EPSILON E31.5

TOOL CHANGE SYSTEM

95619, Rev 00

March 31, 2016

REVISION

Revision	Date	Author	Description
00	3/31/2016	SC	Initial Release

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CONTENTS

1   LIFETIME GUARANTEE

APPLIED ROBOTICS extends a lifetime guarantee to the components that make up the operating cam locking mechanism of the Epsilon Tool Changer. The following components are covered under APPLIED ROBOTICS Lifetime Guarantee.

PART NUMBER	DESCRIPTION
1507-C65N	PISTON, ROBOT
0104-C18N	CAM, ROBOT
48318	PIVOT PIN, ROBOT
1507-C76N	RING, CAM RETAINER

APPLIED ROBOTICS warrants the Epsilon Tool Changer cam locking mechanism **for the lifetime of the product against manufacturer's defects in materials and** workmanship. Additionally, APPLIED ROBOTICS warrants the cam locking mechanism against wear that results in the Epsilon Tool Changer to lose repeatability and precision during the docking sequence of operation (Section 8.1.3).

CONDITIONS OF THE WARRANTY:
Products shall have been subject to only normal use and service as instructed in this manual and shall not have been misused, neglected, altered, improperly set up or otherwise damaged; and, there shall be no evidence of tampering or deliberate misuse or destruction.

Defects to APPLIED ROBOTICS products will be determined solely by APPLIED ROBOTICS and not by any representative or distributor of or for APPLIED ROBOTICS. Upon determination of a defect, APPLIED ROBOTICS sole obligation will be to provide replacement material for the defective part(s). APPLIED ROBOTICS is not liable or responsible for costs borne from lost production or labor related costs for repairing the defective part(s).

Any claim against APPLIED ROBOTICS for defects in material or workmanship must be in writing. APPLIED ROBOTICS must authorize the return of any allegedly defective part before it is returned. The party making the claim must prepay all shipping and transportation costs. APPLIED ROBOTICS will not accept charges for parts purchased unless the conditions of the warranty have been satisfied.

No APPLIED ROBOTICS representative or distributor is authorized to assume for APPLIED ROBOTICS any other obligations or liabilities in connection with the product, or alter the terms of this warranty in any way.

APPLIED ROBOTICS shall not be liable for damages, including special, incidental or consequential damages arising out of or in connection with the performance of an APPLIED ROBOTICS product or its use by the owner.

2 PRECAUTIONS

READ MANUAL
Do not start, operate or service machine until **you read and understand operator's manual.** Failure to do so could result in serious injury.

HAND CRUSH NOTICE
Indicates the possibility for a crush force between components during coupling of the Robot and Tool Adaptor.

⚠ DANGER
Indicates a hazardous situation which, if not avoided, will result in death or serious injury.

⚠ WARNING
Indicates a hazardous situation which, if not avoided, could result in death or serious injury.

⚠ CAUTION
Indicates a hazardous situation which, if not avoided, could result in minor or moderate injury.

NOTICE
Indicates a situation which, if not avoided, could result in equipment damage and voiding the **manufacturer's equipment warranty.**

IGNORING INFORMATION ABOUT POTENTIAL HAZARDS CAN LEAD TO SERIOUS HARM TO PERSONNEL AND/OR DAMAGE TO THE EQUIPMENT, AND MAY RESULT IN THE NULLIFICATION OF THE MANUFACTURER'S EQUIPMENT WARRANTY.

HEED ALL PRECAUTION NOTICES

3   SYSTEM DESCRIPTION

The Epsilon E31.5 Tool Changer provides a strong and reliable method for a manipulator to quickly change between different tools/end-effectors. With Applied Robotics, Inc. modular design, the E31.5 Tool Changer offers the maximum flexibility for any application.

The E31.5 Tool Changer contains two major components:

Robot Adaptor (ER31.5) – Mounts directly to a robot flange utilizing a 31.5mm ISO 9409-1 pattern without the need for adaptor plates (Figure 3-1).

Tool Adaptor (ET31.5) – Mounts directly to a tooling plate utilizing a 31.5mm ISO 9409-1 pattern (Figure 3-2).

The Robot Adaptor and Tool Adaptor lock together by means of a double-acting, pneumatically-driven cam locking mechanism. The three (3) cam self-centering locking mechanism allows for reliable and repeatable operation throughout the life of the tool changer with a unique wear compensating design. As the locking mechanism actuates, the Tool Adaptor is physically connected and disconnected along with any utilities contained in the attached modules.
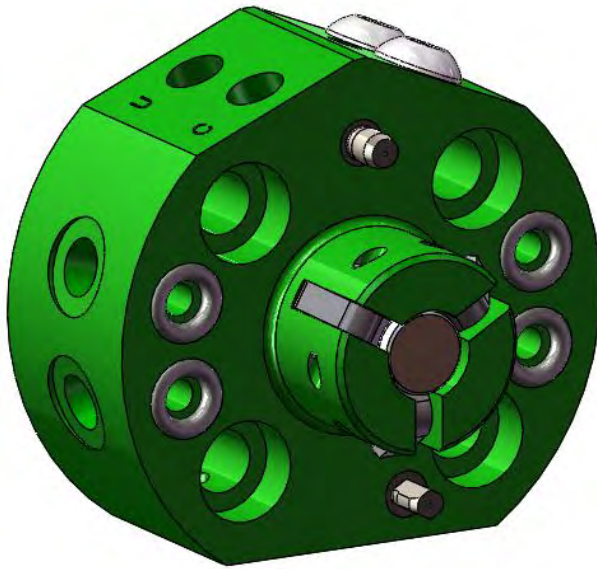
Figure 3-1. ER31.5 Robot Adaptor
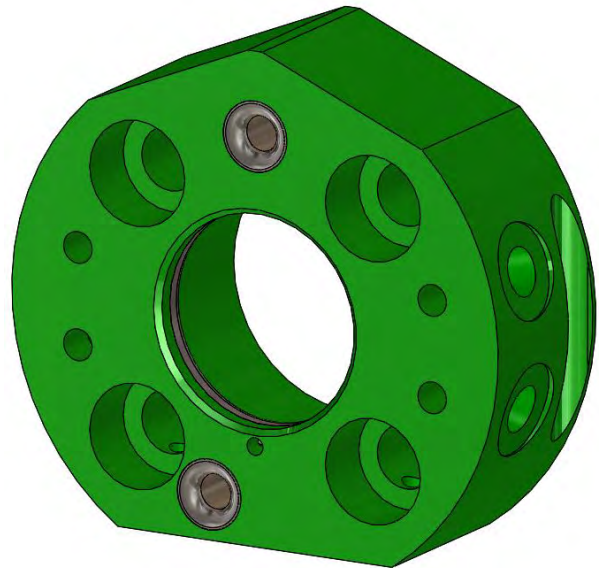
Figure 3-2. ET31.5 Tool Adaptor

3.1   ROBOT ADAPTOR

E☐☐ - ☐ - ☐☐ - ☐ - ☐ - C0000

Assembly Code (Assigned by Factory)

Tool Present Option
- 0 = No TP Switches
- 1 = 1 TP Switch
- 2 = 2 TP Switches
- 3 = 3 TP Switches

Hardware Kit
- N = No Hardware
- A = 16xM16 SHCS w/ 1x12mm Dowel
- B = 11xM12 SHCS w/ 1x12mm Dowel
- C = 6xM12 SHCS w/ 1x12mm Dowel
- D = 11xM10 SHCS w/ 1x10mm Dowel
- E = 11xM10 SHCS w/ 1x10mm Dowel and 10x10.5mm ID washers
- F = 6xM10 SHCS w/ 1x10mm Dowel
- G = 6xM10 SHCS w/ 1x10mm Dowel and 6x10.5mm ID washers
- H = 6xM8 SHCS w/ 1x8mm Dowel
- I = 4xM6 SHCS w/ 1x6mm Dowel
- J = 4xM5 SHCS w/ 1x5mm Dowel
- R = 6xM10 SHCS w/ 1x10mm Dowel (For E125LP)

Boss Size/Diameter
- 160 = 160mm
- 100 = 100mm
- 080 = 80mm
- 063 = 63mm
- 050 = 50mm
- 040 = 40mm
- 031 = 31.5mm
- 020 = 20mm

Sinking/Sourcing
- PNP = Sourcing
- PM12 = Sourcing w/ M12 Connection
- NPN = Sinking
- NM12 = Sinking w/ M12 Connection
- N/A = No Sensing

Bolting Circle
- 200 = 200mm Bolt Circle
- 160 = 160mm Bolt Circle
- 125 = 125mm Bolt Circle
- 125LP = Low Profile 125mm Bolt Circle
- 100 = 100mm Bolt Circle
- 80 = 80mm Bolt Circle
- 63 = 63mm Bolt Circle
- 50 = 50mm Bolt Circle
- 31.5 = 31.5mm Bolt Circle

Housing Type/Construction
- R = Robot Side (Aluminum Sender)
- RS = Robot Side (Steel Sender)

Product Code
- E = EPSILON

3.2 TOOL ADAPTOR

E ☐☐ ☐ - ☐☐ - ☐ - C0000

Assembly Code (Assigned by Factory)

Hardware Kit
- N = No Hardware
- K = 15xM16 SLHCS w/ 2x12mm Dowels
- L = 9xM12 SHCS w/ 2x12mm Dowels
- M = 6xM10 SHCS w/ 2x10mm Dowels
- O = 6xM8 SHCS w/ 2x8mm Dowel
- P = 4xM6 SHCS w/ 2x6mm Dowel
- Q = 4xM5 SLHCS w/ 2x5mm Dowel
- S = 6xM10 SHCS w/ 2x10mm Dowels
  (For E125LP)

Hub Size/Diameter
- 160 = 160mm
- 100 = 100mm
- 080 = 80mm
- 063 = 63mm
- 040 = 40mm
- 022 = 22.5mm

Bolting Circle
- 200 = 200mm Bolt Circle
- 160 = 160mm Bolt Circle
- 125 = 125mm Bolt Circle
- 125LP = Low Profile 125mm Bolt Circle
- 100 = 100mm Bolt Circle
- 63 = 63mm Bolt Circle
- 31.5 = 31.5mm Bolt Circle

Housing Type/Construction
- T = Tool Side (Aluminum)
- TS = Tool Side (Steel)

Product Code
- E = EPSILON

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4   TECHNICAL SPECIFICATIONS

Table 4-1. E31.5 Technical Specifications

Specification		Metric	English
Payload		10 Kg	22 lb
Maximum Operating Moment (Mx, My)		52 Nm	465 in-lb
Maximum E-Stop Moment (Mx, My)		79 Nm	700 in-lb
Maximum Operating Torque (Mz)		30 Nm	265 in-lb
Maximum E-Stop Torque (Mz)		60 Nm	530 in-lb
Maximum Tensile Force (F_T)		934 N	210 lb
Maximum Compressive Force (F_C)		4,159 N	935 lb
Diameter		46 mm	1.81 in
Height (Robot and Tool Coupled)		36 mm	1.42 in
Mass / Weight	Robot	0.09 Kg	0.2 lb
	Tool	0.04 Kg	0.09 lb
Positional Repeatability X, Y & Z axis		+/- 0.02 mm	+/- 0.0008 in
Operating Temperature		5 - 60 °C	40 - 140 °F
Supply Pressure		5 – 7 bar	72 - 101 psi
Couple/Uncouple Voltage (Optional)		10 – 30 Vdc	10 – 30 Vdc
User Pneumatic Pressure Range		0 – 7 bar	0 – 101 psi
User Pneumatic Flow (CFM)		**Contact Applications Engineering**	

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5   INSTALLATION

5.1   ROBOT ADAPTOR INSTALLATION

The E31.5 Robot Adaptor is designed to mount directly to interfaces utilizing an ISO 31.5mm bolt pattern (ISO 9409-1). The E31.5 Robot Adaptor can mount to manipulator interfaces utilizing M5 hardware. For size, locations, and tolerance information on the E31.5 Robot Adaptor mounting patterns, see APPLIED ROBOTICS drawing number 1507-D63A.

NOTICE

TOOL CHANGER PAYLOAD & MOMENT RATINGS BASED ON USING A MINIMUM OF 4xM5 SCREWS TO MOUNT THE ROBOT ADAPTOR TO THE MANIPULATOR INTERFACE.

Installing the E31.5 Robot Adaptor Using M5 Hardware:

NOTICE   **ENSURE THAT THE MATING SURFACES OF THE ROBOT ADAPTOR AND ROBOT FLANGE ARE FLUSH (PLANAR) WHEN FASTENING THE SCREWS.**

1. Locate the Robot Adaptor to the manipulator mounting flange utilizing the locating boss and one (1) M5 locating dowel (Figure 5.1-1).
2. Insert and tighten the M5 socket head cap screws (minimum Property Class 10.9) provided with the Robot Adaptor Assembly. Torque the screws to the robot manufacturer's specification.

NOTICE   **TIGHTEN FACEPLATE MOUNTING SCREWS TO ROBOT MANUFACTURER'S SPECIFICATIONS. IF USING LOCTITE, USE LOCTITE 242 OR EQUIVALENT.**

Mounting Hardware
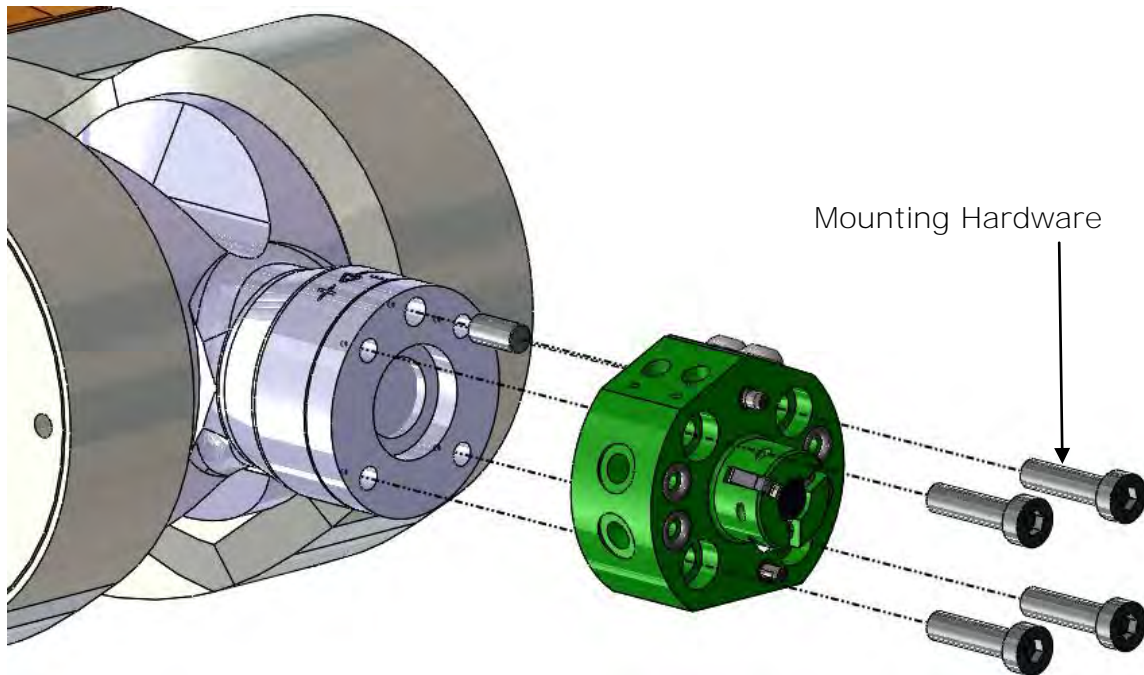
Figure 5.1-1. E31.5 Robot Adaptor Installation w/ M5 Hardware

⚠ WARNING   **DO NOT EXCEED THE MAXIMUM OPERATING OR E-STOP MOMENT OF THE TOOL CHANGER WHEN USING A ROBOT ADAPTOR PLATE TO ADAPT TO OTHER BOLTING PATTERNS.**

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5.2 TOOL ADAPTOR INSTALLATION

The E31.5 is designed to mount directly to customer tooling utilizing an ISO 9409-1 bolt pattern. The Tool Adaptor can be mounted from the top down using M6 hardware on the ISO 31.5mm bolt circle. For size, locations, and tolerance information on the E31.5 Tool Adaptor mounting patterns, see APPLIED ROBOTICS drawing number 1507-D67A.

NOTICE

TOOL CHANGER PAYLOAD & MOMENT RATINGS BASED ON USING 4xM5 SCREWS TO MOUNT THE TOOL ADAPTOR TO THE TOOLING INTERFACE.

If a locating boss/pilot is used on the tool plate to locate the tool to the Tool Adaptor, then the boss cannot protrude into the tool changer greater than 3mm to allow for clearance of the latching mechanism (Figure 5.2-1).

3mm MAX
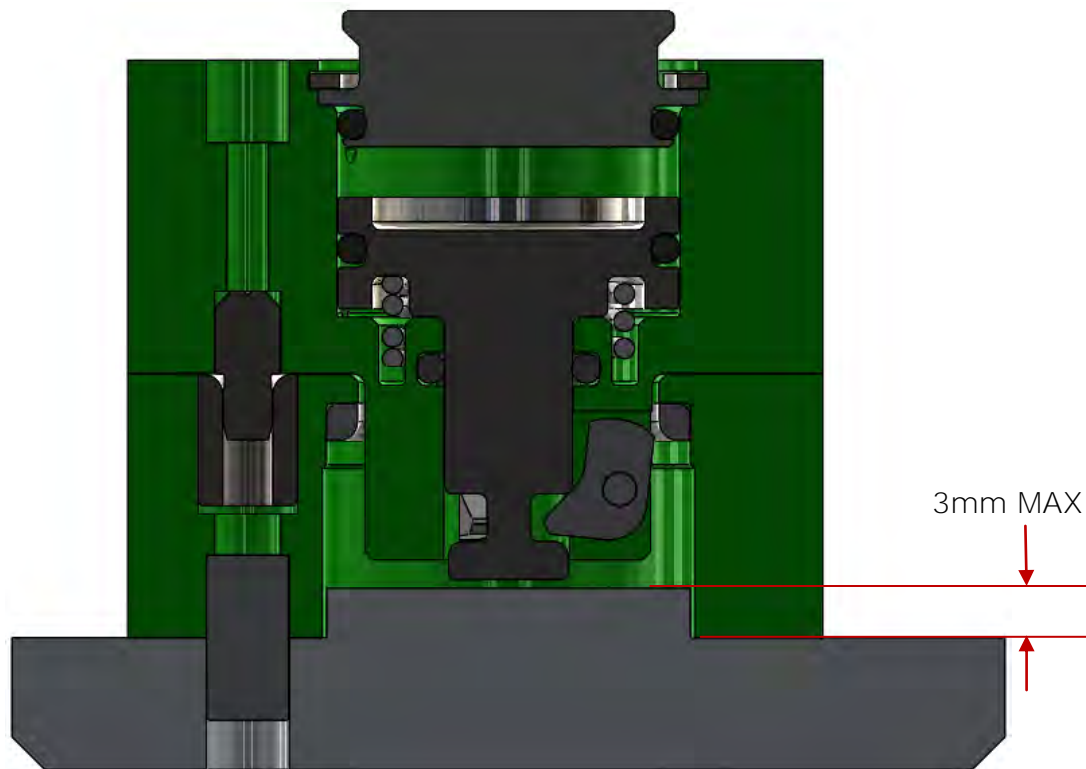
Figure 5.2-1. ET31.5 Tool Adaptor and Tool Plate Installation (w/ Pilot)

Installing the ET31.5 Tool Adaptor From the Top Down:

NOTICE	**ENSURE THAT THE MATING SURFACES OF THE TOOL ADAPTOR AND TOOL PLATE ARE FLUSH (PLANAR) WHEN FASTENING THE SCREWS.**

1. Locate the Tool Adaptor to the tool plate utilizing either the locating hub and one (1) M5 locating dowel, or two (2) M5 locating dowels (Figure 5.2-2).
2. Insert and tighten M5 socket head cap screws (minimum Property Class 10.9) through the Tool Adaptor 31.5mm bolt circle. Applied Robotics recommends the use of steel threads in the tool plate and appropriate thread engagement and torque values.

NOTICE	**TIGHTEN MOUNTING SCREWS TO THE APPROPRIATE SPECIFICATION DEPENDING ON THE END EFFECTOR USED. IF USING LOCTITE, USE LOCTITE 242 OR EQUIVALENT.**

Mounting Hardware
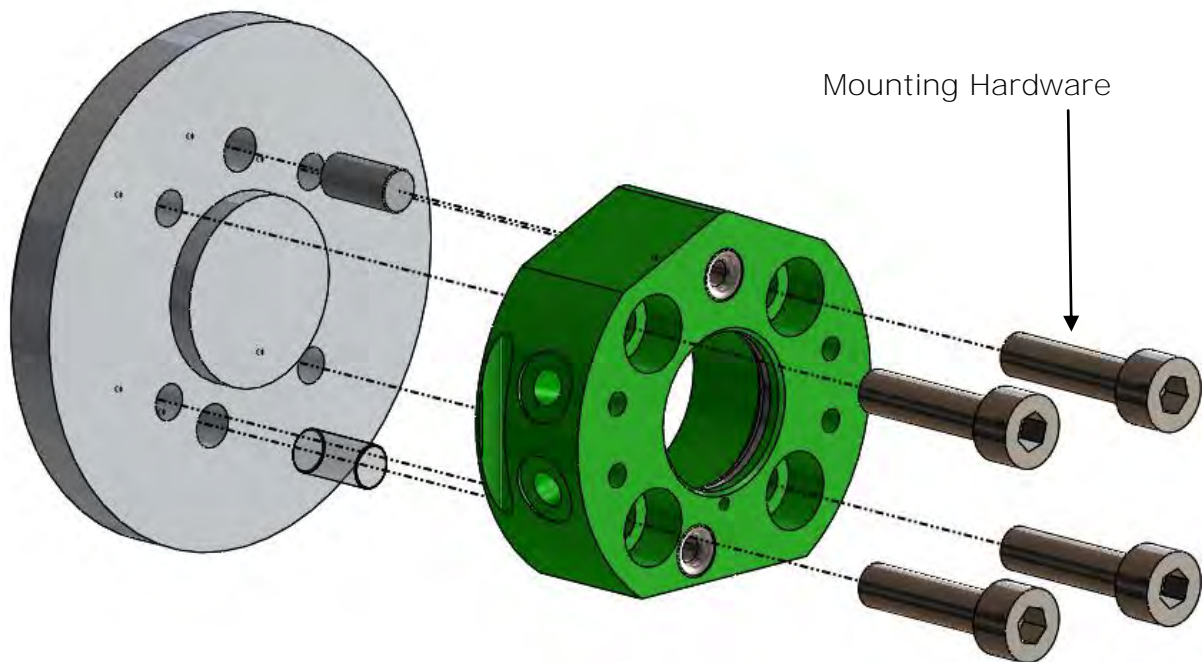
Figure 5.2-2. ET31.5 Tool Adaptor Installation (Bolt Top Down)

⚠ WARNING	**DO NOT EXCEED THE MAXIMUM OPERATING OR E-STOP MOMENT OF THE TOOL CHANGER WHEN USING A ROBOT ADAPTOR PLATE TO ADAPT TO OTHER BOLTING PATTERNS.**

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5.3   CONNECTING THE AIR SUPPLY

The pneumatic supply for the Epsilon Tool Changer can be supplied via directly ported air fittings supplied by the customer (Figure 5.3-1).

⚠ **WARNING**

PNEUMATIC PRESSURE SHOULD NEVER BE SUPPLIED TO THE EPSILON TOOL CHANGE SYSTEM UNLESS THE POSITION OF THE VALVE SUPPLYING THE AIR IS KNOWN AND HAS BEEN CONFIRMED. FAILURE TO DO SO CAN RESULT IN SERIOUS INJURY OR DEATH FROM A DROPPED TOOL.

⚠ **WARNING**

THE ROBOT SHOULD NEVER BE RUN WITHOUT AIR PRESSURE BEING SUPPLIED TO THE TOOL CHANGER. PRESSURE TO THE TOOL CHANGER MUST BE AT LEAST 5 BAR (72 PSIG) FOR PROPER OPERATION.

UNCOUPLE (M5)
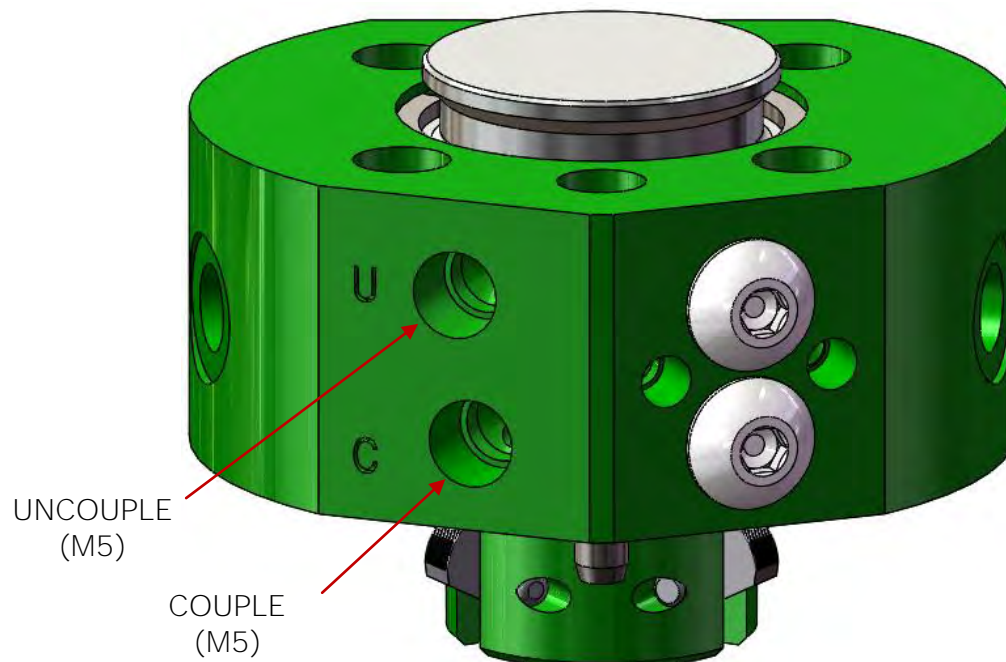
COUPLE (M5)

Figure 5.3-1. E31.5 Robot Adaptor Air Supply Ports

Both the couple and uncouple actuation port lines must be installed in order for the Epsilon Tool Change System to function properly. To control air to the different ports, a single solenoid, spring-return, 4-way valve or a double solenoid, 4-way valve can be used.

WARNING

IF A SINGLE SOLENOID, SPRING-RETURN, 4-WAY PNEUMATIC VALVE IS USED, THE FOLLOWING MUST BE UNDERSTOOD AND ADHERED TO:

- IN THE DE-ENERGIZED STATE, THE VALVE MUST PROVIDE AIR TO THE COUPLE PORT ONLY.

IF A DOUBLE SOLENOID, 4-WAY PNEUMATIC VALVE IS USED, THE FOLLOWING MUST BE UNDERSTOOD AND ADHERED TO:

WARNING

- THE VALVE WILL REMAIN IN ITS PRESENT POSITION UNTIL EITHER THE ALTERNATE SOLENOID IS ENERGIZED OR BY MANUALLY PRESSING THE ALTERNATE SOLENOID OVERRIDE BUTTON (IF APPLICABLE).
- TO CHANGE THE STATE OF THE VALVE, ONE SIDE OF THE SOLENOID MUST BE ENERGIZED AND THE OTHER SIDE DE-ENERGIZED. IF BOTH SIDES ARE ENERGIZED (OR DE-ENERGIZED), THE VALVE WILL NOT CHANGE STATES.
- THE VALVE MUST BE PILOT ACTUATED SO THAT THE POSITION OF THE VALVE WILL NOT CHANGE UNLESS THERE IS AIR SUPPLIED TO THE VALVE.

5.4 COUPLE & UNCOUPLE SIGNALS (OPTIONAL)

Couple and uncouple signals are optional on the E31.5 Robot Adaptor and are provided via flying lead connections (Figure 5.4-1). APPLIED ROBOTICS utilizes proximity switches to provide indication of piston limit positions (couple and uncouple). Switches are preset at the factory and do not require any adjustment for the lifetime of the tool changer.

CAUTION

COUPLE AND UNCOUPLE SENSOR SIGNALS SHOULD BE CONTINUALLY MONITORED TO VERIFY THAT THE TOOL CHANGER IS IN THE PROPER STATE BEFORE COMMANDING THE ROBOT TO MOVE.

Should the switches need to be replaced, see Section 10.1.2.
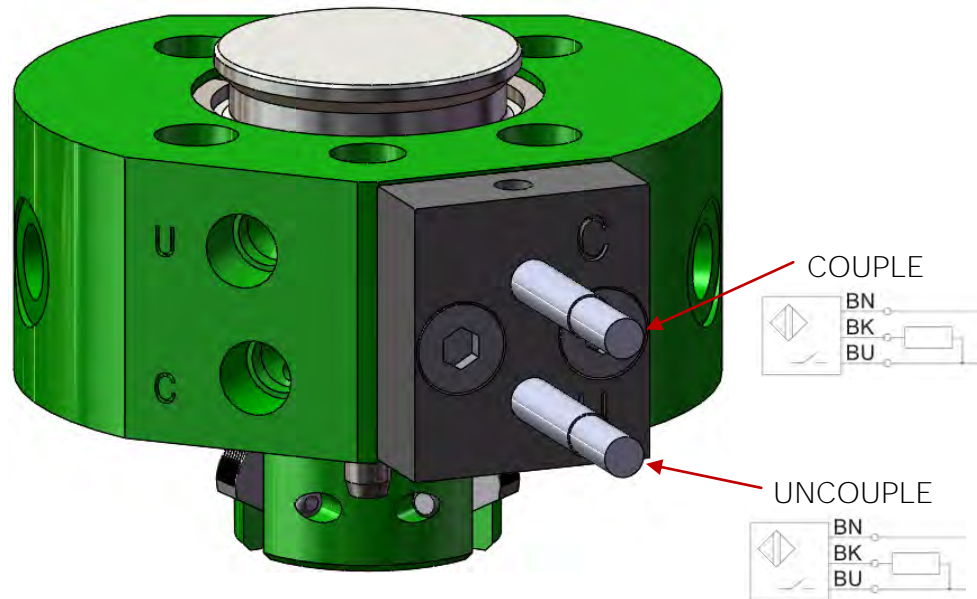
Figure 5.4-1. Couple/Uncouple Signal Interface (Optional)

NOTICE

MAKING CONNECTIONS WHILE UNDER POWER COULD RESULT IN DAMAGE TO THE EQUIPMENT. TO AVOID DAMAGING EQUIPMENT, ENSURE THAT ALL CABLES ARE CONNECTED BEFORE SUPPLYING POWER TO THE EQUIPMENT.

5.5   CONNECTING USER PNEUMATIC PORTS

The E31.5 Tool Changer has 4 available user pneumatic ports to supply air through the tool changer to the specific tool being used. The tool changer must be coupled and be fitted with an o-ring seal for these ports to be operational. Air can be supplied via directly ported air fittings supplied by the customer (Figure 5.5-1).

AIR FROM
ROBOT
(4x M5)

AIR TO
TOOL
(4x M5)
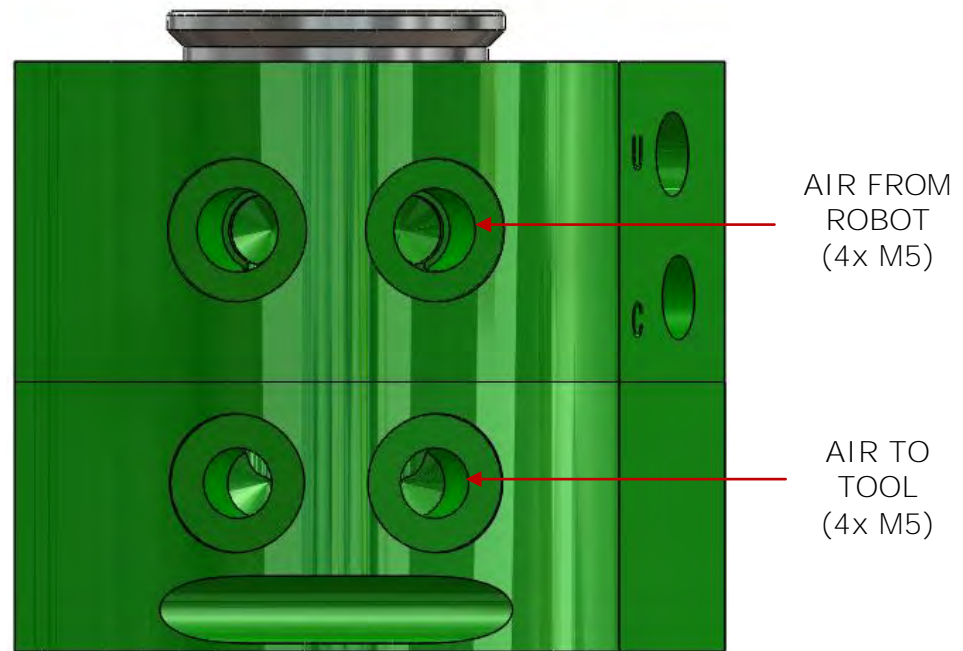
Figure 5.5-1. E31.5 User Pneumatic Ports

6 GUIDE TO OPERATION

6.1 INITIAL TEST

Once the air supply has been plumbed to the couple and uncouple ports, control power is connected to the air supply valve, and the couple and uncouple position sensors are in communication with the robot controller/PLC, perform the following steps to verify the proper operation of the Epsilon Tool Changer.

⚠ **CAUTION**

DURING TESTING, KEEP YOUR FINGERS CLEAR OF THE MECHANICAL COUPLING MECHANISM AND THE COUPLING INTERFACE SURFACES. <u>KEEP OUT OF THE ROBOT WORK ENVELOPE</u> WHEN DRIVE POWER IS ON.

1. Verify that the Robot Adaptor is clear of any obstruction and not coupled to the Tool Adaptor.
2. Turn on supply air to the control valve and verify that the cams move to the extended position (Figure 6.1-1). If using a single solenoid, spring return, 4-way valve, this will verify that it is plumbed correctly.
3. Supply control power to the solenoid valve and supply the signal from the controller/PLC to move the valve to the uncoupled (solenoid energized) position. The cams should retract to the uncoupled position (Figure 6.1-2) and the input from the uncoupled sensor (optional) should be received by the robot controller/PLC.
4. Change the state of the solenoid valve by turning off the uncouple signal (solenoid de-energized). The cams should extend back to the couple position and the uncouple sensor (optional) signal should turn OFF (LOW) and the couple sensor signal should turn ON (HIGH) at the robot controller/PLC.
5. Repeat steps 3 and 4 several times. The cam action should be smooth and quick.
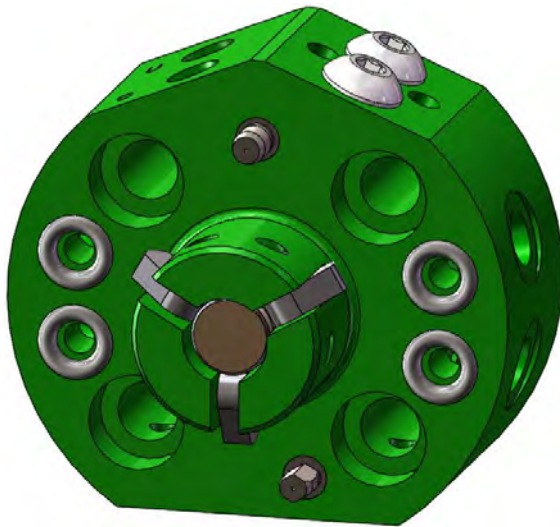
Figure 6.1-1. Robot Adaptor Coupled (Cams Extended)
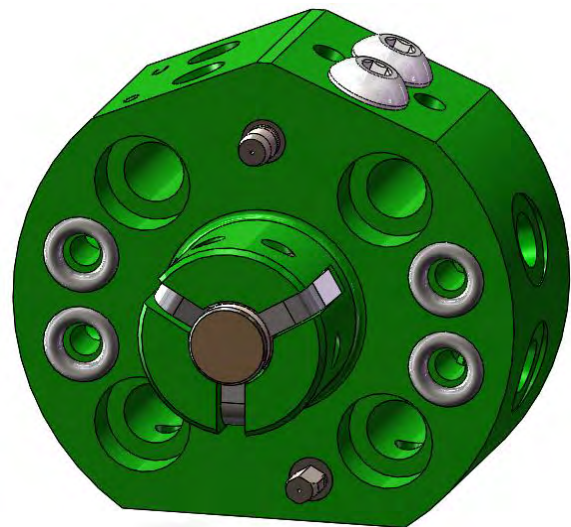
Figure 6.1-2. Robot Adaptor Uncoupled (Cams Retracted)

6.2 PROGRAMMING THE COUPLE AND UNCOUPLE POINTS

⚠ **WARNING**

THE ROBOT SHOULD NEVER BE RUN WITHOUT A MINIMUM AIR PRESSURE OF 5 BAR (72 PSIG) BEING SUPPLIED TO THE ROBOT ADAPTOR.

When programming the "dock" and "undock" points of each tooling, the following steps should be taken:

1. Orient the Robot Adaptor and Tool Adaptor so that the centerline axes are aligned and the interface surfaces are parallel. Maintain approximately 15mm minimum separation between the Robot Adaptor and Tool Adaptor interface surfaces (Figure 6.2-1).
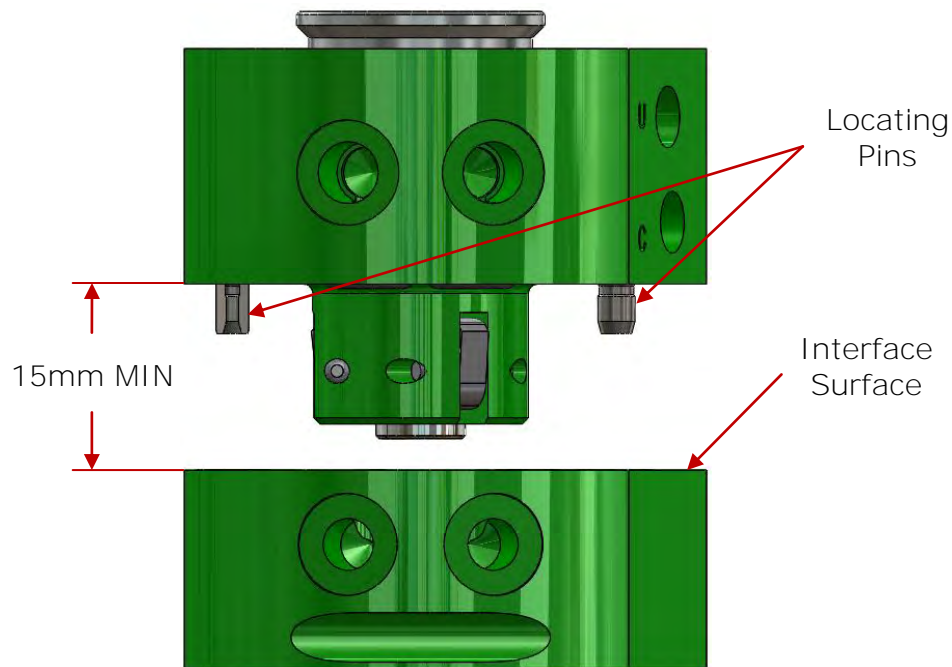
Figure 6.2-1. E31.5 Tool Changer – Docking Orientation

2. Energize the solenoid, resulting in an uncoupled (cams retracted) state.
3. Rotate the Robot Adaptor so that the locating pins are centered on the bushings in the Tool Adaptor.
4. Start to bring the Robot and Tool Adaptors together while visually checking the alignment of the locating pins and bushings. Make lateral adjustments as necessary to center the locating pins to the bushings. Exact alignment is not required; however limit the amount of interference between the locating pins and bushings while docking. Interference between the locating pins and bushings while docking increases wear and decreases the life of the locating pins.
5. Stop the motion when the distance between the Robot Adaptor interface surface and Tool Adaptor interface surface are touching or as close as can reasonably be achieved. At this time, any electrical or fluid connections will be made through the use of available side modules. Note that when the interface surfaces of the Robot Adaptor and Tool Adaptor are in contact, the outer edge of the Adaptors should be touching (Figure 6.2-2).
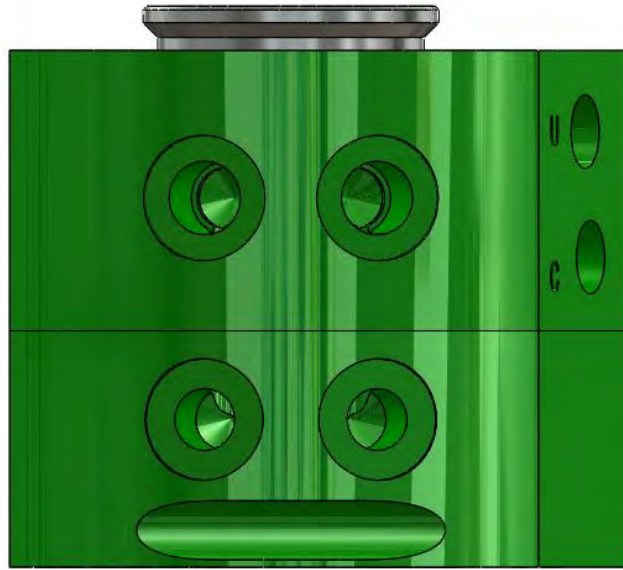
Figure 6.2-2. E31.5 Tool Changer – Docked Position

NOTICE

MINIMIZING THE DISTANCE BETWEEN THE ROBOT ADAPTOR AND TOOL ADAPTOR INTERFACE SURFACES WHEN PROGRAMMING THE DOCK AND UNDOCK POINTS WILL ENSURE OPTIMUM PERFORMANCE OF THE TOOL CHANGER OVER ITS OPERATIONAL LIFE SPAN.

SEPARATION BETWEEN THE ROBOT ADAPTOR AND TOOL ADAPTOR INTERFACE SURFACES, GREATER THAN 1mm DURING DOCKING OR UNDOCKING WILL RESULT IN ADDITIONAL WEAR TO THE TOOL CHANGER AND REDUCE THE OVERALL LIFE EXPECTANCY.

6. De-energize the solenoid that controls the air pressure to the couple port. This will couple the Robot Adaptor with the Tool Adaptor.
7. Cycle the cams by energizing and de-energizing the solenoid several times to verify that the Tool Adaptor is properly connected and released from the Robot Adaptor. If properly programmed, the Robot Adaptor and Tool Adaptor should not move when the cams are coupled (extended) and uncoupled (retracted).
8. Record the position from Step 5 as the "dock" and "undock" coordinates for the Tool Adaptor. Depending on the docking station used, separate dock and undock positions may be required.
9. Repeat procedure for each Tool Adaptor used in conjunction with the corresponding Robot Adaptor.

6.3 RECOMMENDED SEQUENCE OF OPERATION

NOTICE **THE EPSILON TOOL CHANGER SYSTEM SHOULD NEVER BE UNCOUPLED UNLESS THE ATTACHED TOOL IS FULLY SUPPORTED IN A DOCKING STATION/TOOL STAND.**

The following is a standard sequence of operation for a Robot, Tool Changer, and Tool combination. See Figure 6.3-1 for a graphical representation of this sequence. Note that the **BOLD** indicates a change in status and not all signals may be applicable to your application.

1. The Tool Changer is in the uncoupled state (cams retracted) and in the "Home" position (Tool Changer out of the tool stand with NO tool, all tool stand covers are closed, and air supply is ON).

   INPUTS:
   Uncouple Signal .... HIGH
   Couple Signal... LOW
   Ready to Couple Signal .... LOW
   Tool Present Signal................................... LOW
   Tool Stand Present Signal......................... LOW
   Tool Cover Open Signal............................. LOW
   Tool Cover Closed Signal .... HIGH

   OUTPUTS:
   Uncouple Command.................................. HIGH
   Tool Cover Open Command .... LOW
   Tool Cover Close Command .... HIGH

2. Open tool stand cover.

   INPUTS:
   Uncouple Signal .... HIGH
   Couple Signal... LOW
   Ready to Couple Signal .... LOW
   Tool Present Signal................................... LOW
   Tool Stand Present Signal......................... LOW
   Tool Cover Open Signal............................. **HIGH**
   Tool Cover Closed Signal .... **LOW**

   OUTPUTS:
   Uncouple Command.................................. HIGH
   Tool Cover Open Command .... **HIGH**
   Tool Cover Close Command .... **LOW**

3. Move to "Pre-Dock" position (Approximately 15mm above the Tool Adaptor).

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INPUTS:

Uncouple Signal .... HIGH
Couple Signal... LOW
Ready to Couple Signal .... LOW
Tool Present Signal................................... LOW
Tool Stand Present Signal......................... LOW
Tool Cover Open Signal............................. HIGH
Tool Cover Closed Signal........................... LOW

OUTPUTS:

Uncouple Command................................. HIGH
Tool Cover Open Command .... HIGH
Tool Cover Close Command .... LOW

4. Move to **the "Dock" position (See Section** 6.2). Once Robot and Tool Adaptors are within range (~0.75mm or closer), the electrical contacts on the side modules will begin to communicate.

INPUTS:

Uncouple Signal .... HIGH
Couple Signal... LOW
Ready to Couple Signal .... **HIGH**
Tool Present Signal................................... **HIGH**
Tool Stand Present Signal......................... **HIGH**
Tool Cover Open Signal............................. HIGH
Tool Cover Closed Signal........................... LOW

OUTPUTS:

Uncouple Command................................. HIGH
Tool Cover Open Command .... HIGH
Tool Cover Close Command .... LOW

5. Once in the "Dock" position, Couple to the tool.

INPUTS:

Uncouple Signal .... **LOW**
Couple Signal... **HIGH**
Ready to Couple Signal .... HIGH
Tool Present Signal................................... HIGH
Tool Stand Present Signal......................... HIGH
Tool Cover Open Signal............................. HIGH
Tool Cover Closed Signal........................... LOW

OUTPUTS:

Uncouple Command................................. **LOW**
Tool Cover Open Command .... HIGH
Tool Cover Close Command .... LOW

6. **Move to the "Post-Dock" position**. Ensure the pins and bushings on the docking fixture are clear from one another before leaving the docking station.

   INPUTS:
   Uncouple Signal .... LOW
   Couple Signal.. HIGH
   Ready to Couple Signal .... HIGH
   Tool Present Signal.................................. HIGH
   Tool Stand Present Signal......................... **LOW**
   Tool Cover Open Signal .... HIGH
   Tool Cover Closed Signal .... LOW

   OUTPUTS:
   Uncouple Command.................................. LOW
   Tool Cover Open Command .... HIGH
   Tool Cover Close Command .... LOW

7. The Robot performs the specified task with the connected tool. Depending on the cell layout and operation being performed, the Tool Cover may need to be closed to avoid interference.

   INPUTS:
   Uncouple Signal .... LOW
   Couple Signal.. HIGH
   Ready to Couple Signal .... HIGH
   Tool Present Signal.................................. HIGH
   Tool Stand Present Signal......................... LOW
   Tool Cover Open Signal .... HIGH
   Tool Cover Closed Signal .... LOW

   OUTPUTS:
   Uncouple Command.................................. LOW
   Tool Cover Open Command .... HIGH
   Tool Cover Close Command .... LOW

8. **Return to the "Post-Dock" position (alternatively could identify a "Pre-Undock" position) after completing the task**.

   INPUTS:
   Uncouple Signal .... LOW
   Couple Signal.. HIGH
   Ready to Couple Signal .... HIGH
   Tool Present Signal.................................. HIGH
   Tool Stand Present Signal......................... LOW
   Tool Cover Open Signal .... HIGH
   Tool Cover Closed Signal .... LOW

   OUTPUTS:

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Uncouple Command...................................... LOW
Tool Cover Open Command .... HIGH
Tool Cover Close Command .... LOW

9. Move to the "Dock" position (alternatively, could identify an "Undock" position) with the tool.

   INPUTS:

   Uncouple Signal .... LOW
   Couple Signal.. HIGH
   Ready to Couple Signal .... HIGH
   Tool Present Signal.................................... HIGH
   Tool Stand Present Signal........................... **HIGH**
   Tool Cover Open Signal.............................. HIGH
   Tool Cover Closed Signal............................ LOW

   OUTPUTS:

   Uncouple Command.................................... LOW
   Tool Cover Open Command .... HIGH
   Tool Cover Close Command .... LOW

10. Once in the "Dock"/"Undock" position and the weight is fully supported by the docking station, Uncouple the Tool Changer.

    INPUTS:

    Uncouple Signal .... **HIGH**
    Couple Signal.. **LOW**
    Ready to Couple Signal .... HIGH
    Tool Present Signal.................................... HIGH
    Tool Stand Present Signal........................... HIGH
    Tool Cover Open Signal.............................. HIGH
    Tool Cover Closed Signal............................ LOW

    OUTPUTS:

    Uncouple Command.................................... **HIGH**
    Tool Cover Open Command .... HIGH
    Tool Cover Close Command .... LOW

11. Move to the "Pre-Dock" (alternatively, could identify a "Post-Undock" position). Once Robot and Tool Adaptors are separated by approximately 0.75mm, the electrical contacts on the side modules will lose contact and the robot side modules will lose communication with the tool side modules.

    INPUTS:

    Uncouple Signal .... HIGH
    Couple Signal.. LOW
    Ready to Couple Signal .... **LOW**

Tool Present Signal.................................... **LOW**
Tool Stand Present Signal........................... **LOW**
Tool Cover Open Signal............................. HIGH
Tool Cover Closed Signal............................ LOW

OUTPUTS:

Uncouple Command................................. HIGH
Tool Cover Open Command .... HIGH
Tool Cover Close Command .... LOW

12. Move back to the "Home" position and close the tool stand cover.

INPUTS:

Uncouple Signal .... HIGH
Couple Signal.. LOW
Ready to Couple Signal .... LOW
Tool Present Signal................................... LOW
Tool Stand Present Signal........................... LOW
Tool Cover Open Signal............................. **LOW**
Tool Cover Closed Signal............................ **HIGH**

OUTPUTS:

Uncouple Command................................. HIGH
Tool Cover Open Command .... **LOW**
Tool Cover Close Command .... **HIGH**

Figure 6.3-1. Sequence of Operations Diagram

[1] Customer is required to continuously monitor the SCM OK signal, verifying that the signal remains HIGH throughout the entire operation. If SCM OK signal goes LOW, stop the robot, remove the Uncouple Commands and refer to the Troubleshooting section.
[2] Signals (dual channel) are only available via LED's on ARI's Safety Control Module (SCM). Not available for monitoring by the robot controller.
[3] Second Uncouple Command is required when using ARI's Safety Control Module (SCM) and should be applied simultaneously with the first Uncouple Command.
- Verify the status of all signals before proceeding to the next step.
- Input/Output HIGH = 1, LOW = 0
- Dotted circles indicate a intermediate state of an actuating cylinder when neither "Open" or "Close" signal is present.

7   TROUBLESHOOTING

7.1   TECHNICAL SUPPORT

If you require assistance, contact APPLIED ROBOTICS Technical Support Department at:

Phone: +1 518 384-1000
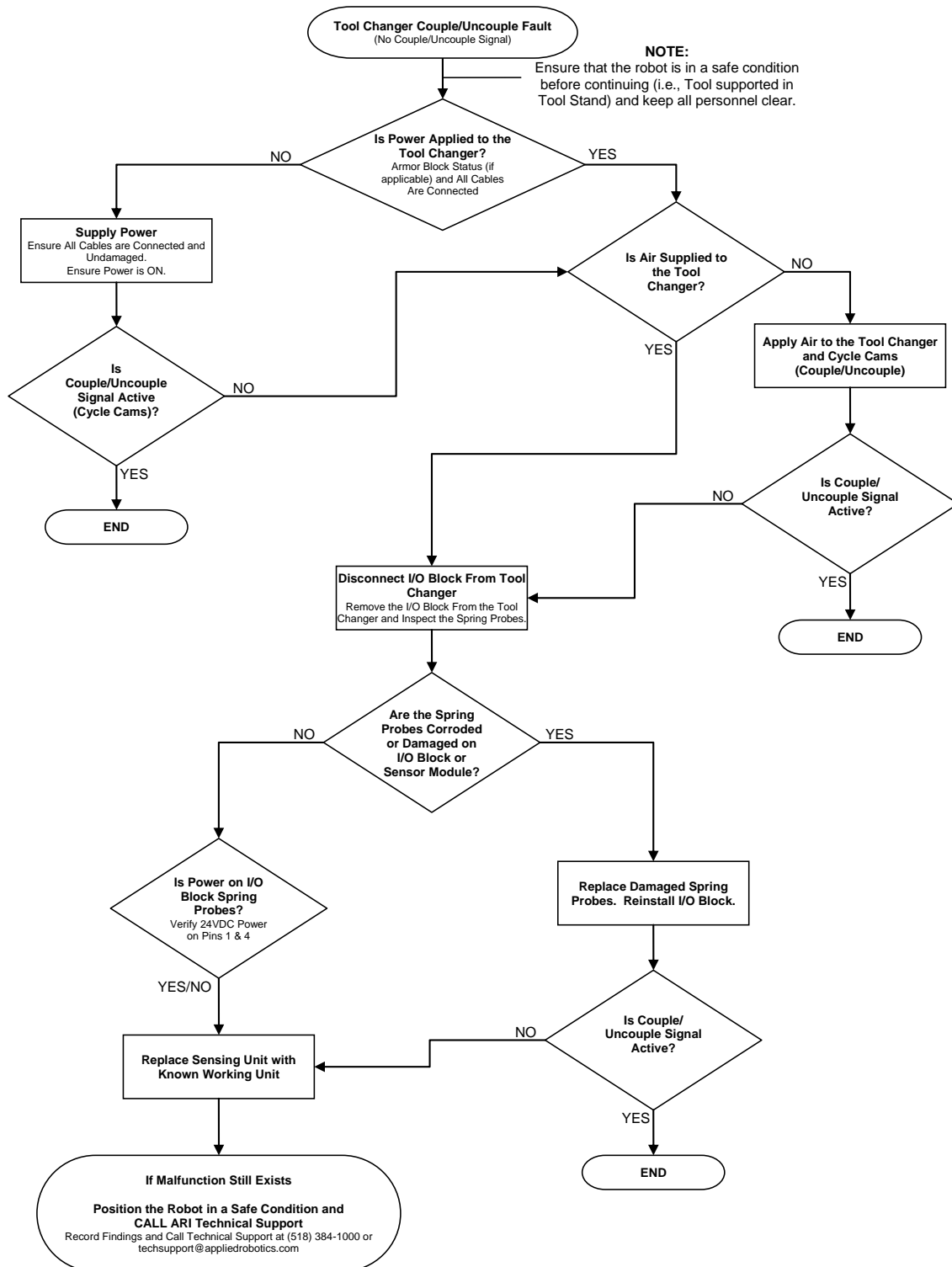E-mail: techsupport@appliedrobotics.com.

7.2   TROUBLESHOOTING GUIDE

Table 7.2-1. Troubleshooting Guide

Symptom	Possible Cause	Resolution
Tool Changer Will Not Couple	Tool Changer not within required distance for coupling (<1mm)	Adjust Robot program to move within the required distance (<1mm)
	Electrical connection to the actuation valve has been lost (only if using double-acting solenoid)	Verify all connections are in place and that valve is not damaged and operating correctly
Tool Changer Will Not Uncouple	Air supply to the Tool Changer has been lost	Verify all air connections are in place and air is being supplied to the Robot cell
	Electrical connection to the actuation valve has been lost	Verify all connections are in place and that valve is not damaged and operating correctly
	Tool is not in Tool Stand	Verify the tool is supported in the tool stand and that the Tool Stand Present signal is activated
	Spring Failure	Replace piston spring
Tool Changer Couples, But No Coupled Signal is Being Received	Coupled sensing (optional) has failed	Replace sensor puck (See Section 10.1.2)
	Cable/Connections supplying signal failed	Inspect cables/connections and replace if necessary
	Air supply to the Tool Changer has been lost (Coupled via the sender spring)	Verify all air connections are in place and air is being supplied to the Robot cell
Tool Changer Uncouples, But No Uncoupled Signal is Being Received	Uncoupled sensing (optional) has failed	Replace sensor puck (See Section 10.1.2)
	Cable/Connections supplying signal failed	Inspect cables/connections and replace if necessary

7.3   TROUBLESHOOTING FAULT TREE

The fault tree provides guidance for troubleshooting a Tool Changer
Couple/Uncouple signal fault (Optional).

Tool Changer Couple/Uncouple Fault
(No Couple/Uncouple Signal)

NOTE:
Ensure that the robot is in a safe condition
before continuing (i.e., Tool supported in
Tool Stand) and keep all personnel clear.

Is Power Applied to the Tool Changer?
Armor Block Status (if applicable) and All Cables Are Connected

NO — YES

Supply Power
Ensure All Cables are Connected and Undamaged.
Ensure Power is ON.

Is Air Supplied to the Tool Changer?

NO — YES

Apply Air to the Tool Changer and Cycle Cams (Couple/Uncouple)

Is Couple/Uncouple Signal Active (Cycle Cams)?

NO

YES

END

Is Couple/ Uncouple Signal Active?

NO — YES

END

Disconnect I/O Block From Tool Changer
Remove the I/O Block From the Tool Changer and Inspect the Spring Probes.

Are the Spring Probes Corroded or Damaged on I/O Block or Sensor Module?

NO — YES

Is Power on I/O Block Spring Probes?
Verify 24VDC Power on Pins 1 & 4

YES/NO

Replace Damaged Spring Probes. Reinstall I/O Block.

Is Couple/ Uncouple Signal Active?

NO

YES

END

Replace Sensing Unit with Known Working Unit

If Malfunction Still Exists

Position the Robot in a Safe Condition and CALL ARI Technical Support
Record Findings and Call Technical Support at (518) 384-1000 or
techsupport@appliedrobotics.com

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7.4   MANUAL UNCOUPLE

A feature has been designed into the E31.5 Tool Changer that allows the system to be manually uncoupled in the event that damage occurs that prevents the system from uncoupling under normal means.

⚠ WARNING   **ENSURE THAT THE ATTACHED TOOLING IS SAFELY SUPPORTED, PREFERABLY IN ITS TOOL STAND.**

The following steps must be followed to ensure that the E31.5 Tool Changer is manually uncoupled in a safe manner:

1. Ensure that the attached tooling is safely supported, preferably in its tool stand, so that no damage or personal injury occurs when the tool is released.
2. Ensure that all unnecessary personnel are clear of the tooling before going further in this procedure.
3. Shut off the air supply to the actuating cylinder. The cylinder must not be pressurized for this operation to be performed successfully.
4. Insert a 1.5mm allen wrench (alternatively, a 1.5mm punch may be used) as shown in Figure 7.4-1. This requires any tool side modules to be removed.
5. While pushing the cams back with the allen wrench, pull down on the Tool Adaptor to separate the tool from the Robot Adaptor.

NOTICE   **WHEN AIR SUPPLY IS OFF, THE COUPLE/UNCOUPLE SIGNALS WILL BE LOST DUE TO THE LACK OF AIR. ONLY MOVE THE ROBOT AFTER THE CAMS HAVE BEEN FULLY RETRACTED.**
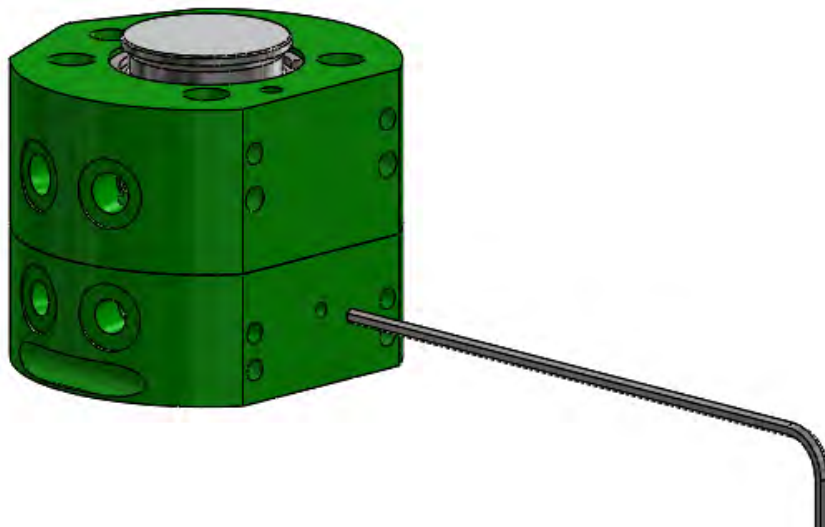
Figure 7.4-1. Manual Uncouple Feature

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8 MAINTENANCE

NOTICE

FAILURE TO FOLLOW THE MAINTENANCE SCHEDULE DESCRIBED IN THIS SECTION COULD ALTER OR VOID THE WARRANTY PROVIDED BY APPLIED ROBOTICS, INC.

The following table provides a schedule for preventive maintenance to be performed for the Epsilon Tool Changer.

Table 8-1. Preventive Maintenance Schedule

Frequency of Maintenance				
Every 2 Weeks	250,000 Cycles	500,000 Cycles	750,000 Cycles	1,000,000 Cycles
Robot Adaptor Visual Checks (Section 7.1.2.1)		Lubrication (Section 7.1.1.1) & Visual Checks (Section 7.1.2.1)		Lubrication (Section 7.1.1.1) & Visual Checks (Section 7.1.2.1) & Replace Locating Pins if Worn or Damaged & Inspect Piston Spring Functionality and Replace if Necessary[1]
Tool Adaptor Visual Checks (Section 7.1.2.2)		Lubrication (Section 7.1.1.2) & Visual Checks (Section 7.1.2.2)		Lubrication (Section 7.1.1.2) & Visual Checks (Section 7.1.2.2) & Replace Locating Bushings if Worn or Damaged

Frequency of Maintenance				
Every 2 Weeks	1,250,000 Cycles	1,500,000 Cycles	1,750,000 Cycles	2,000,000 Cycles[2]
Robot Adaptor Visual Checks (Section 7.1.2.1)		Lubrication (Section 7.1.1.1) & Visual Checks (Section 7.1.2.1)		Lubrication (Section 7.1.1.1) & Visual Checks (Section 7.1.2.1) & Inspect the Following Parts for Wear or Damage and Replace if Necessary; Locating Pins, Piston Head, Piston O-Ring, Cam Shaft, Cams. & Inspect Piston Spring Functionality and Replace if Necessary
Tool Adaptor Visual Checks (Section 7.1.2.2)		Lubrication (Section 7.1.1.2) & Visual Checks (Section 7.1.2.2)		Lubrication (Section 7.1.1.2) & Visual Checks (Section 7.1.2.2) & Replace Cam Pickup Dowels if Worn or Damaged & Replace Locating Bushings if Worn or Damaged

[1] To test Piston Spring functionality, retract the cams (Figure 6.1-2) using air pressure, then completely vent off all air and ensure that the cams return to the extended position (Figure 6.1-1).
[2] Continue Lubrication and Visual Checks every 250,000 Cycles. Continue inspecting for wear or damaged components every 500,000 cycles.

8.1 PREVENTIVE MAINTENANCE

8.1.1 Lubrication

Proper lubrication of wear components is essential to maintaining the performance and prolonging the operational life of the E31.5 Tool Changer. Failure to apply proper lubrication could result in increased wear and shorten the life expectancy of the Tool Changer. The following lubricants are approved for use on the E31.5 Tool Change System.

Table 8.1.1-1. Approved Lubricants

Lubricant	ARI Part #	Manufacturer	Manufacturer's Part #
Lube-A-Cyl	51120	Parker	0766130000
White Lithium Grease	91504-P1037	Century Lubricants	ST-80
Staburags NBU 30 Grease	0903-P11N	Klüber	NBU 30
White EP Bearing Grease	96503-P1018	Dow Corning	White EP Bearing Grease

8.1.1.1 Robot Adaptor

1. Clean the latching cams, locating/alignment pins, and driver/washer to ensure all existing grease, dirt, and debris is removed.
2. Apply a liberal coating of white lithium grease to the contact surfaces on the three (3) latching cams, the cylindrical surfaces of the locating/alignment pins, and the contact surfaces between the latching cams and driver, as shown in Figure 8.1.1.1-1 and Figure 8.1.1.1-2 with the surfaces highlighted blue.
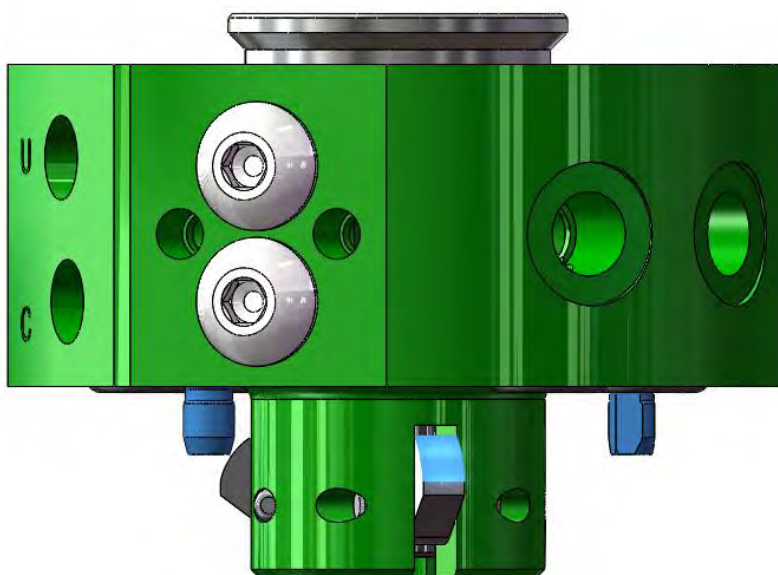
Figure 8.1.1.1-1. E31.5 Robot Adaptor Lubrication – Locating Pins & Cams
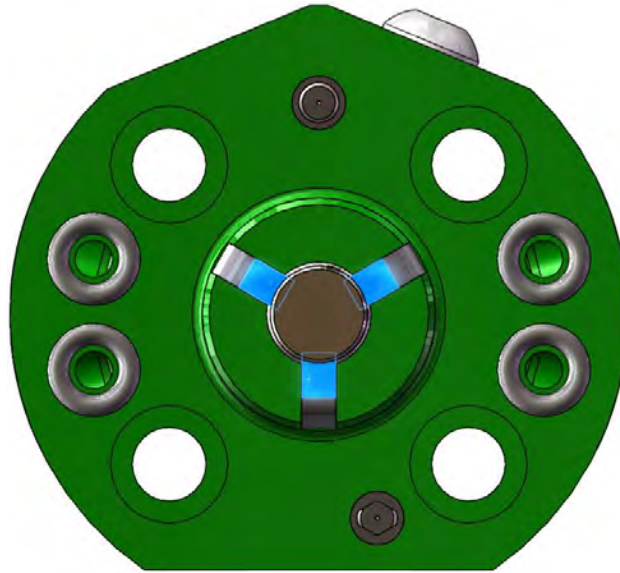
Figure 8.1.1.1-2. E31.5 Robot Adaptor Lubrication – Cams & Washer

8.1.1.2 Tool Adaptor

1. Clean the inner surface of the tool ring, the locating/alignment bushings, and the latching surfaces to ensure all existing grease, dirt, and debris is removed.
2. Apply a liberal coating of white lithium grease to the latching surfaces and to the inner surface of the locating/alignment bushings, as shown in Figure 8.1.1.2-1 with the surfaces highlighted blue.
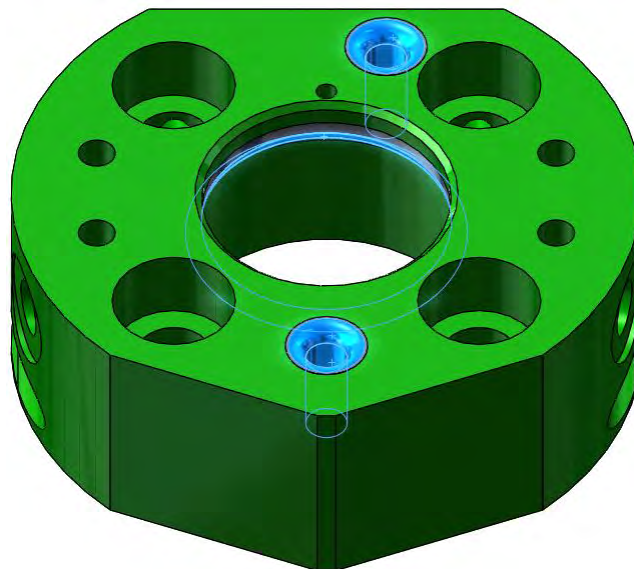
Figure 8.1.1.2-1. ET31.5 Tool Adaptor Lubrication

8.1.2 Visual Checks

Periodic visual checks of the E31.5 Tool Changer provide early detection of breakage or wearing components.

8.1.2.1 Robot Adaptor

1. The latching cams and locating/alignment pins should be inspected for proper lubrication as defined in Section 8.1.1.1.
2. Inspect the latching cams and locating/alignment pins for rust, breakage, or wear[3].
3. Inspect the Robot Adaptor mating surface for raised material[4] or dings that could prevent proper mating to the Tool Adaptor.
4. Uncouple the Robot Adaptor from the Tool Adaptor and cycle the coupling mechanism several times to verify the latching cams are operating smoothly. The cycling of the coupling mechanism will also ensure that the operating cylinder remains properly lubricated.

Figure 8.1.2.1-1. E31.5 Robot Adaptor Visual Inspection

---

[3] If excessive wear is found on the locating/alignment pins, latching cams, or Robot Adaptor mating surface, review the docking and undocking sequence of the robot program and adjust if necessary.
[4] All raised material should be filed smooth.

8.1.2.2 Tool Adaptor

1. The locating/alignment bushings and the latching surfaces should be inspected for proper lubrication as defined in Section 8.1.1.2.
2. Inspect the latching surfaces and locating/alignment bushings for rust, breakage, or wear[5].
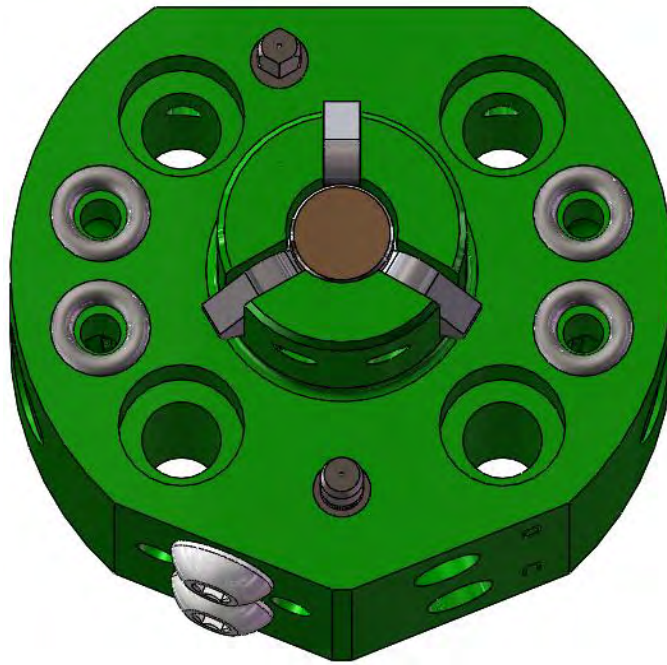3. Inspect the Tool Adaptor mating surface for raised material[6] or dings that could prevent proper mating to the Robot Adaptor.
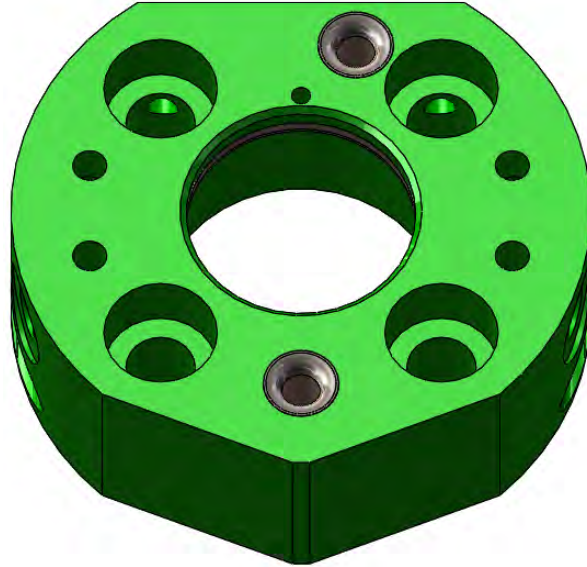
Figure 8.1.2.2-1. ET31.5 Tool Adaptor Visual Inspection

8.1.3 Checking Wear of the Cam Locking Mechanism

In the unlikely event that the Epsilon Tool Changer begins to demonstrate signs of wear in the cam locking mechanism, causing the connection between the Robot Adaptor and Tool Adaptor to lose repeatability and precision, the following can be used to check the wear of the locking mechanism.

1. Remove the Robot Adaptor from the Robot/Manipulator.
2. Remove the Tool Adaptor from the Tool.
3. Remove the face seals from the Robot Adaptor.
4. With the adaptors positioned on a workbench, inspect the mating surfaces of the Robot (Figure 8.1.3-1) and Tool (Figure 8.1.3-2) Adaptor for any raised material. If any raised material is found, file it smooth before proceeding.

---

[5] If excessive wear is found on the locating/alignment bushings, latching surfaces, or Tool Adaptor mating surface, review the docking and undocking sequence of the robot program and adjust if necessary.
[6] All raised material should be filed smooth.

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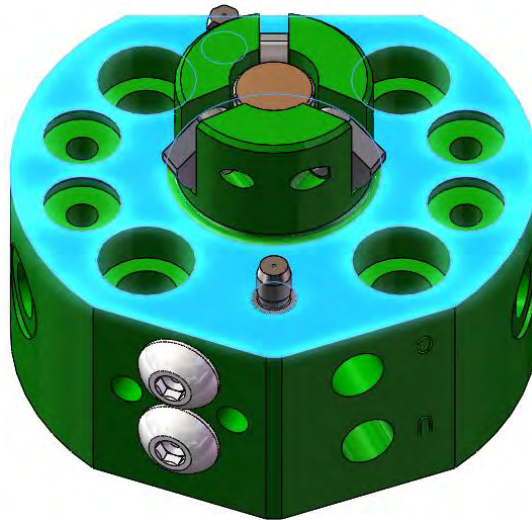
Figure 8.1.3-1. Robot Adaptor – Raised Material Inspection
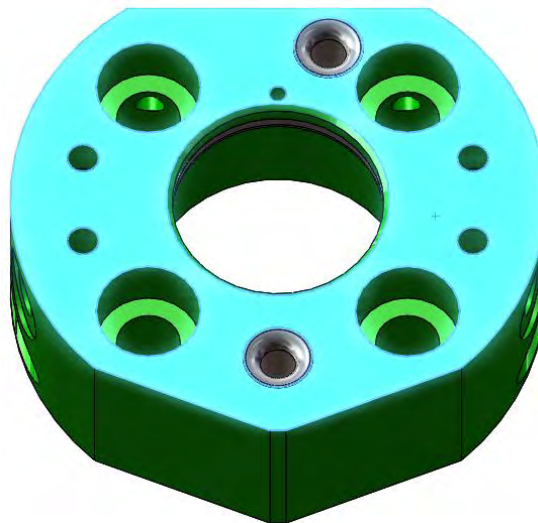
Figure 8.1.3-2. Tool Adaptor – Raised Material Inspection

5. Connect the couple and uncouple actuation port lines (Figure 5.3-1) so that the locking mechanism can be manually actuated.
6. With the cams retracted (Figure 6.1-2), position the Robot Adaptor and Tool Adaptor so that they can be coupled together.
7. Place a 0.05mm piece of shim stock at the locations shown in Figure 8.1.3-3, one location at a time.
8. Actuate the cams to couple the Robot Adaptor to the Tool Adaptor (Figure 6.1-1).
9. With a slight tug, check if the piece of shim stock is securely clamped between the Robot Adaptor and Tool Adaptor interface surfaces.
10. Uncouple the Robot Adaptor from the Tool Adaptor.
11. Repeat steps 6 through 9 for each location shown in Figure 8.1.3-3.
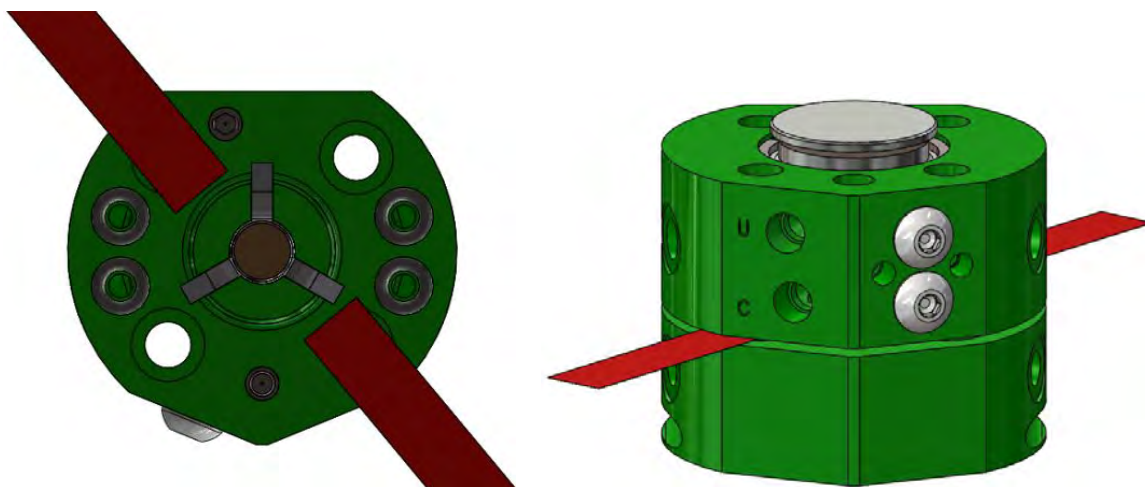
Figure 8.1.3-3. Shim Test of the Cam Locking Mechanism

If the piece of shim stock is able to be pulled free from the coupling interface while the cams are actuated (Figure 6.1-1), record the serial number of the Robot Adaptor and Tool Adaptor and contact APPLIED ROBOTICS Technical Support Department at (518) 384-1000 or techsupport@appliedrobotics.com.

9 SPARE PARTS

The spare parts listed below are recommended to be maintained in stock for the life of the Tool Changer. These quantities are based on a single unit. If higher quantities are purchased, please contact the Technical Support Department at (518) 384-1000 or techsupport@appliedrobotics.com to determine the quantity of spares recommended for the size of your installation.

Table 9-1. Robot Adaptor Spare Parts

ROBOT ADAPTOR		
Description	**Part Number**	**Quantity**
PIN, ALIGNMENT, MXC5	1004-P67N	1
PIN, ALIGNMENT, DIAMOND MXC5	1004-P68N	1
SUBASSY, PNP MODULE ER31.5 (Optional)	1507-D69A	1
O-RING, .145 ID X .07 70VT	96504-P1019	4

Table 9-2. Tool Adaptor Spare Parts

TOOL ADAPTOR		
Description	**Part Number**	**Quantity**
RING, CAM RETAINER ET31.5	1507-C76N	1
BUSHING, 6MM O.D.	49429	2

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10 SPARE PARTS REPLACEMENT

The following procedures explain the correct method for removing and replacing the recommended spare parts listed in Section 9 of this manual.

10.1 ROBOT ADAPTOR

10.1.1 Locating/Alignment Pins

1. Remove the Robot Adaptor from the Robot/Manipulator.
2. Using a punch, press the Locating Pin(s) out through the front face of the Robot Adaptor Housing.
3. Apply a liquid adhesive to the Locating Pin(s) before pressing into housing.
4. Press the new Locating Pin(s) into the appropriate mounting hole (Figure 10.1.1-1) until the pin is fully seated at the bottom of the hole.
5. Lubricate Locating Pin per Section 8.1.1.1.

1004-P68N

1004-P67N
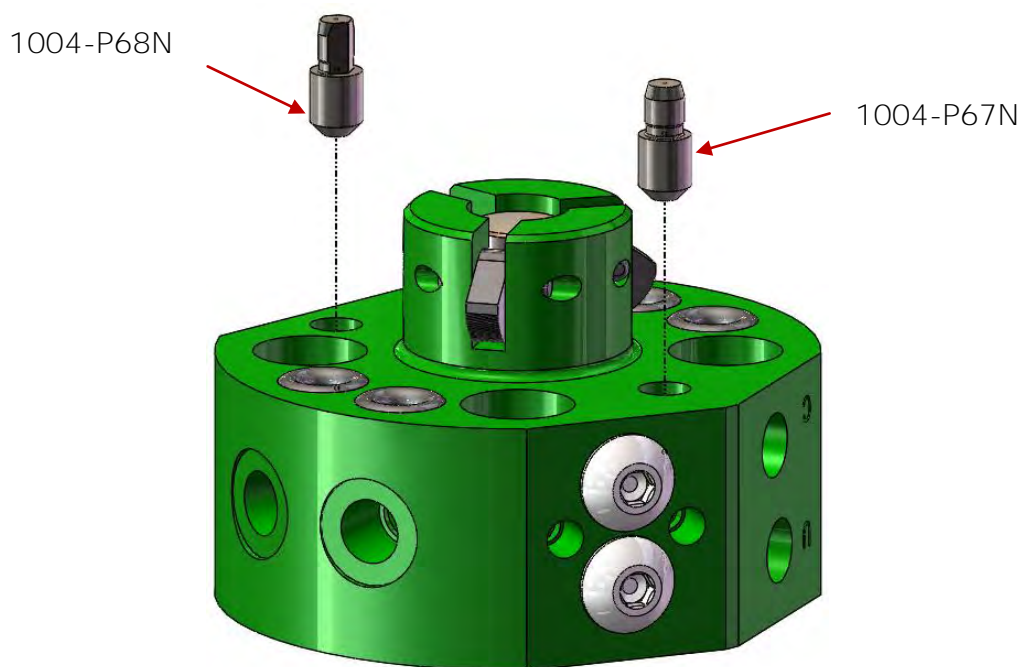
Figure 10.1.1-1. Locating/Alignment Pin Replacement

10.1.2 Couple/Uncouple Sensing Module (Optional Feature)

1. Remove the module (1507-D69A).
2. Loosen the M3 flat head socket cap screws holding the Sensing Module using a 2.5mm allen wrench.
3. Remove the Sensing Module and either discard or send to APPLIED ROBOTICS for repair.
4. Replace unit with another Sensing Module.
5. Ensure that the cavity in the Robot Adaptor Housing holding the Sensing Module is free of all foreign objects.
6. Ensure that the two (2) o-rings (97501-P1084) for the proximity sensors, supplied with the Sensing Module, are properly positioned.
7. Apply Loctite 242, or equivalent, to the threads of the flat head socket cap screws before installing.
8. Install the new Sensing Module using the flat head socket cap screws.
9. Prior to coupling the Tool Changer, cycle the actuating cylinder for the Robot Adaptor several times to ensure that the sensors are working properly and the correct inputs are being received by the robot controller.
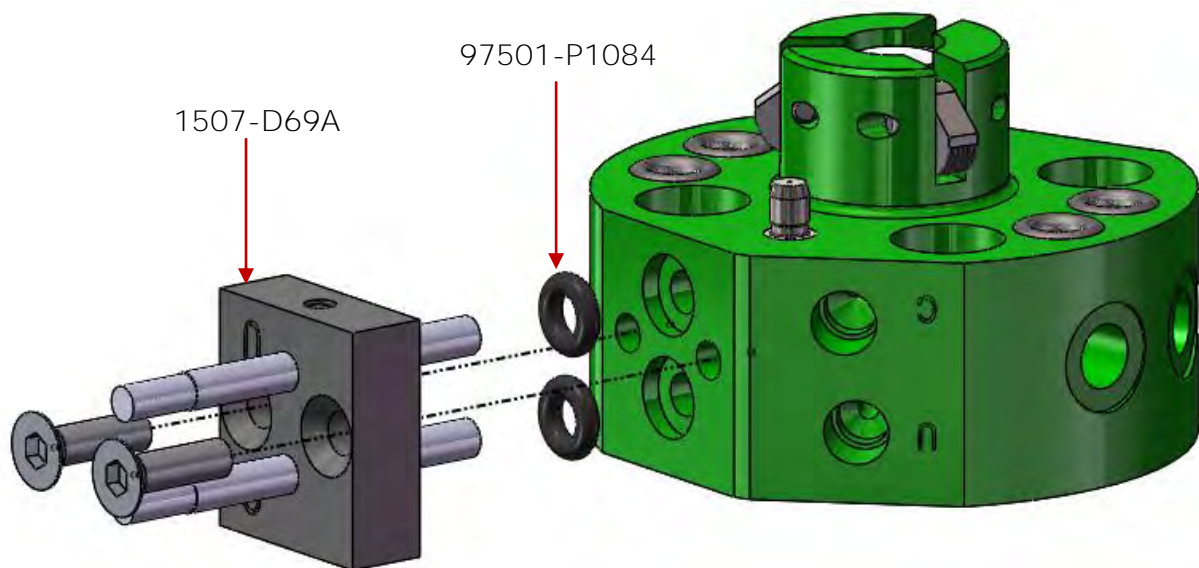
Figure 10.1.2-1. Couple/Uncouple Sensing (Optional) Module Replacement

NOTICE

MAKING CONNECTIONS WHILE UNDER POWER COULD RESULT IN DAMAGE TO THE EQUIPMENT. TO AVOID DAMAGING EQUIPMENT, ENSURE THAT ALL CABLES ARE CONNECTED BEFORE SUPPLYING POWER TO THE EQUIPMENT.

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10.2 TOOL ADAPTOR

10.2.1 Locking Ring

1. Remove the Tool Adaptor from the Tool.
2. Remove the M3 socket head set screws (48417) using a 1.5mm allen wrench.
3. Remove the Locking Ring (96503-B1054) from the Tool Adaptor.
4. Place new Locking Ring into the Tool Adaptor.
5. Apply Loctite 222, or equivalent, to M3 socket head set screws removed in step 2 (clean threads before applying thread locker) and screw into the Tool Adaptor Housing.
6. Lubricate Latching Dowels per Section 8.1.1.2.

1507-C76N
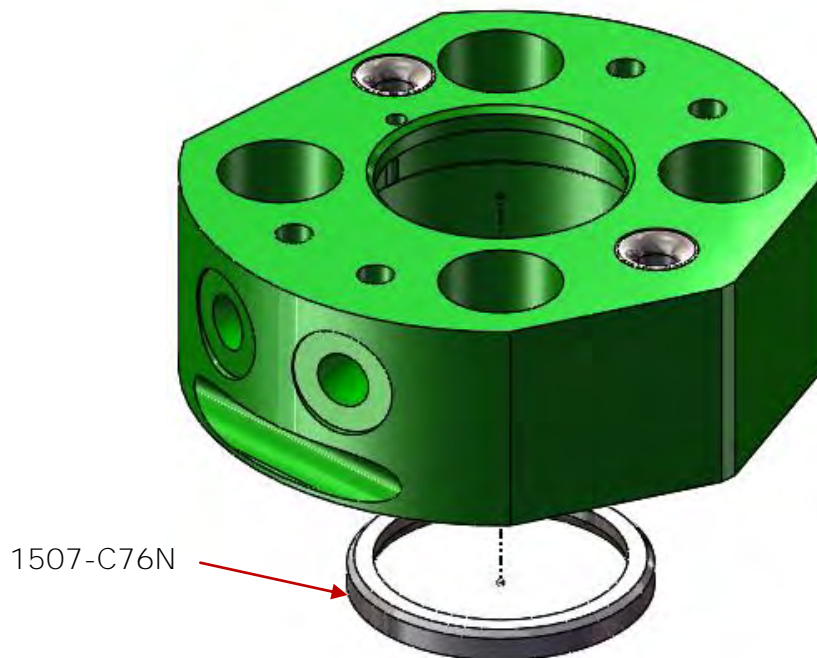
Figure 10.2.1-1. Latching Dowel

10.2.2 Locating Bushing

1. Remove the Tool Adaptor from the Tool.
2. Press out the Locating Bushings (49429) from the bottom of the Tool Adaptor Housing.
3. Press in new Locating Bushings from the top of the Tool Adaptor Housing until it is just below the Tool Adaptor Housing surface. Ensure that the rounded edge of the Locating Bushing faces the top surface of the Tool Adaptor Housing.
4. Lubricate the Locating Bushing per Section 8.1.1.2.

49429
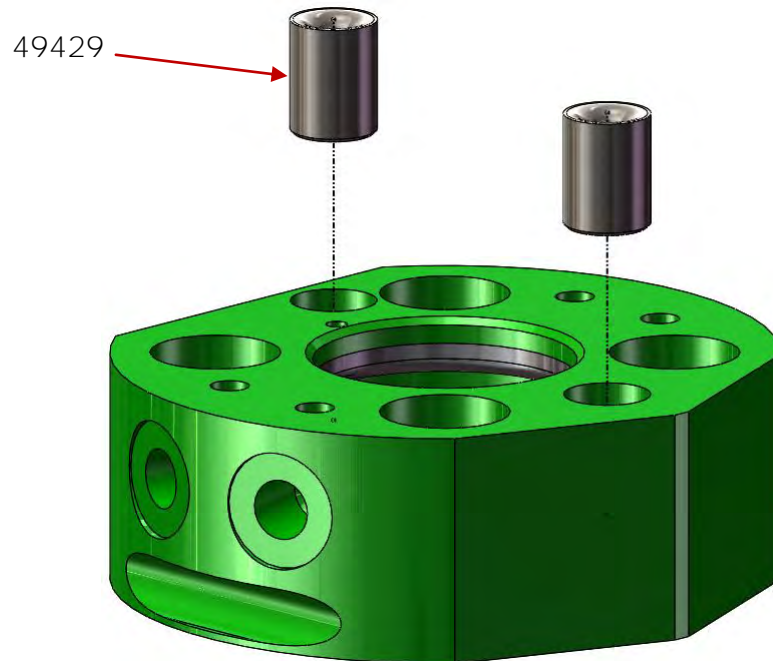
Figure 10.2.2-1. Locating Bushing Replacement

11 INFORMATIONAL DRAWINGS

The drawings in this section can assist with installation, use and identification of replacement parts for the Epsilon Tool Changer. Please contact **APPLIED ROBOTICS Technical Support** if you have any questions.

DRAWING NUMBER	DESCRIPTION
1507-D63A	ER31.5-N/A-020-N-0-C0000
1507-D67A	ET31.5-022-N-C0000

REVISIONS

ZONE	REV	DESCRIPTION	DR	CHK	DATE	ECR/ESR NO.
	00	RELEASE FOR MANUFACTURE.	JV	SA	3/30/2016	EMIN-87JKUZ

⌀ 4.20 ↧ 6.00
M5X0.8 - 6H ↧ 4.50

VIEW D-D
SCALE 2 : 1

⌀M5 h6 DOWEL
⊕ ⌀ .03 Ⓜ A B

A — A

13
14
3
1
5

20 h7 B

3
3
5
10
10

4 11 2 7 12

NOTE 3

SECTION A-A
SCALE 2 : 1

4X M5 PASS THROUGH
AIR PORTS

(31.28)
(20)

NOTE 3 8 12 9 NOTE 3

A

3 1

7

(⌀46)
6

4X M5 SHCS

9 ORIENTATED AS SHOWN

(⌀31.5)

1

NOTES:

1. ALL PARTS TO RECEIVE LOCTITE ARE TO BE THOROUGHLY CLEANED FROM GREASE AND OIL.
2. ALL SURFACES OR O-RINGS THAT RECEIVE LUBE-A-CYL (51120) APPLY ONLY A THIN FILM. ITEMS 14 - 18.
3. APPLY LITHIUM GREASE, ARI #91504-P1037.
4. APPLY LOCTITE 222, ARI #86005-P1020.
5. APPLY LOCTITE 271, ARI #86005-P1304.
6. TORQUE TO 18 IN/LBS.

ITEM NO.	QTY	PART NO.	DESCRIPTION
14	2	47003	SCR, BUT HD SOC CAP M4 X 6(SS)
13	2	97501-P1084	O-RING, .070 ID X .070 (P)
12	3	49989	DOWEL, M2 X 8 SS M6
11	1	89501-P1096	O-RING, .301 ID X .07 70 BUNA (P)
10	2	91500-P1032	O-RING, .676 ID X .07 70
9	1	1004-P68N	PIN, ALIGNMENT, DIAMOND MXC5
8	1	1004-P67N	PIN, ALIGNMENT, MXC5
7	3	0104-C18N	CAM, MXC5M-02M3
6	4	96504-P1019	O-RING, .145 ID X .07 70VT (P)
5	1	1507-P77N	RING, RETAINING
4	1	1502-P94N	SPRING, COMPRESSION 15.24MM OD X 12
3	1	1507-C66N	CAP, ROBOT ER31.5 20mm HUB
2	1	1507-C65N	PISTON, ROBOT ER31.5
1	1	1507-D64N	HOUSING, ROBOT ER31.5

THIRD ANGLE PROJECTION

METRIC
UNLESS OTHERWISE SPECIFIED:
UNTOLERANCED DIMS ARE BASIC

△ .25 | A | B | C
⊕ ⌀ .25 Ⓜ | A | B | C

ALL HOLE DIAMETERS +/- 0.25
INTERNAL RADII & BROKEN EDGES TO BE .13-.38
ALL SURFACE FINISHES 1.6Ra

DR:	J. VALLELUNGA
CHK:	S. ATKINS
ENG:	J. DELMONACO
MFG:	C. BEST
QC:	M. DUDNATH

3D MODEL NUMBER:
1507-D63A

MAT'L:
-

SCALE: 2:1
DO NOT SCALE DRAWING

SURFACE TREATMENT:
-

DIM. AND TOLERANCING IN ACCORDANCE WITH ANSI Y14.5M-1994

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www.appliedrobotics.com

TITLE:
ER31.5-N/A-020-N-0-C0000

ISO 9001
REGISTERED

SIZE	DRAWING NUMBER	REV
D	1507-D63A	00

WEIGHT: 0.09 kg   RoHs COMPLIANT: -   SHT. 1 OF 1

PRINT DATE
3/31/2016

REVISIONS

ZONE	REV	DESCRIPTION	DR	CHK	DATE	ECR/ESR NO.
	00	RELEASE FOR MANUFACTURE.	JV	SA	3/30/2016	EMIN-87JKUZ

(45°)

3

(∅31.5)

A — A

(∅46)

1

4X M5 SHCS
EQUALLY SPACED

1

A

4X M5 PASS THROUGH
AIR PORTS

(16)

3 1

NOTE 5 2

SECTION A-A
SCALE 2 : 1

NOTES:
1. ALL PARTS TO RECEIVE LOCTITE ARE TO BE THOROUGHLY CLEANED FROM GREASE AND OIL.
2. ALL SURFACES OR O-RINGS THAT RECEIVE LUBE-A-CYL (51120) APPLY ONLY A THIN FILM. ITEMS 14 - 18.
3. APPLY LITHIUM GREASE, ARI #91504-P1037.
4. APPLY LOCTITE 222, ARI #86005-P1020.
5. APPLY LOCTITE 271, ARI #86005-P1304.
6. TORQUE TO 18 IN/LBS.

2X ∅ M5 h6 DOWELS
⊕ ∅ .03 Ⓜ A

16°

(∅31.5)

3	2	49429	BUSHING, 6MM O.D.
2	1	1507-C76N	RING, CAM RETAINER ET31.5
1	1	1507-D68N	HOUSING, TOOL ET31.5
ITEM NO.	QTY	PART NO.	DESCRIPTION

THIRD ANGLE PROJECTION

METRIC
UNLESS OTHERWISE SPECIFIED:
UNTOLERANCED DIMS ARE BASIC
△ .25 | A | B | C
⊕ ∅ .25 Ⓜ | A | B | C
ALL HOLE DIAMETERS +/- 0.25
INTERNAL RADII & BROKEN EDGES TO BE .13-.38
ALL SURFACE FINISHES 1.6Ra

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CHK:	S. ATKINS
ENG:	J. DELMONACO
MFG:	C. BEST
QC:	M. DUDNATH

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TITLE:
ET31.5-22.5-N-C0000

3D MODEL NUMBER:
1507-D67A

MAT'L:
-

SCALE: 2:1
DO NOT SCALE DRAWING

DIM. AND TOLERANCING IN ACCORDANCE WITH ANSI Y14.5M-1994

SURFACE TREATMENT:
-

ISO 9001
REGISTERED

SIZE	DRAWING NUMBER	REV
D	1507-D67A	00

WEIGHT: 0.04 kg | RoHs COMPLIANT: - | SHT. 1 OF 1

PRINT DATE
3/31/2016