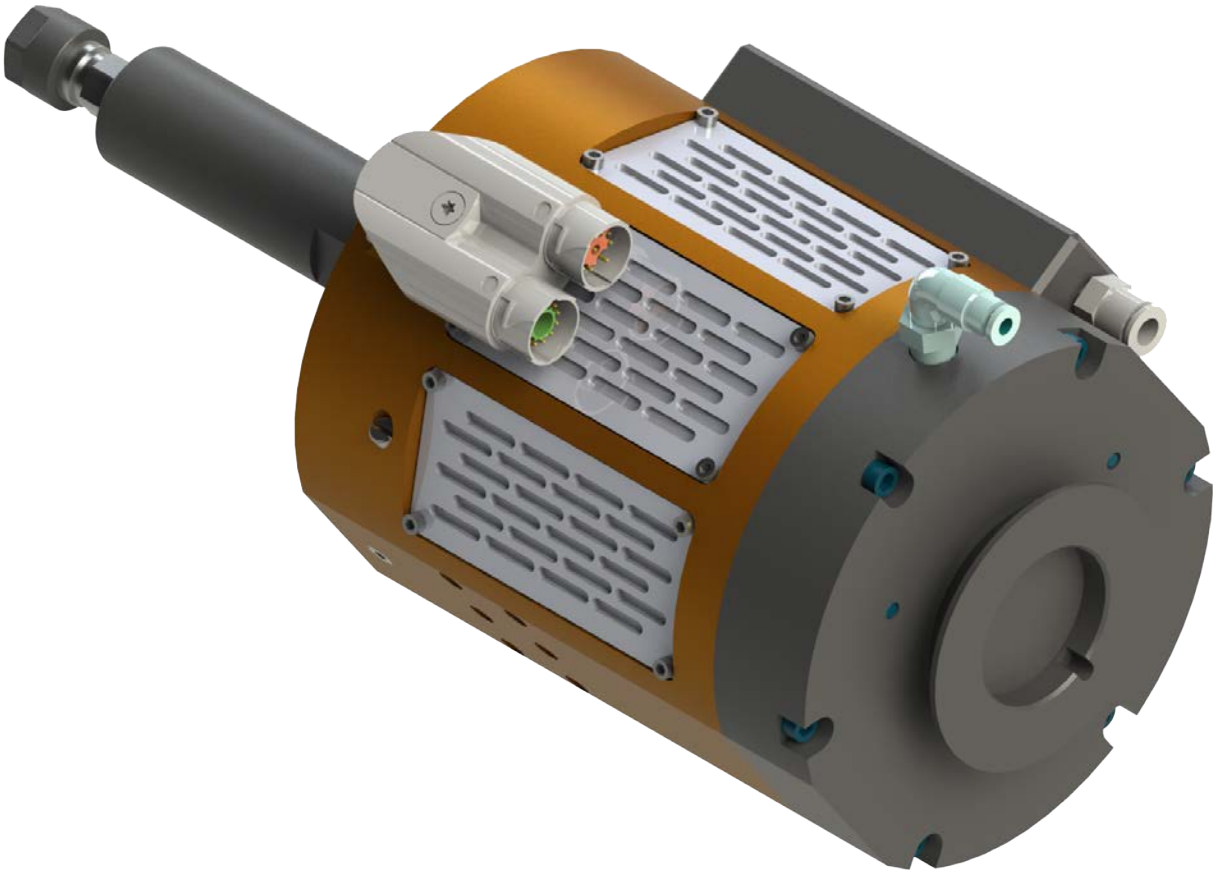
ATI Multi-Axis, Radially-Compliant Electric Deburring Tool

(Model 9150-RCE-710 and 9150-RCE-710-E)

Product Manual



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Engineered Products for 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.

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Table of Contents

Glossary

Term	Definition
Adapter Plate	Device for attaching the RCE to either a robot flange or a stationary mounting surface.
Burr	Any unwanted, raised protrusion on the workpiece.
Bur	Cutting tool used to remove burrs from the workpiece. Alternatively referred to as a rotary file, bur, or bit.
Climb Milling	Cutting method where the direction of media rotation and tool motion are the same.
Collet	Gripping device used to hold cutting tools in the spindle.
Compliance	The ability of the spindle to passively move in response to deviations of the workpiece.
Conventional Milling	Method of cutting where the direction of tool motion is opposite 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.
Regulator	Device used to set and control the supplied air pressure to acceptable levels.
Spindle	The rotating portion of the RCE assembly.

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.

HIGH VOLTAGE: 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.

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

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

1.2 General Safety Guidelines

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

All pneumatic fittings, electrical connections, and tubing must be capable of withstanding the repetitive motions of the application without failing. The routing of pneumatic lines and electrical cables 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

DANGER: Motor control equipment and electronic controllers are connected to hazardous line voltages. When servicing drives and electronic controllers, there may be exposed components with housings or protrusions at or above line potential. Extreme care should be taken to protect against shock. Stand on an insulating pad and make it a habit to use only one hand when checking components. Always work with another person in case an emergency occurs. Disconnect power before checking controllers or performing maintenance. Be sure equipment is properly grounded. Wear safety glasses whenever working on electronic controllers or rotating machinery.

WARNING: This equipment should be installed, adjusted, and serviced by qualified electrical maintenance personnel familiar with the construction and operation of the equipment and the hazards involved. Failure to observe this precaution could result in bodily injury.

CAUTION: The heat sink fins will have a high temperature. Be careful not to touch them. Otherwise, there is the danger of getting burned.

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

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

CAUTION: Do not perform maintenance or repair on the deburring tool 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 deburring tool product.

2. Product Overview

ATI's Multi-Axis, Radially-Compliant Electric Motor Deburring Tool (RCE) is a robust, high-speed, and lightweight electric motor deburring unit for deburring materials with a robot such as aluminum, plastic, and steel. The RCE is especially suited for removal of parting lines and flash from parts. However, its flexible design allows it to be used in a variety of applications.

The deburring tool's pneumatically controlled compliance, articulated design allows the cutting bit to follow the part profile and compensate for surface irregularities while maintaining a constant, configurable force. The design allows high feed rates with uniform quality in any orientation.

The RCE has a lockout feature to limit articulation and provide compliance solely in a direction normal to the surface of the workpiece. This allows the media to resist superfluous, chatter parallel to robot feedrate. The rigid parallel support is capable of producing greater control of surface finish and reduced tool chatter. To maintain the proper orientation of the cutting tool and the part profile requires extensive skill/effort in robot programming. The RCE can be locked to single axis compliance using the single axis lockout (refer to *Section 4.5—Locking and Unlocking Single Axis Compliance* for more information)

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 RCE utilizes standard industrial bits as well as abrasive brushes that allow for that allow for adaptation to changing assembly lines and part requirements.

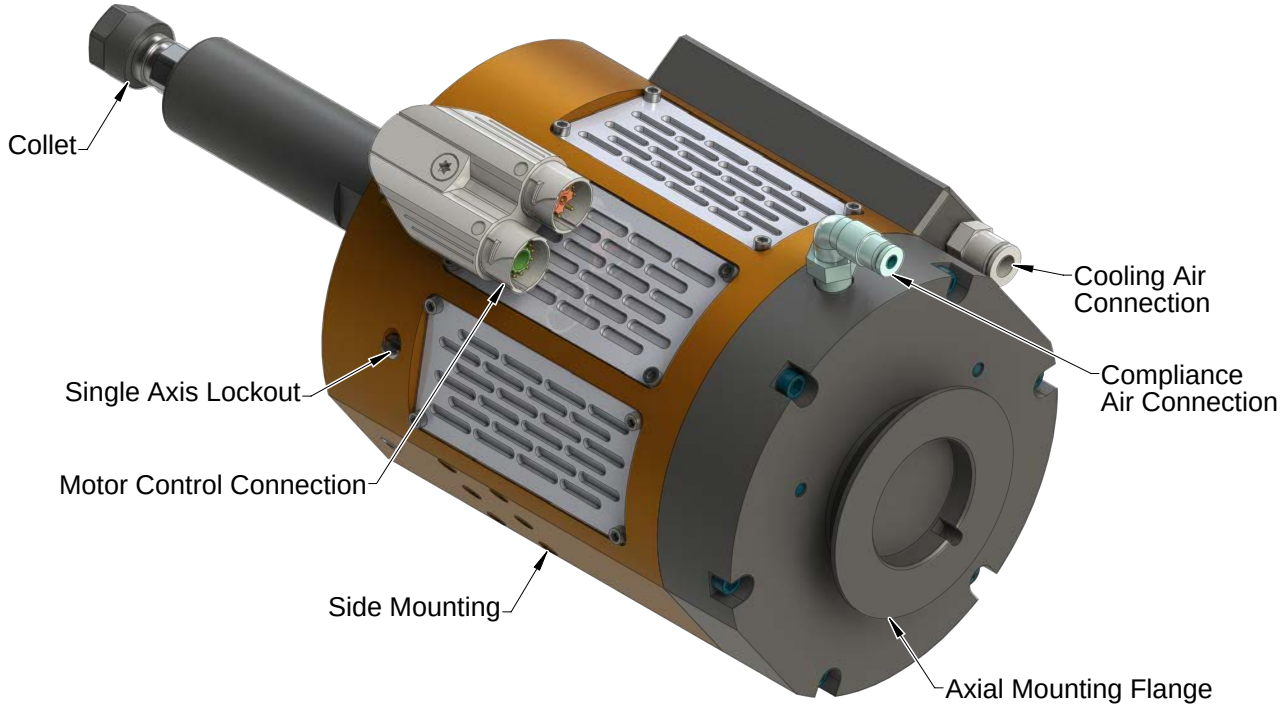
The RCE provides a side mounting pattern with (2) dowel pin locations and threaded holes. Custom adapter plates for side mounting are available from ATI.

The RCE is equipped with a push-to-connect fittings to supply the compliance and cooling air.

An ER-11 tool collet system secures the bur. Many collet sizes and media tools are available to accommodate a wide variety of applications.

For drawing and more information, please refer to *https://www.ati-ia.com/Products/deburr/deburring_rc_main.aspx*.

Figure 2.1—RCE Deburring Tool



2.1 Tool Collet Systems

The standard tool holding system for RCE series of products is an economical, industry standard ER-11 collet design. This design is suitable for most applications where industry standard shank diameter cutting tools are used. The ER-11 collet system is used worldwide on machine tools which allows users to procure different collet sizes from local industrial supply firms.

All deburring tool products utilize removable collets to grip customer supplied cutting tools. Different collet diameters may be substituted to retain the various media 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, wrenches are used to tighten the collet nut causing the collet to secure the cutting tool.

2.2 Technical Description

A technical overview of the product is provided in the following section: For additional technical specifications (refer to *Section 8—Specifications*)

2.2.1 Environmental Limitations

2.2.1.1 Operation

Table 2.1—Operation	
Installation Position	Mounted to robot by means of the side and rear mounting pattern.
	Mounted to a table or stand by means of the bench adapter. The robot is carrying the work piece to the RCE.
Temperature Range	5 °C – 155 °C 41 °F – 311 °F
Utilities	The tool requires the following: • The electric motor can be operated with the proper electrical supply to the motor. • The radial compliance (centering) air must be supplied at 1.0–4.1 Bar (15–60 psi) from a regulated source. • Always run with cooling air ON. The tested and recommended minimum values are 30 psi at 6 CFM. Lower values subject to change motor performance. Never operate without cooling air.

2.2.1.2 Storage

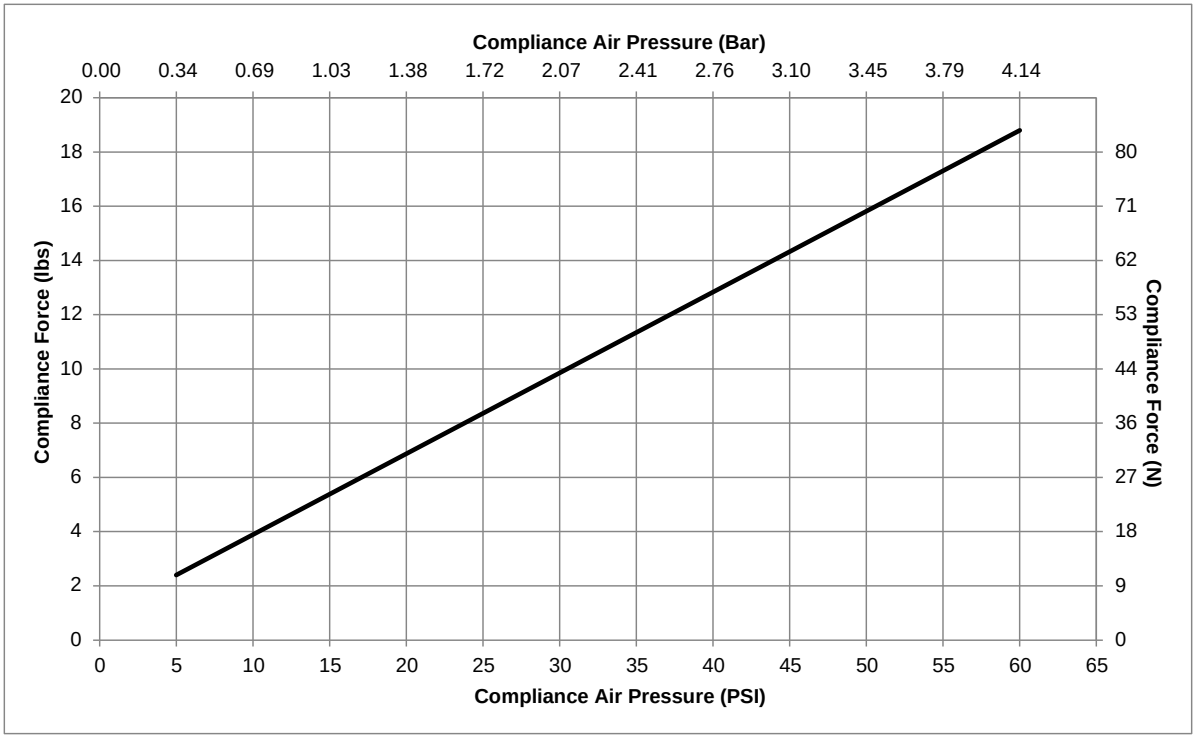
Table 2.2—Storage	
Temperature Range	0 °C – 45 °C 32 °F – 113 °F
Conditions	The tool should be stored in its crate and in a dry place. When not in use, keep the unit in its crate if possible. Consult *Section 3.4—Storage and Preventive Maintenance During Storage* of this manual.

2.2.2 Compliance Unit Performance

The following graph illustrates the variation of compliance force with applied air pressure in the vertical orientation with the collet pointed downward toward the ground. Measurements may vary from one product to another and should only be regarded as nominal.

The actual force characteristics are dependent on the mounting orientation and condition of the unit. In applications where the RCE 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 workpiece, type of media tool, and the amount of material that is removed.

Figure 2.2—RCE-710 Compliance Force Curves (Measured at the Spindle Tip)



2.2.3 Electric Motor Performance

The RCE-710 has been tested for continuous 100% duty cycle at an average of 2 in-lb (.23 Nm) of torque over the entire 0-13000 speed range. The motor performance can vary based on feed rate, material, and size of burr removed all can affect the ATI rated performance. The motor will stall if the torque required to perform a specific task exceeds the maximum available speed. Therefore, multiple light passes are preferred over slow, heavy cuts.

3. Installation

The RCE is delivered fully assembled. Operational equipment such as mounting adapter plates, media tools, and additional collets will be sold separately.

3.1 Protection During Transportation

The RCE is packaged in a crate that secures and protects the tool during transportation. Always use the crate when transporting the RCE in order to minimize the risk of damage.

3.2 Inspection of Condition When Delivered

Upon receipt, the following should be checked:

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

If there is damage to any of the packaging, or if any of the goods have been exposed to abnormal handling, unpack those parts that may have been damaged for closer inspection. Notify ATI for assistance in the evaluation of the product condition, if necessary.

3.3 Unpacking and Handling

The RCE should always be placed inside the accompanying crate while transporting, storing, and handling.

Pneumatic lines 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 RCE should always be stored in its crate when not in use. The RCE should be stored in a dry place. For long-term storage, the RCE should be thoroughly cleaned of any burrs or debris. Do not disassemble the RCE. Place the RCE within a sealed plastic bag inside the crate.

3.5 Procedure for Setting up the RCE-710 and Controls

1. Mount the RCE-710 to the robot.
2. Plug in the Orange Power Cable to the Orange connector on the RCE-710.
3. Plug in the Green Signal Cable to the Green connector on the RCE-710.
4. Plug in the 4mm / 5/32” Compliance Air and the 6mm / ¼” Cooling Air Tubes.
5. Route all utilities down the robot ensuring ample bend radii for programming.
6. Open Control Box and reset all circuit breakers.
7. Ensure Control Box is closed and locked.
8. Plug in Orange and Green Cables to respective connectors on control box.
9. Plug Control Box into 120v Outlet.
10. Turn on the control box.
11. Use the menu navigation to find the “Motor Direction” option.
12. Set the desired direction (clockwise or counter clockwise) using the directional arrows.
13. Hit enter to set.
14. Use the menu navigation to find the “Set Speed” option.
15. Set the desired speed (0-13000rpm) using the turn knob.
16. Hit enter to set.
17. Try the robot program on a test part. Observe the finish.
18. If the part finish is not desirable, change set speed or customer supplied media.
19. Repeat steps 11-18 until desired finish is achieved.

3.6 Helpful tips for smooth motor operation:

- Always run with cooling air ON. The tested and recommended minimum values are 30 psi at 6 CFM. Lower values subject to change motor performance. Never operate without cooling air.
- When inspecting desired finish after deburring, use caution around the tool as the exterior surfaces can become hot to the touch.
- If motor faults, cycle power to reset and restart deburring.

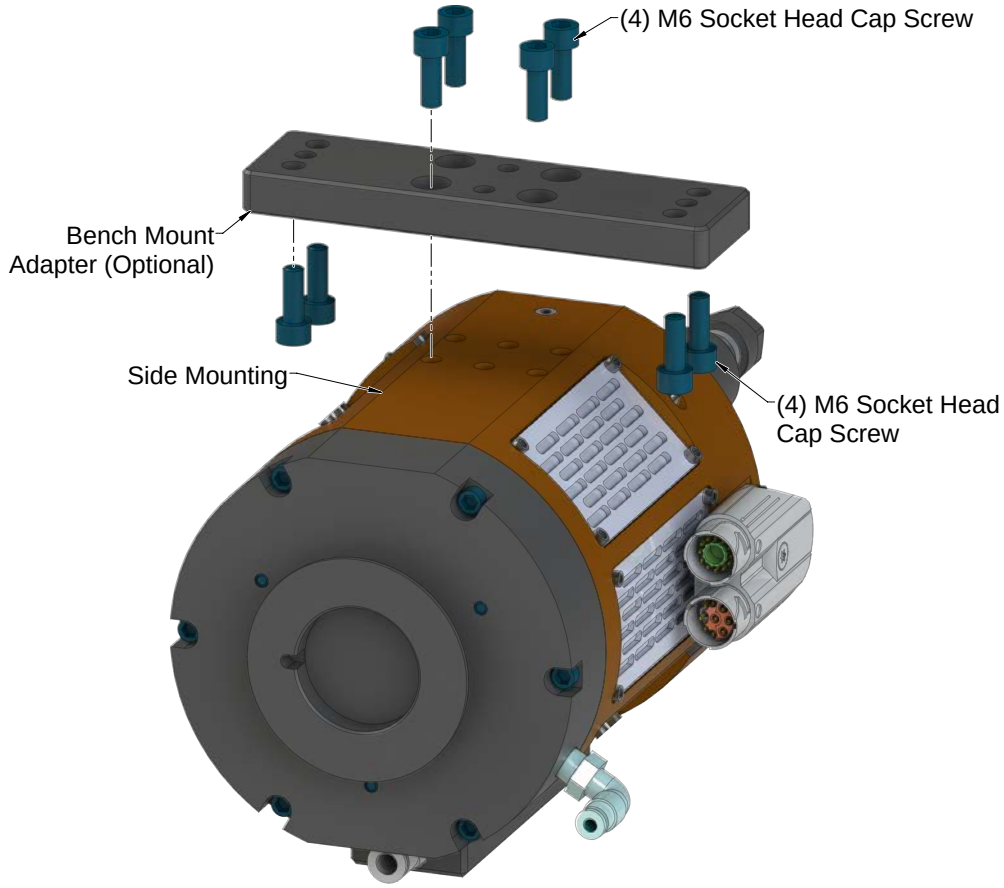
3.7 Side Mounting Installation

CAUTION: The length of the fasteners should not interfere with the compliant motion of the electric motor spindle 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 RCE consists of (2) dowel pin holes and (4) threaded holes (refer to *Figure 3.1*) An optional bench mount adapter plate allows the RCE to attach to a bench or other work surface. The bench mount adapter may also be used with intermediate plates to attach the RCE to a robot flange or to an ATI Tool Changer. If the RCE is permanently mounted to a work surface, the robot carries the part to the deburring tool to be deburred.

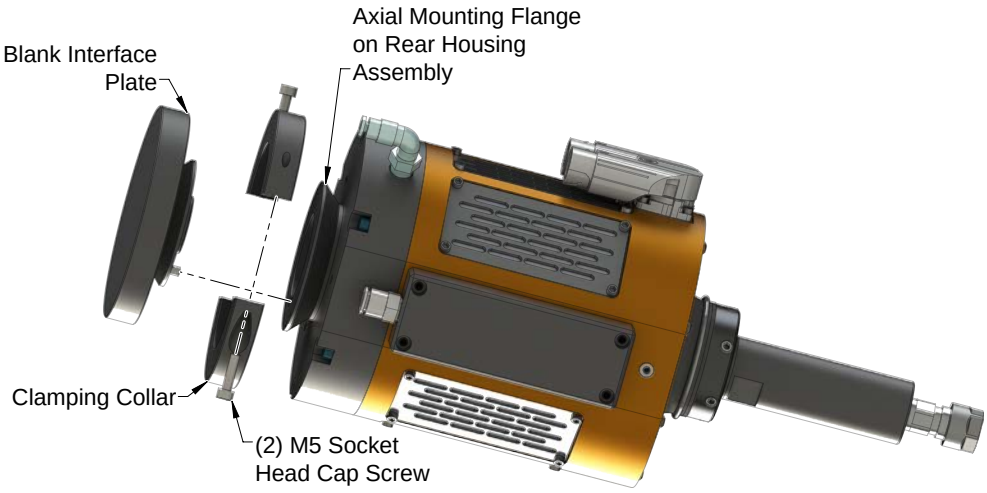
Figure 3.1—Side Mounting Installation



3.8 Axial Mounting Installation

A blank robot adapter plate is available to allow axial mounting off the rear of the RCE housing. This plate may be modified by the system integrator or by the owner/user of the RCE. ATI can provide custom interface plates and adapters upon request. The axial mounting requires a clamping collar kit which includes the blank rear adapter plate. The kit is available from ATI (Part Number: 9005-50-1005). Other plate kits are available upon request.

Figure 3.2—Axial Installation (Model shown for reference)



3.9 Pneumatics

Conventional, customer-supplied, pneumatic components are used to control the air supply to the RCE.

A precision, self-relieving regulator (ATI P/N 9005-50-6164, or equivalent) and valve supply air to the compliance (centering) mechanism. The compliance air pressure corresponds to the side of radially applied force on the rotary bur. Adjust the compliance air pressure and robot traverse speed to achieve the desired finish. The compliance air supply must be dry.

If the work piece can be deburred with equal force, a conventional manual pressure regulator can be used for the compliance air supply. If the burrs 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 that is controlled from the robot. An analog output port in the robot or logic controller will be needed.

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

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 the equipment.

Table 3.1—Pneumatic Connections

Connection Function	Connection Type	Pressure Requirement
Motor cooling inlet	1/4” tapped port (1/4 NPT in the motor body)	2 bar (30 psi) at 6 cfm
Compliance (radial) force inlet	4 mm (5/32”) quick-connect tube	1.0–4.1 bar (15–60 psi) (Maximum)
Exhaust	Vented to atmosphere	Not Applicable

The sound level around deburring equipment cannot be predicted by ATI because the sound pressure from deburring operations is process and part dependent. 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*). Another approach to reduce sound is reducing the speed of the RCE spindle.

The compliance force, air supply pressure regulator should have a range of 1-4.1 Bar (15-60 psi). When testing for the proper contact force, start with about 1 bar (15 psi) and increase the air supply slowly until the desired cut is achieved.

4. Operation

These operating instructions are intended to help system integrators program, start up, and set up a 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

WARNING: Never use the RCE for purposes other than deburring. If used in any other way, serious injury or damage to equipment may occur.

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

WARNING: All personnel involved in the operation of the 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 RCE.

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

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

HOT SURFACE: Outside surface of motor enclosure can become hot. Wait for surface to cool before any contact with it is attempted.

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

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

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

4.1.1 Air Quality

The air supply should be clean, lubricated, dry, and filtered. A coalescing filter that has elements rated for 5 micron or better is required.

Air quality affects tool performance more than almost any other factor. Particulate can block airflow.

4.1.2 Lubrication

No lubrication.

4.1.3 Media Selection, Design, and Maintenance

Use carbide bits under 11/16" diameter and 2" in length.

Use brush media under 3" diameter and 1" in length. 3" total length with shank

Do not use media that requires axial loading.

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.

In many deburring applications, including steel and aluminum, no cooling or lubrication of the rotary media is necessary. For some materials and situations, the addition of coolants or compressed air may aid the cutting process. If it is determined that liquid coolants are required, a non-oil, cutting type fluid should be used to prevent premature wear of the spindle bearing.

4.1.4 Deburring Tool Approach Path Should Be Slow and at an Angle

The RCE 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, gouging and premature wear of the tool bearings and premature failing of the unit can occur.' Additionally, collisions could result and create a hazardous situation for both personnel and equipment.

4.1.5 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 media contacts the underlying material below the edge; this causes axial loading on the tool and bearings. This axial loading results in premature failing of the unit.

Do not attempt to deburr to a depth of more than 30% of the diameter of the bur. Exceeding this depth causes excessive chatter and could result in the following: premature media wear, the motor stalling, and damage to the bearings, the compliance ring, or both.

When deburring holes, interpolate the perimeter. Do not use a countersink tool because that tool results in axial loading and premature wear of the bearings.

4.1.6 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.

4.2 Deburring Tool Working Environment

As described in previous sections, the RCE 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 RCE and robot are stopped before entering the robot cell. When installing and testing, never be present in the cell when the RCE is running.

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

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

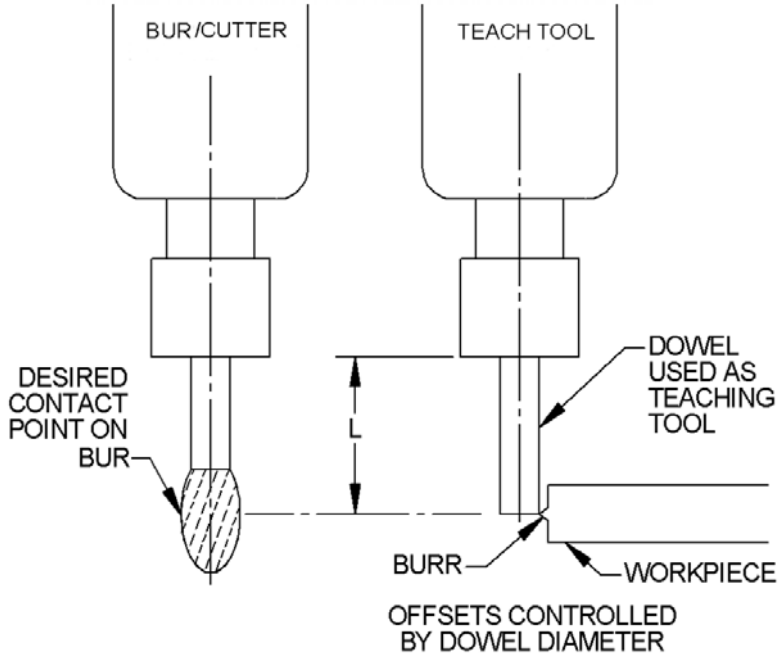
The RCE should not be used to deburr materials that are prone to fracture. A fracturing work piece may result in pieces of material damaging surrounding working environment and personnel. Material removed correctly should be in the form of chips.

4.3 Tool Center Point (TCP) Position and Programming

The RCE provides radial compliance and performs best when the cuts taken are not excessively deep. The RCE 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).

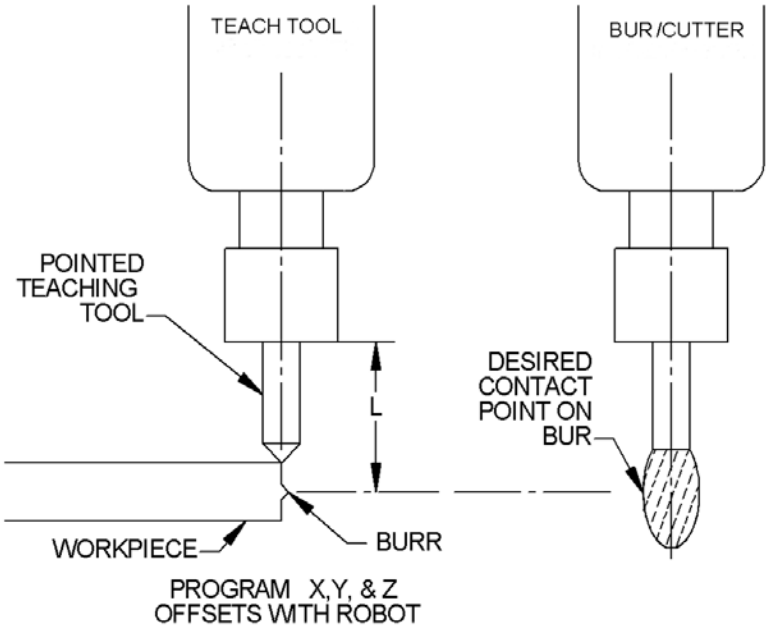
Two programming methods are suggested, but others are possible. In the first method, a dowel pin of suitable diameter is inserted in place of a cutting tool (simulating the media shank diameter) when teaching the robot path. For 6 mm collets, this will mean a 6 mm diameter pin is of suitable length.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

Figure 4.1—Dowel Teaching Tool



Another programming method is to teach the path using the centerline of the media 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 media path (*Figure 4.2*). The programming method used depends on the robot's capabilities and programmer preferences.

Figure 4.2—Pointed Teaching Tool



Interior corners present a complex situation for compliant deburring tools. In general, the media must not be allowed to simultaneously contact both perpendicular surfaces of an interior corner. The resulting force imbalance in two planes causes severe tool chatter. The customer is advised to create a tool path that prevents the media from simultaneously contacting two perpendicular surfaces. A tapered media may reach further into an interior 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 media the surface cutting speed is reduced).

When deburring interior radii, moderate to severe tool chatter may occur (similar to example given in previous paragraph). Do not attempt to deburr an inside radius less than 1.5 times the diameter of the desired media (Rmin = 1.5 x Media diameter).

When running the robot program for 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 the robot may deviate from the programmed path. Verify that the media is deflected but continues to contact the work surface at operational robot path speed. Once the robot path has been confirmed, the compliance force of the media should be adjusted, as described in *Section 3.9—Pneumatics* (in order to achieve a correct depth of cut).

4.4 Media Operation and Media Selection

The RCE will perform best in climb milling (when the media directions of travel and rotation are the same). In the case of the RCE, the media 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 media enters the workpiece and the chip becomes narrower as the cut is completed. In conventional milling, the media travels in a direction opposite of media rotation. This may aid in media stability for some operations, however, the cutting edge of the media is subjected to higher friction and cutting forces. Media wear is accelerated in this mode and surface finish quality generally is reduced. When using conventional milling technique, take extra care around corners. A corner poses a potential hazard where the cutting force can deflect the media and cause the media to break as the robot continues along its path.

The selection of a media is dependent upon the workpiece material, geometry, and the depth of cut. Please see *Section 4.4.1—Media Selection* for a short list of burs and suitable applications. A 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 present a difficult deburring challenge due to the phenomenon of chip re-welding. In this process, if the media is dull or the settings are not correct for the material, chips will melt and weld to the media or workpiece. Re-welding can quickly load a media and produce unacceptable results. In general, the traverse or feed rate of the RCE is higher for plastics to minimize melting and welding. A faster feed rate creates larger cuts that more effectively remove heat from the bur-tool interface.

4.4.1 Media Selection

Standard length commercial burs are used with the RCE. 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 with descriptions such as: "long" or "extended" shank. Using long or extended shank burs in the RCE will place higher loads and vibrations on the motor bearings and result in reduced motor life. Bearing failure caused by the use of long or extended shank burs is not covered under warranty.

CAUTION: Do not use long or extended shank burs with the RCE. Long shank tools can lead to premature failure of the electric motor and is not covered under warranty. Use a standard length commercial media with the RCE.

ATI can provide guidance in media selection; however, only experimentation will yield desired result. The following table includes many common media types and burs recommended for particular applications.

Table 4.1—Media Selection

	Materials/Application	Features/Benefits
	**9150-RC-B-24033–Diamond Cut, 1/4" Media Diameter, 5/8" Media 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" Media Diameter, 3/4" Media 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" Media Diameter, 3/4" Media 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" Media Diameter, 5/8" Media 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—Media Selection		
	Materials/Application	**Features/Benefits**
	**9150-RC-B-24645–Aluminum Cut, 3/8” Media Diameter, 5/8” Media 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
	**3710-50-1492 - Media 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” Media Dia., 3/4” Media Length, 1/4” Shank**	
	• Universal use, for ferrous and non-ferrous metals, and 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

4.5 Locking and Unlocking Single Axis Compliance

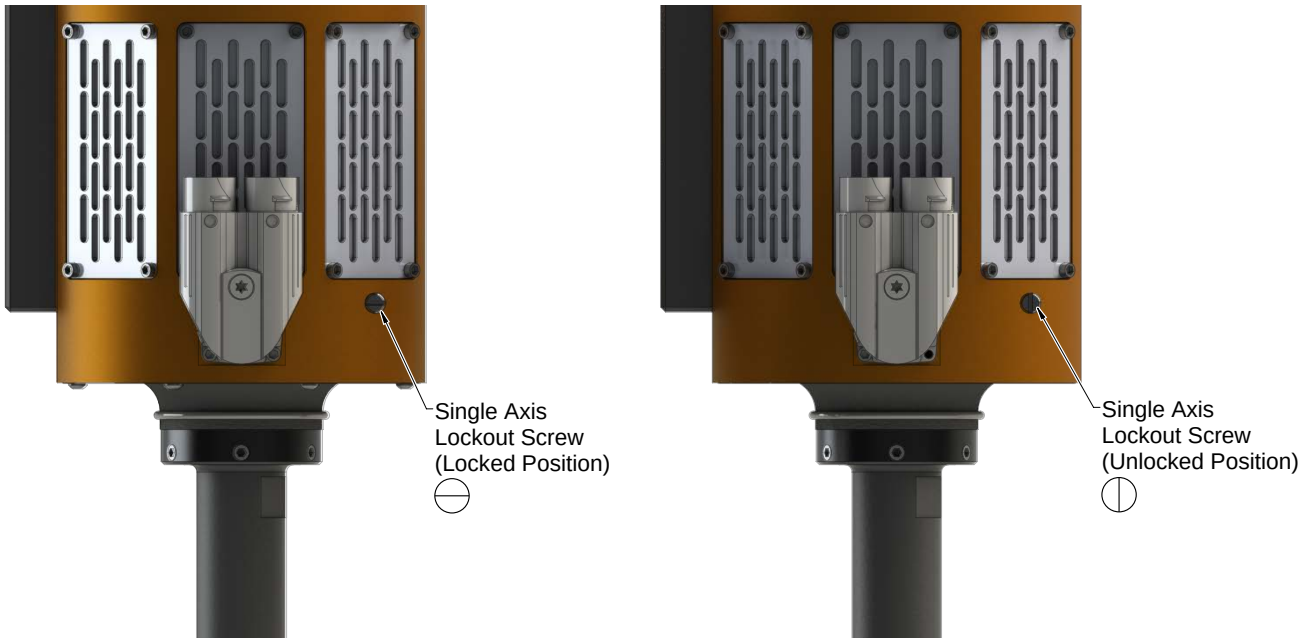
The RCE can be locked to be compliant in a single axis.

Tools required: *Flat headed screwdriver*

1. Turn the single axis lockout screw as shown in *Figure 4.3* for desired compliance.

- Locked = Single axis compliance
- Unlocked = 360° of compliance

Figure 4.3—Single Axis Compliance



5. Maintenance

The RCE is designed to provide reliable service for long periods of operation. While simple in design, there are parts in the assembly that are serviceable by the user. The user is encouraged to return the unit to ATI for service.

For all service, it is necessary that the power and air supply be disconnected. Discharge power and purge any trapped air pressure in the lines. Power and air supply must 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*.

The RCE is of modular construction. The subassemblies shown in *Section 7—Serviceable Parts* may be purchased and installed quickly to return a unit to operation.

5.1 Pneumatics

The air lines to the deburring tools should be checked routinely for their general condition and replaced as required. The air to the RCE must be filtered and dry. 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 Media Inspection

The media will wear depending on cut depth, feed rate, and the material that is being deburred. Inspect the media regularly for wear and refer to *Section 6—Troubleshooting and Service Procedures* for symptoms of a worn bur. If necessary, replace the media (refer to *Section 6.2.1—Media Replacement*)

5.3 Spindle Boot Inspection

The spindle boot prevents debris from entering the housing and protects internal components. Inspect the boot regularly for damage (refer to *Section 6.2.3—Boot 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 RCE is designed to provide reliable service for long periods of operation. While simple in design, there are parts in the assembly that are serviceable by the user. 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 necessary that the power and air supply be disconnected. Discharge power and purge any trapped air pressure in the lines. Power and air supply must 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.*

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
Media wear	Hard work material	Use better grade material with add coating (TiAlN)
	Too heavy a cut	Decrease width of cut, make multiple passes
	Feed rate is too slow	Increase feed rate
Media breakage	Too heavy a cut	Decrease width of cut, make multiple passes
	Deflection at 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 6.2.2—Ring Cylinder Assembly Replacement*)
Poor finish on work piece	Feed rate is too fast	Reduce feed rate
	Media is worn	Inspect media if worn, replace (refer to*Section 6.2.1—Media Replacement*)
Media 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 media selection	Choose media designed for work material
	Media is worn	Inspect bur. If worn, replace (refer to *Section 6.2.1—Media Replacement*)
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 media selection	Choose media designed for work material
	Media is worn	Inspect bur. If worn, replace (refer to *Section 6.2.1—Media Replacement*)
Chip packing of Media	Too heavy a cut	Decrease width of cut, make multiple passes
	Not enough chip clearance	Use a Media with less flutes
Media stalls	Media is not secure in collet	Properly tighten Media in collet
	Too much side load	Decrease width of cut, make multiple passes

6.2 Service Procedures

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

HIGH VOLTAGE: Hazard of electrical shock. Disconnect incoming power before working on this tool. Wait at least five (5) minutes after turning off the input power supply before performing maintenance or an inspection. Otherwise, there is the danger of electric shock.

HOT SURFACE: Outside surface of motor enclosure can become hot. Wait for surface to cool before any contact with it is attempted.

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

6.2.1 Media Replacement

In normal operation, the media becomes worn. If improper feeds and speeds are used, the media may become “loaded” with material. In both instances, replace the bur. During initial production, the media and the workpiece should be examined often in order to determine when the media should be replaced. When replacing the same size bur, it's not necessary to replace the collet. When replacing the old media with a different shank size bur, the collet must be replaced.

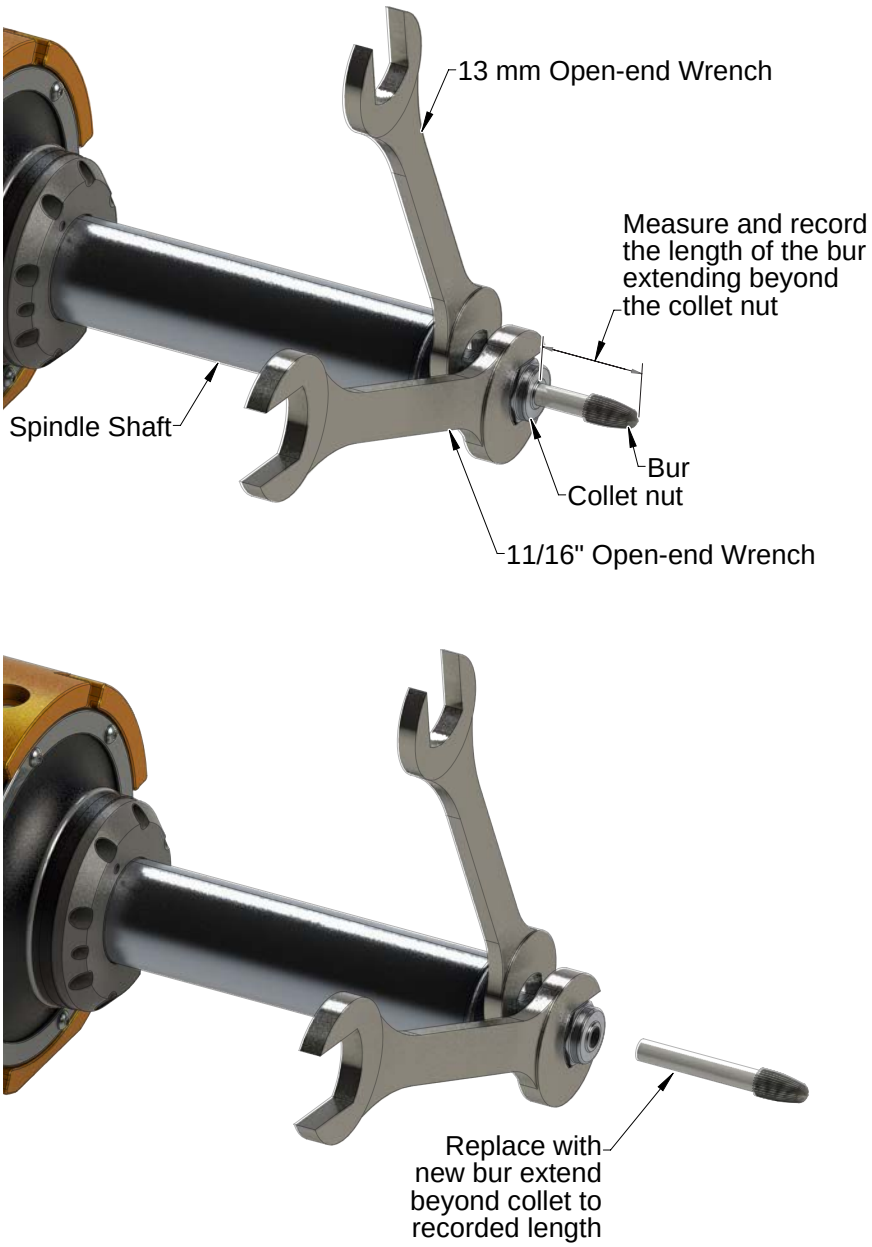
Refer to the following procedure for replacing the bur.

Refer to *Figure 6.1*.

Tools required: *13 mm open-end wrench, 11/16" open-end wrench*

1. Lock-out and remove the spindle motor air supply (De-energize all energized circuits such as: air and power).
2. If the media is to be replaced with one of an identical type, measure and record the tool length extending beyond the collet lock nut. Alternatively, the optional ATI 9150-RC-T-4230 media setting tool accessory can be used to duplicate the tool exposure length.
3. Use the 13 mm open-end wrench to hold the body of the collet holder just behind the collet nut.
4. Use the 11/16" open-end wrench to turn the collet locknut counterclockwise (when viewed from the media tip) to loosen the collet.
5. To remove a worn bur, pull the media out of the loosened collet by hand.
6. If an identical new media is replacing a worn one, measure and adjust the length of its exposed portion according to the measurement taken in step *2* of this procedure.
7. Use the 13 mm open-end wrench to hold the body of the collet holder just behind the collet nut.
8. Use the 11/16" open-end wrench to turn the collet locknut clockwise to tighten the collet.
9. Safely resume normal operation.

Figure 6.1—Media Replacement



6.2.2 Ring Cylinder Assembly Replacement

The compliant motion of the electric motor spindle is accomplished using an array of pistons (ring cylinder) installed inside the rear of the RCE. After extended operation, this component may need to be replaced to ensure free motion of the pistons. The unit is replaced as an assembly. The ring cylinder subcomponents are not user serviceable. To replace the ring cylinder assembly, perform the following procedure:

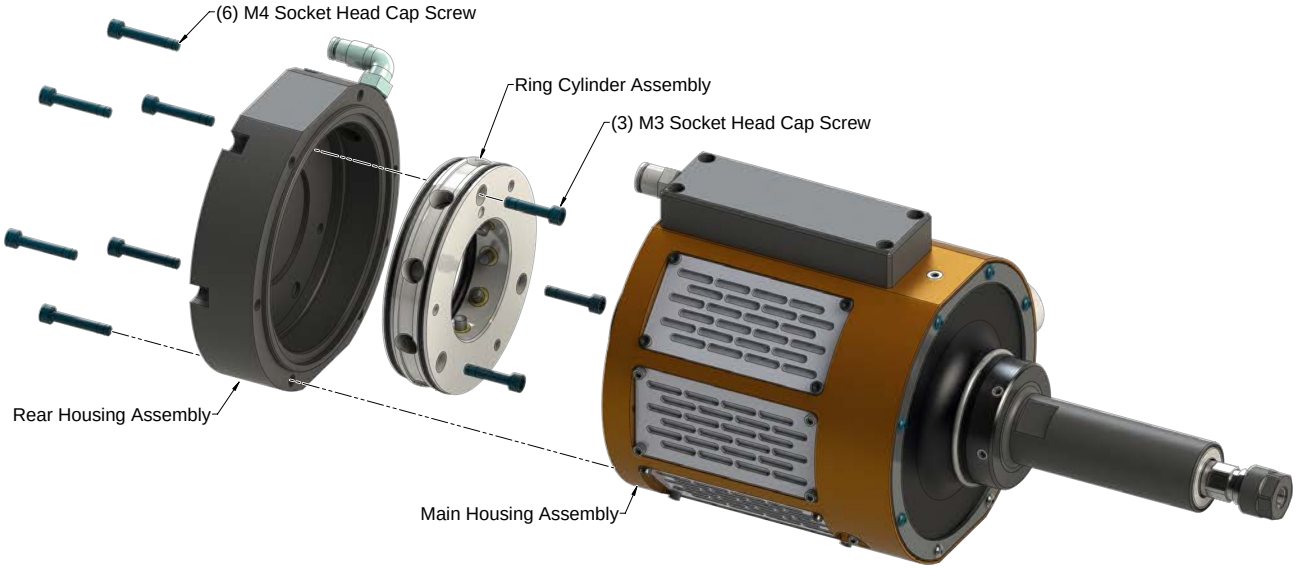
Parts required: *Refer to Section 7—Serviceable Parts.*

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

Supplies required: *Clean rag, Loctite 222, light grease NLGI-2, Magnalube*

1. Lock-out and remove the spindle motor air supply (De-energize all energized circuits such as: air and power).
2. Remove the RCE from the robot or work location.
3. Disconnect hoses from the fittings on the rear of the RCE.
4. Remove the rear housing assembly.
   a. Using a 3 mm hex key, remove the (6) M4 socket head cap screws that secure the rear housing assembly to the main housing.
5. Remove the ring cylinder assembly.
   a. Using a 2.5 mm hex key, remove the (3) M3 socket head cap screws that secure the ring cylinder to the rear housing.
   b. Move those (3) M3 socket head cap screws, which were removed in previous step, to the tapped holes in the ring cylinder and tighten them slowly. The screws will push the ring cylinder assembly away from the rear housing so it can be removed.

Figure 6.2—Ring Cylinder Replacement



6. Install the new ring cylinder assembly.
   a. Use light grease (NLGI-2) to lubricate the bores in the entrance to the rear housing assembly and the O-rings in the new ring cylinder assembly.
   b. Locate the alignment mark hole on the ring cylinder and align it with the drill point on the rear housing.
   c. Insert the ring cylinder slowly by hand while maintaining the orientation of the alignment marks.
   d. Using a 2.5 mm hex key, secure the new ring cylinder assembly to the front housing assembly with the (3) M3 socket head cap screws. Tighten them to 12 in-lbs (1.356 Nm).
7. Install the rear housing assembly.
   a. Install the rear housing assembly to the main housing assembly.
   b. Using a 3 mm hex key, secure the rear housing assembly to the front housing assembly with the (6) M4 socket head cap screws. Tighten to 25 in-lbs (2.825 Nm).
8. Connect the hoses to the fittings on the rear of the RCE.
9. Install the RCE to the robot or work location.
10. Safely resume normal operation.

6.2.3 Boot Replacement

The boot prevents debris from entering the housing and protects internal components. Replace the boot if it shows signs of damage (refer to *Figure 6.2e 6.3*)

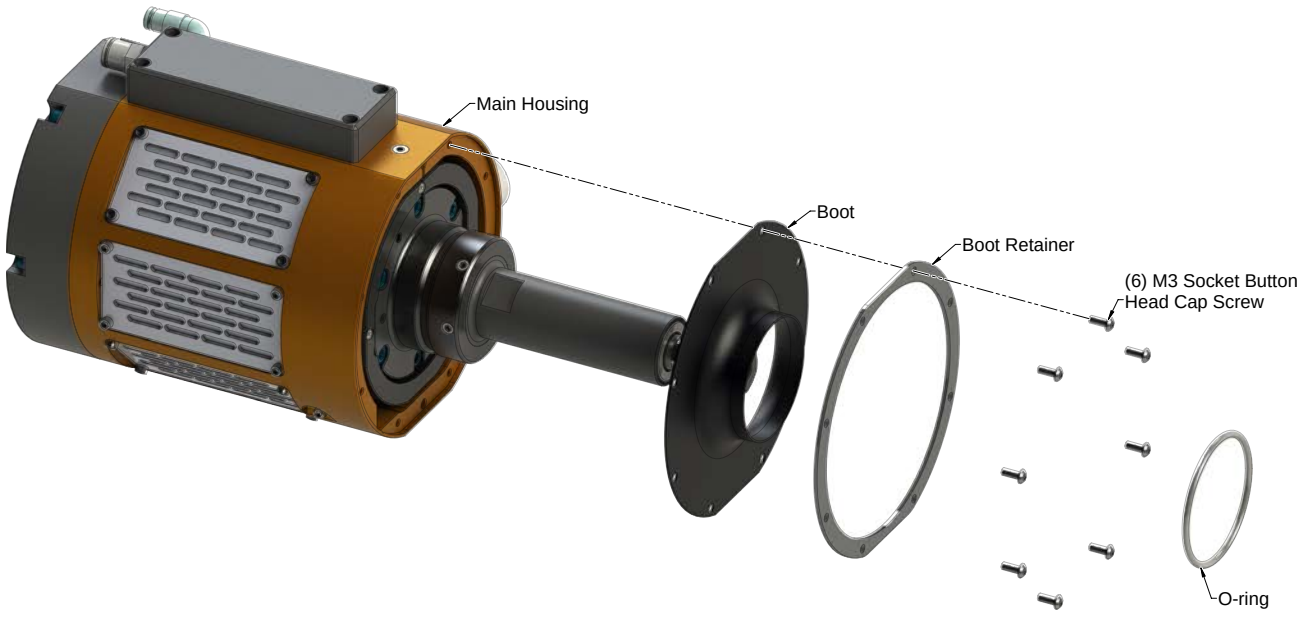
Parts required: *Refer to Section 7—Serviceable Parts.*

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

Supplies required: *Clean rag, Loctite 222*

1. Lock-out and remove the spindle motor air supply (De-energize all energized circuits such as: air and power).
2. Remove the RCE from the robot or work location.
3. Clean debris from the RCE using compressed air and a clean rag to wipe any grease from the outer surfaces.
4. Ease the O-ring off the spindle.
5. Using a 2 mm hex key, remove the (6) M3 socket button head cap screws that secure the boot ring to the housing.
6. Remove the boot ring and boot.
7. Align the boot ring and boot with the holes in the housing and slide the boot onto the spindle. Align the edge of the boot to the edge of the contact surface.
8. Apply Loctite 222 to the threads of the (6) M3 socket button head cap screws.
9. Using a 2 mm hex key, install the (6) M3 socket button head cap screws that secure the boot to the housing. Tighten to contact plus one half turn.
10. Stretch the O-ring over the boot.
11. Install the RCE to the robot or work location.
12. Safely resume normal operation.

Figure 6.3—Spindle Boot Replacement



7. Serviceable Parts

The serviceable parts for the 9150-RCE-710 are in the following table:

Table 7.1—Serviceable Parts		
Qty	**Part Number**	**Description**
1	9005-50-6061	Ring Cylinder Assembly, RCE
1	3700-50-9039	Front Boot, RCE, Viton

7.1 Accessories

Table 7.2—Accessories		
Qty	**Part Number**	**Description**
-	Burs	Refer to *Table 4.1* for media part numbers and descriptions
1	3710-50-1471	Wrench, 11/16"
1	3710-50-1463	Collet
1	3710-50-1464	Collet
1	3710-50-1465	Collet
1	3710-50-1466	Collet Nut, RCE
1	9150-RC-T-4230	Media Setting Fixture (not shown)

8. Specifications

Table 8.1—Specifications	
Parameter	**Rating**
Motor	Electric
Working Speed (RPM)	0-15,000
Torque (Max. Power)	1.4 in-lbs (0.16 Nm)
Power	0.95 hp (710 Watts)
Weight (without Adapters	7.4 lb (3.36 kg)
Compensation (Radial)	+/- .325" (8 mm) Recommended
Compliance Force (Measured at Collet)	1.5-12 lb (6.7-53.4 N)
Burr Surface Speed	Dependent on application
Electric Requirement	120 VAC
Collet Size, Standard[1]	1/4” (6 mm & 8 mm Supplied on Euro Models)
Abrasive Media	Customer-Supplied
Rotary Burrs [2]	13,000 RPM maximum
Notes: 1. Optional sizes are available (refer to *Section 7—Serviceable Parts*) 2. ATI can supply burrs (refer to *Section 4.4.1—Media Selection*)	

9. Drawings

The following link provides access to the drawing for the RCE-710: *RCE-710 Drawings.*

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 that are 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 the 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 no later then 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 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: collet nuts/chucks are considered consumable and are not covered by warranty. The customer should expect to service or replace these items at designated service intervals. For any part this is not detailed in this manual, contact ATI for part numbers and pricing.

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

10.1.1 Brushless Motor Products

Brushless electric motors have long service lives, but components can require regular service. At that time the customer should expect to replace the bearings. Windings and electrical connections should also be inspected for heat damage regularly and replaced as necessary. Electric motors perform best and longest with thermal management. Running the tool without liquid or air cooling will result in a significant drop in performance. Power generation will suffer as the temperature increases and the tool will shut down if it reaches a critical temperature. The expected life of a properly cooled electric motor in normal operation is entirely application dependent based on a multitude of factors. To maximize the life of brushless electric motor products the customer should follow closely the normal operation guide in the product manual. The supplied air must be filtered to remove particulates and moisture. Premature bearing failure can occur from sudden impacts or collisions. Other failure modes are outlined in the manual and relate to improper machining practices and deburring media selection.