please contact ATI. For exploded drawings showing all the user replaceable components, refer to the *ATI customer drawing*. 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

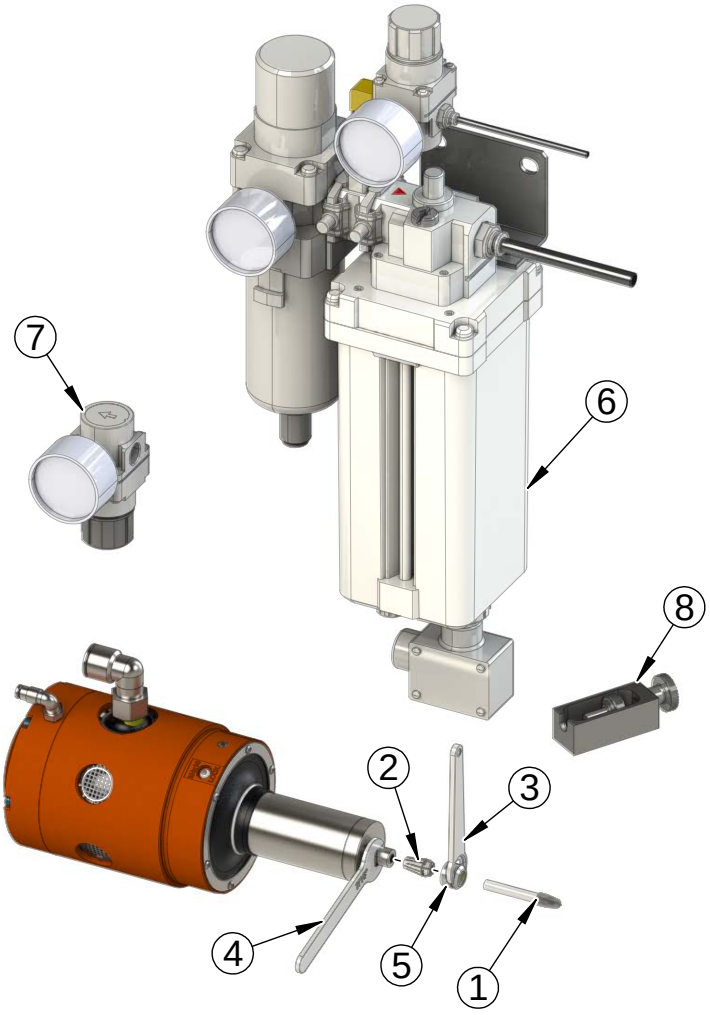


Table 7.1—Serviceable Parts			
Item No.	**Qty**	**Part Number**	**Description**
1	1	9150-RC-B-XXXXX	Refer to *Table 4.1* for bur part numbers and descriptions
2	1	9150-RC-C-11048	Ø 4 mm ER-11 Collet for ER series RC
		9150-RC-C-87694477	Ø 6 mm-1/4" ER-11 Collet for ER series RC
		9150-RC-C-22768	Ø 6 mm, ER-11, Collet
3	1	9150-RC-T-11058	10 mm Wrench for ER-11 Collet
4	1	9150-RC-T-12475	7/16” [11 mm] Open End Wrench
5	1	9150-RC-C-11057	Collet Nut, ER-Collet
6	1	9005-50-6166	High-Flow Filter/Regulator Assembly
7	1	9005-50-6164	Precision Regulator
8	1	9150-RC-T-4230	Bur Setting Fixture, RC/RS Tools

8. Specifications

Table 8.1—9150-RC-900-ER and 9150-RC-900-ER-E Models[1]	
Parameter	**Rating**
Motor	Turbine
Motor part number	3490-0001059-01
Motor Series	450XHD
Idle Speed (RPM)	25,000 (27,500 Max.)
Power	900 watts
Weight (without Adapters)	Approx. 7.6 lbs (3.4 kg)
Compensation (Radial)	+/- 9 mm max., +/- 5 mm recommended
Compliance Force (Measured at Collet)	28.9 - 86.7N (6.5-19.5 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)
Spindle Air Consumption	11.8-19 l/s (25-40 CFM)
Sound Pressure Level[2]	78 dBa
Collet Size, Standard[3]	6 mm-1/4" (ER-11 Type with Large Grip Range)
Rotary Burs[4]	Commercial Units Rated 40,000 RPM or Higher
Special Tools	Open End Wrenches (1 Pair Supplied) 11 mm (7/16”) Open End 10 mm Narrow (Only for use with ER11 Collets)

Notes:

1. Specifications applied to a series of models cover the basic “inch” designs and metric -E models.
2. 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.
3. Optional Sizes Available, See *Section 7—Serviceable Parts*.
4. ATI Can Supply Burs, See *Section 4.6.1—Bur Selection*.

Table 8.2—9150-RC-1040-ER and 9150-RC-1040-ER-E Models[1]	
Parameter	**Rating**
Motor	Turbine
Motor part number	3490-0001058-01
Motor Series	450XHD
Idle Speed (RPM)	40,000 (44,000 Max.)
Power	1040 watts
Weight (without Adapters)	Approx. 7.6 lbs (3.4 kg)
Compensation (Radial)	+/- 9 mm max., +/- 5 mm recommended
Compliance Force (Measured at Collet)	28.9 - 86.7N (6.5-19.5 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)
Spindle Air Consumption	11.8-19 l/s (25-40 CFM)
Sound Pressure Level[2]	78 dBa
Collet Size, Standard[3]	6 mm-1/4" (ER-11 Type with Large Grip Range)
Rotary Burs[4]	Commercial Units Rated 40,000 RPM or Higher
Special Tools	Open End Wrenches (1 Pair Supplied) 11 mm (7/16”) Open End 10 mm Narrow (Only for use with ER11 Collets)

Notes:

1. Specifications applied to a series of models cover the basic “inch” designs and metric -E models.
2. 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.
3. Optional Sizes Available, See *Section 7—Serviceable Parts*.
4. ATI Can Supply Burs, See *Section 4.6.1—Bur Selection*.

9. Terms and Conditions

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

9.1 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 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.

9.1.1 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.