

# **EPSILON E80 TOOL CHANGE SYSTEM**

**95622, Rev 01**

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## REVISION

| Revision | Date       | Author | Description                                                  |
|----------|------------|--------|--------------------------------------------------------------|
| 00       | 04/01/2016 | SC     | Initial Release                                              |
| 01       | 07/10/2020 | DS     | - Description changes<br>- Removed Lubrication on Robot Side |

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# 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                    |
|-------------|--------------------------------|
| 49628       | RETAINING RING, EXT, 8MM SHAFT |
| 1506-C53N   | PISTON, ACTUATOR               |
| 1502-C61N   | CAM, HIGH LOCK                 |
| 97500-B1028 | DOWEL, MODIFIED CAM            |

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). For the purposes of this warranty, APPLIED ROBOTICS defines the lifetime as 8 years or 8,000,000 total cycles completed with regularly scheduled maintenance as per Section 8 of this manual.

## 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 Side.



**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 E80 Tool Changer provides a strong and reliable method for a manipulator to quickly change between different tools/end-effectors. With Applied Robotics, Inc. six-sided design, the E80 Tool Changer offers the maximum flexibility for any application.

The E80 Tool Changer contains two major components:

**Robot Side (ER80)** – Mounts directly to a robot flange utilizing an 80mm ISO 9409-1 pattern without the need for adaptor plates (Figure 3-1).

**Tool Side (ER100)** – Mounts directly to a tooling plate utilizing a 100mm ISO 9409-1 pattern (Figure 3-2).

The Robot Side and Tool Side 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. Each cam also contains a mechanical locking feature which prevents the Robot Side and Tool Side from separating/disconnecting in the event of power and/or air pressure loss. As the locking mechanism actuates, the Tool Side is physically connected and disconnected along with any utilities contained in the attached modules.

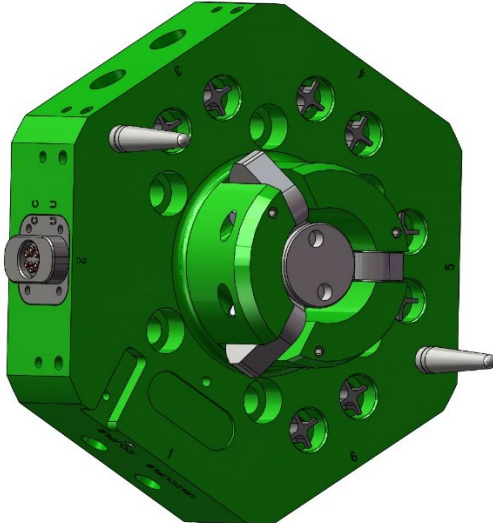


Figure 3-1. ER80 Robot Side

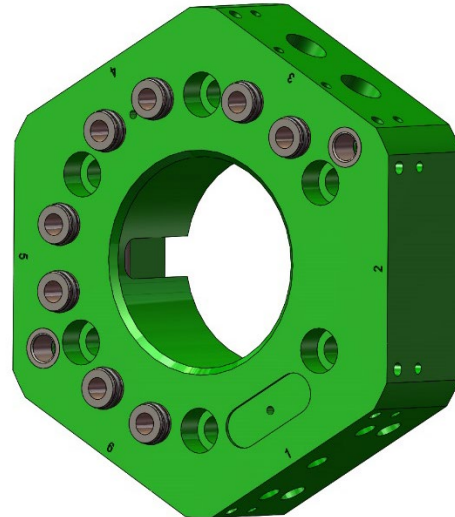
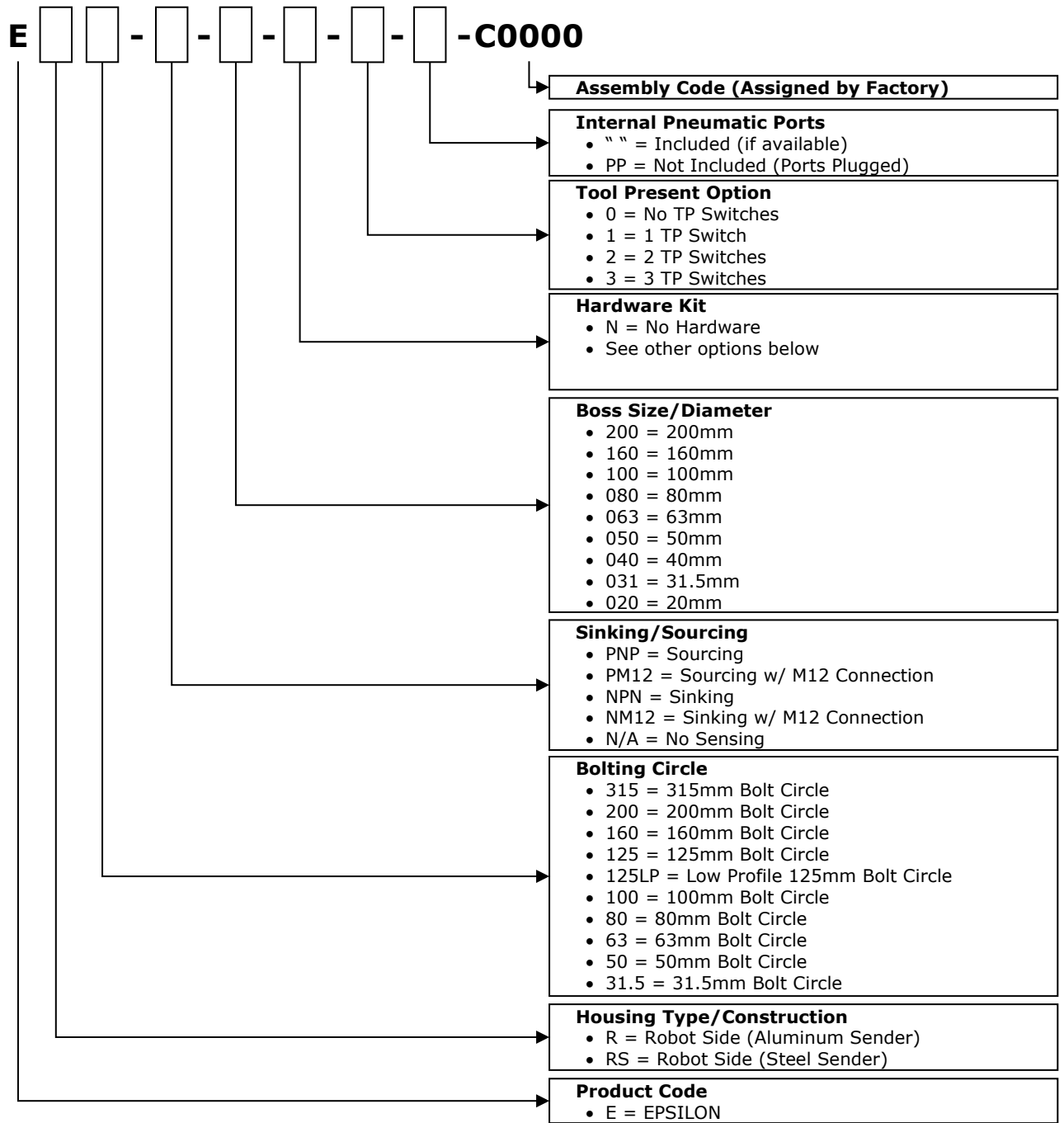


Figure 3-2. ET100 Tool Side

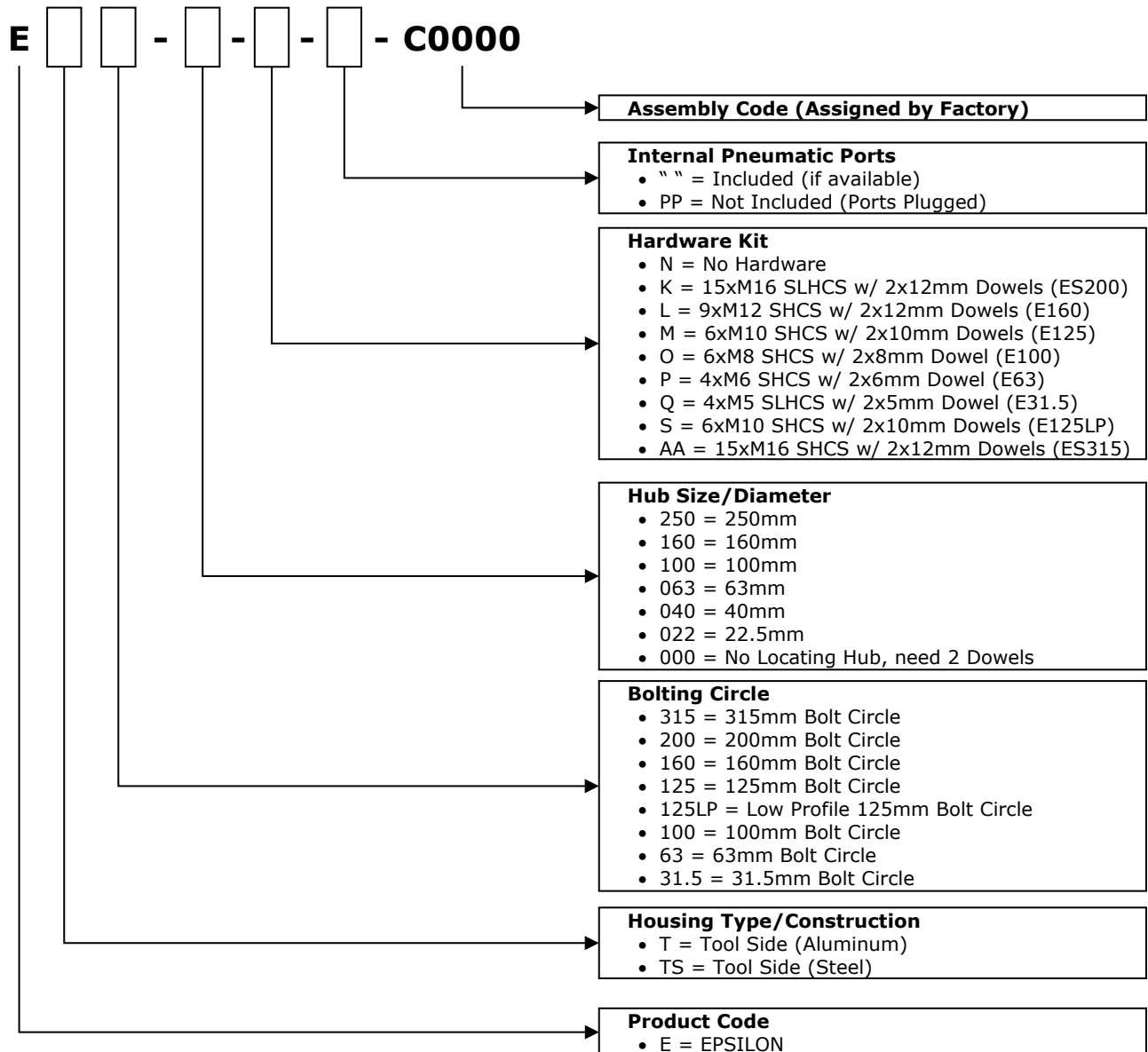
### 3.1 ROBOT SIDE



#### Hardware Kit

- N = No Hardware
- A = 16xM16 SHCS w/ 1x12mm Dowel (ES200)
- A2 = 6xM12 SHCS w/ 1x12mm Dowel (ES200)
- B = 11xM12 SHCS w/ 1x12mm Dowel (E160)
- B2 = 10xM12 SHCS w/ 2x12mm Dowels (E160)
- C = 6xM12 SHCS w/ 1x12mm Dowel (E160)
- D = 11xM10 SHCS w/ 1x10mm Dowel (E125)
- D2 = 10xM10 SHCS w/ 2x10mm Dowels (E125)
- E = 11xM10 SHCS w/ 1x10mm Dowel and 11x10.5mm ID washers (E160)
- E2 = 12xM10 SHCS w/ 2x10mm Dowels and 10x10.5mm ID washers (E160)
- F = 6xM10 SHCS w/ 1x10mm Dowel (E125)
- G = 6xM10 SHCS w/ 1x10mm Dowel and 6x10.5mm ID washers (E160)
- H = 6xM8 SHCS w/ 1x8mm Dowel (E80 & E100)
- I = 4xM6 SHCS w/ 1x6mm Dowel (E50 & E63)
- J = 4xM5 SLHCS w/ 1x5mm Dowel (E31.5)
- R = 6xM10 SHCS w/ 1x10mm Dowel (E125LP)
- Z = 15xM16 SHCS w/ 1x12mm Dowel (ES315)

### 3.2 TOOL SIDE



ET50-031-N-T-C0000 is a specific tool side, which has a thread-in 50mm Bolt Circle pattern.

Note: If " " (blank) is chosen, remove "-" (dash) if that is the only input between dashes.

## 4 TECHNICAL SPECIFICATIONS

**Table 4-1. E80 Technical Specifications**

| Specification                                               |       | Metric                                           | English           |
|-------------------------------------------------------------|-------|--------------------------------------------------|-------------------|
| Payload                                                     |       | 90 kg                                            | 198 lb            |
| Maximum Operating Moment (M <sub>x</sub> , M <sub>y</sub> ) |       | 465 Nm                                           | 4,120 in-lb       |
| Maximum E-Stop Moment (M <sub>x</sub> , M <sub>y</sub> )    |       | 890 Nm                                           | 7,880 in-lb       |
| Maximum Operating Torque (M <sub>z</sub> )                  |       | 640 Nm                                           | 5,665 in-lb       |
| Maximum E-Stop Torque (M <sub>z</sub> )                     |       | 1,585 Nm                                         | 14,025 in-lb      |
| Maximum Tensile Force (F <sub>T</sub> )                     |       | 13,345 N                                         | 3,000 lb          |
| Maximum Compressive Force (F <sub>C</sub> )                 |       | 31,649 N                                         | 7,115 lb          |
| Diameter                                                    |       | 152 mm                                           | 5.98 in           |
| Height (Robot and Tool Coupled)                             |       | 71.5 mm                                          | 2.81 in           |
| Mass / Weight *                                             | Robot | 1.52 kg                                          | 3.34 lb           |
|                                                             | Tool  | 1.22 kg                                          | 2.68 lb           |
| Rotational Repeatability                                    |       | ± .01°                                           |                   |
| Operating Temperature                                       |       | 5 °C to 60 °C                                    | 40 °F to 140 °F   |
| Supply Pressure                                             |       | 5 bar to 7 bar                                   | 72 psi to 101 psi |
| Couple/Uncouple Voltage                                     |       | 10 to 30 VDC                                     |                   |
| Noise Emission                                              |       | ≤ 70 dB(A) in any direction                      |                   |
| Transportation and Storage Humidity                         |       | Up to 50%,<br>Maximum Temperature 70 °C (158 °F) |                   |
| Transportation and Storage Temperature                      |       | -25 °C to 70 °C                                  | -13 °F to 158 °F  |
| User Pneumatic Pressure Range                               |       | 0 bar to 7 bar                                   | 0 psi to 101 psi  |
| User Pneumatic Flow (Cv)                                    |       | 0.37                                             |                   |

\* Weight may vary depending on specific configuration.

## 5 INSTALLATION

### 5.1 ROBOT SIDE INSTALLATION

The E80 Robot Side is designed to mount directly to interfaces utilizing an ISO 80mm bolt pattern (ISO 9409-1). The E80 Robot Side can mount to manipulator interfaces utilizing M8 hardware. For size, locations, and tolerance information on the E80 Robot Side mounting patterns, see Informational Documents (Section 11).

#### **NOTICE**

**TOOL CHANGER PAYLOAD & MOMENT RATINGS BASED ON USING A MINIMUM OF 6xM8 SCREWS TO MOUNT THE ROBOT SIDE TO THE MANIPULATOR INTERFACE.**

### 5.1.1 M8 Hardware

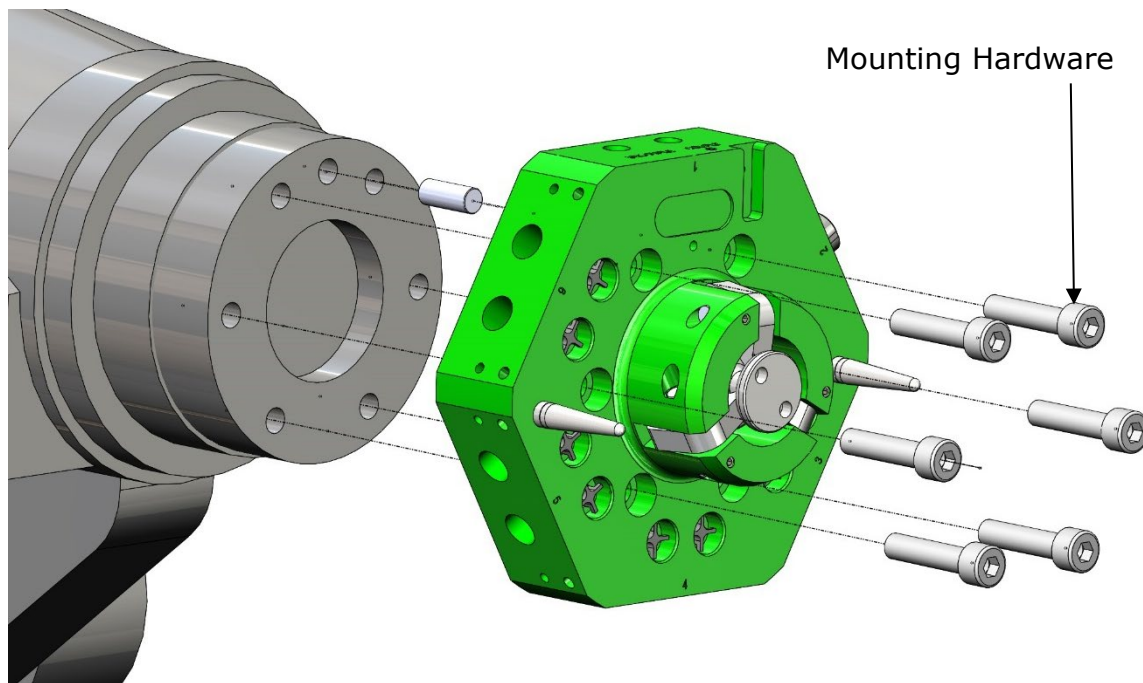
#### NOTICE

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

1. Locate the Robot Side to the manipulator mounting flange utilizing the locating boss and one (1) M8 locating dowel (Figure 5.1.1-1).
2. Insert and tighten the M8 socket head cap screws (minimum Property Class 10.9) provided with the Robot Side 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.**



**Figure 5.1.1-1. E80 Robot Side Installation w/ M8 Hardware**



#### WARNING

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

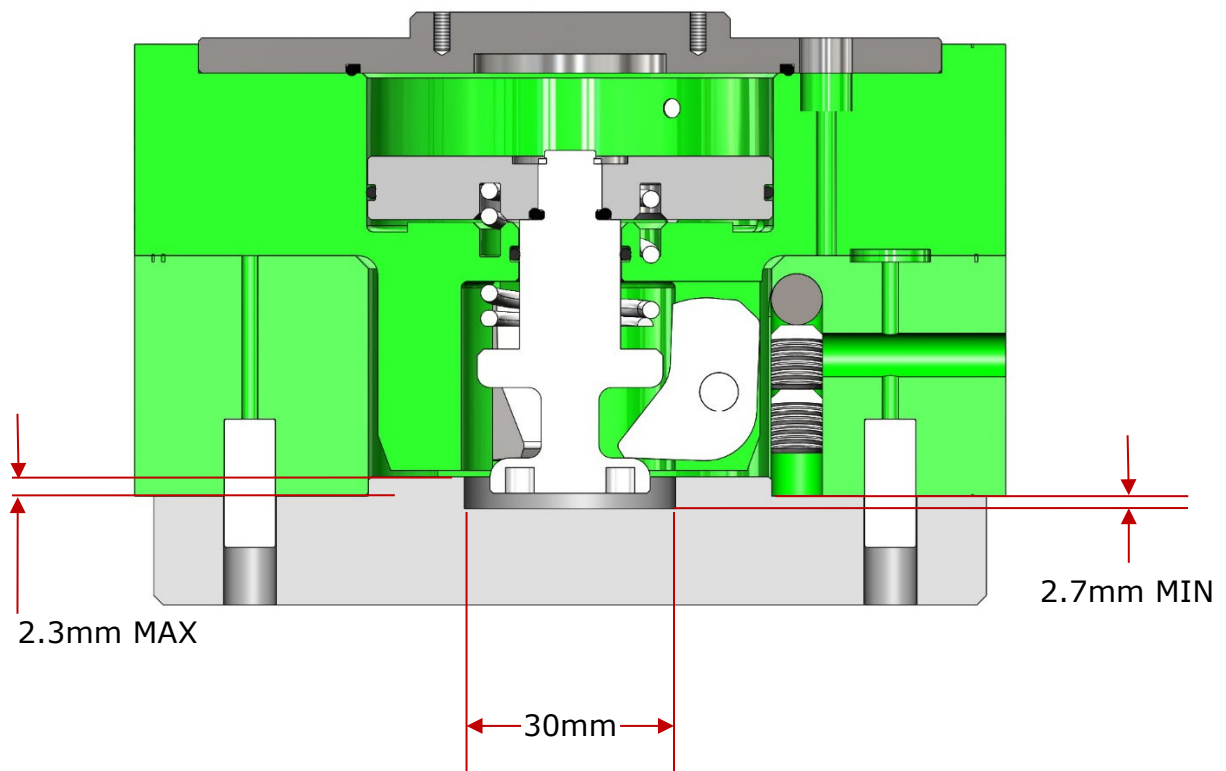
## 5.2 TOOL SIDE INSTALLATION

The E80 utilizes the same Tool Side as the E100 (ET100) and is designed to mount directly to customer tooling utilizing an ISO 9409-1 bolt pattern. The Tool Side can be mounted from the top down using M8 hardware on the ISO 100mm bolt circle. For size, locations, and tolerance information on the Tool Side mounting patterns, see Informational Documents (Section 11).

### NOTICE

**TOOL CHANGER PAYLOAD & MOMENT RATINGS BASED ON USING 6xM8 SCREWS TO MOUNT THE TOOL SIDE TO THE TOOLING INTERFACE.**

If a locating boss/pilot is used on the tool plate to locate the tool to the Tool Side, then the boss cannot protrude into the tool changer greater than 2.3mm and a 30mm diameter counter-bore with a minimum depth of 2.7mm below the Tool Side and Tool Plate interface must be made into the boss to allow for clearance of the latching mechanism (Figure 5.2-1).



**Figure 5.2-1. ET100 Tool Side and Tool Plate Installation**

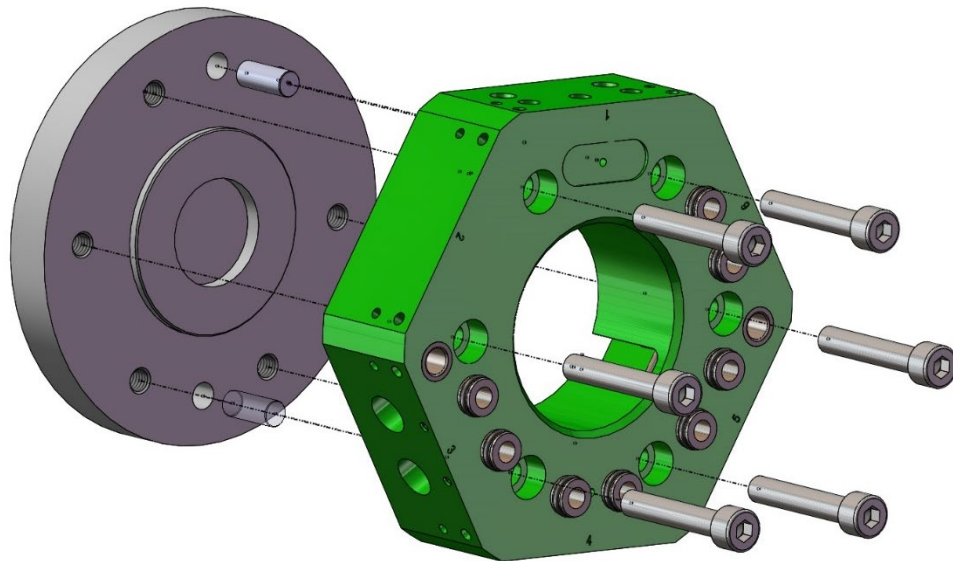
**Installing the ET100 Tool Side from the Top Down:****NOTICE**

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

1. Locate the Tool Side to the tool plate utilizing either the locating hub and one (1) M8 locating dowel, or two (2) M8 locating dowels (Figure 5.2-2).
2. Insert and tighten M8 socket head cap screws (minimum Property Class 10.9) through the Tool Side 100mm 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.**



**Figure 5.2-2. ET100 Tool Side Installation (Bolt Top Down)**

**WARNING**

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

### 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).



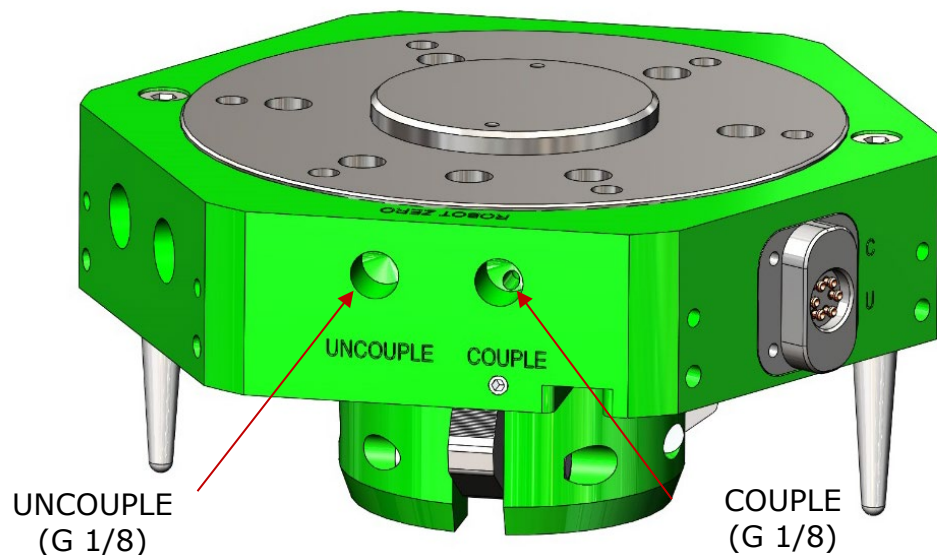
#### WARNING

**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.**



**Figure 5.3-1. E80 Robot Side 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:**

- 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.

**WARNING**

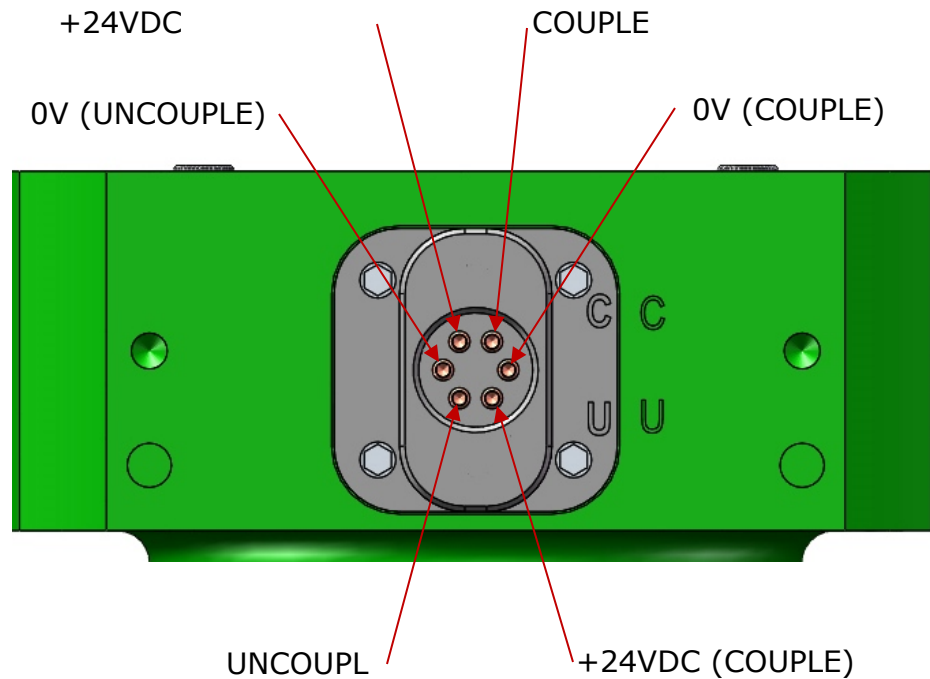
## 5.4 COUPLE AND UNCOUPLE SIGNALS

Couple and uncouple signals are provided via an electrical interface at Position 2 of the E80 Robot Side (Figure 5.4-1 or Figure 5.4-2). 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.

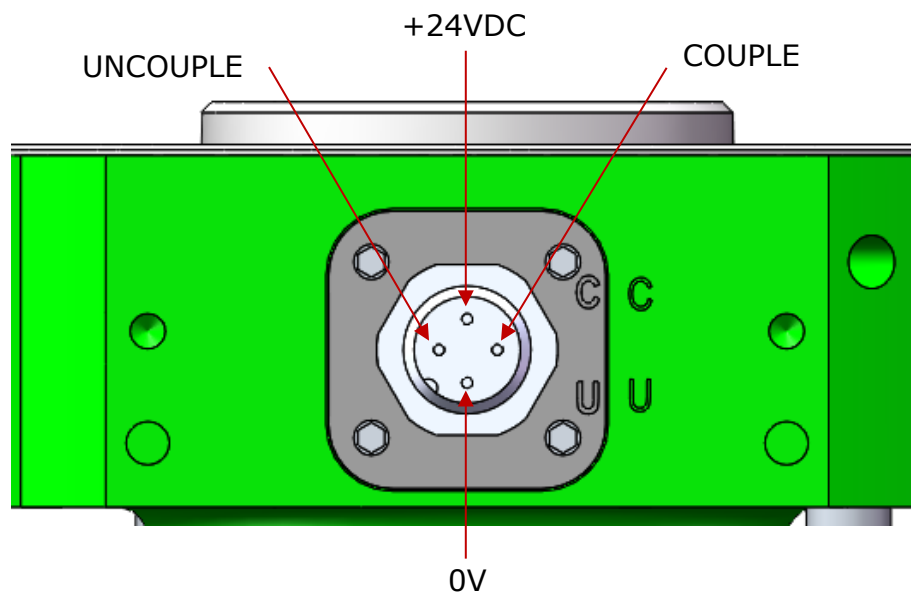
**CAUTION**

**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**



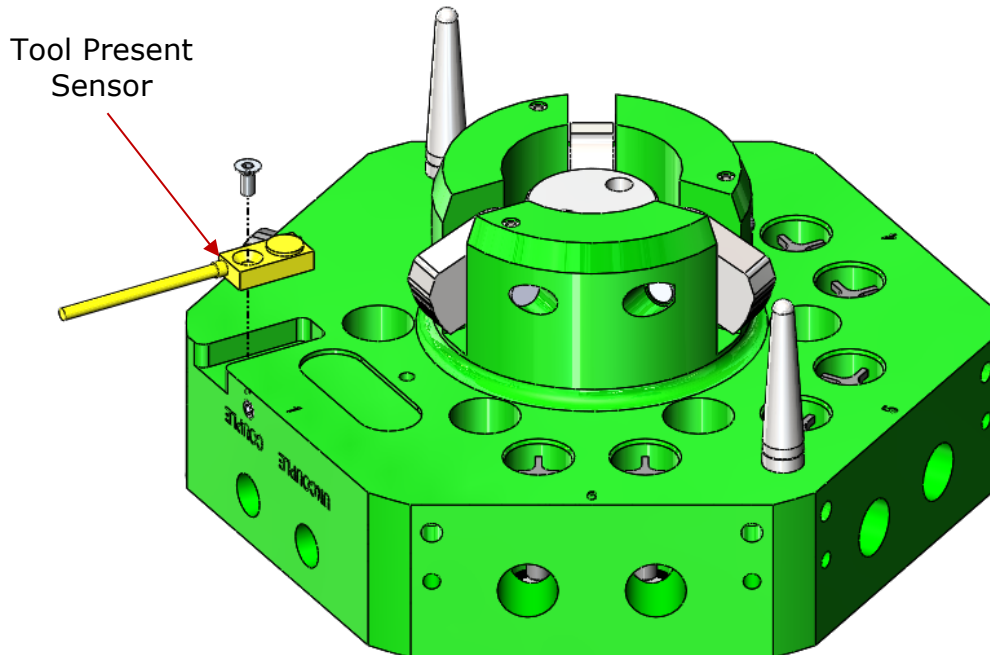
**Figure 5.4-2. M12 Couple/Uncouple Signal Interface**

## 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.**

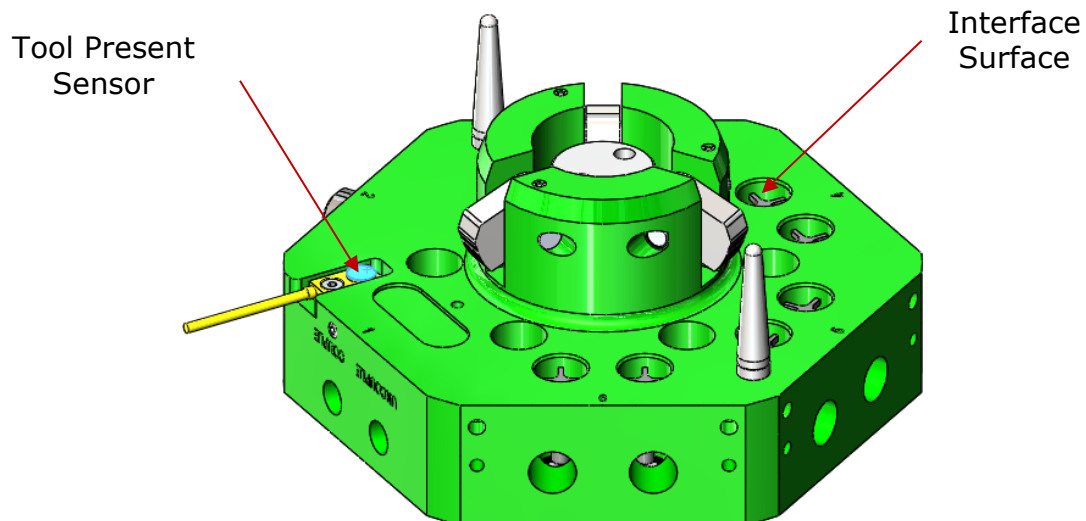
## 5.5 TOOL PRESENT SIGNAL (OPTIONAL)

The E80 Tool Changer contains a built-in feature for Tool Present detection via a proximity sensor (Figure 5.5-1). This option provides direct detection of the Tool Side and the signal can be directly monitored by the robot controller.



**Figure 5.5-1. Tool Present Option**

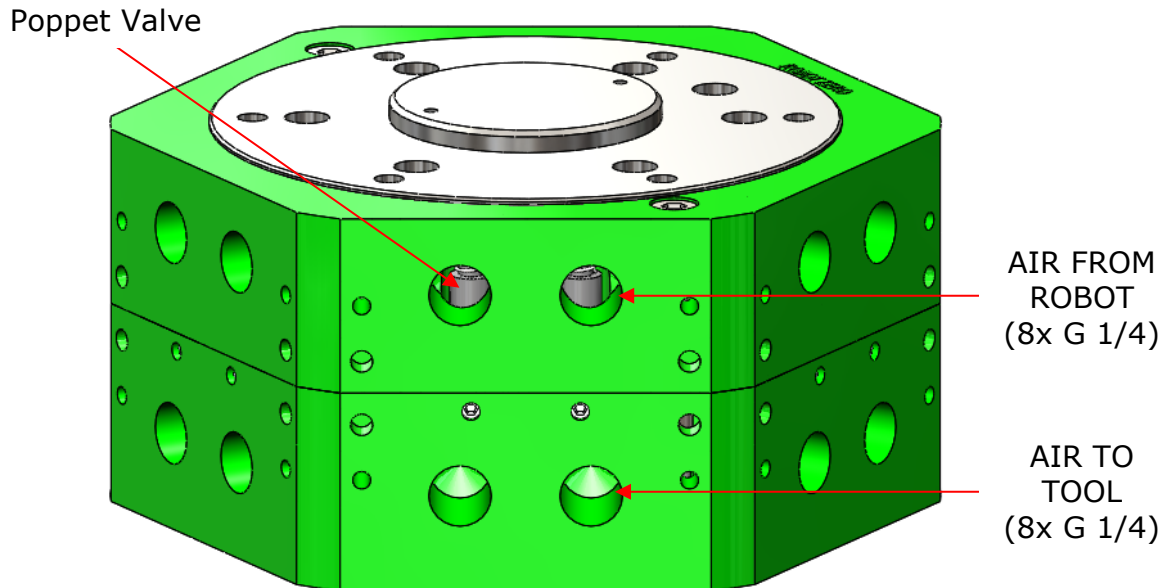
When the Tool Present sensors are installed, ensure that the tip of the sensor (highlighted blue) does not protrude past the Robot Side interface (Figure 5.5-2).



**Figure 5.5-2. Tool Present Sensor Installation**

## 5.6 CONNECTING USER PNEUMATIC PORTS

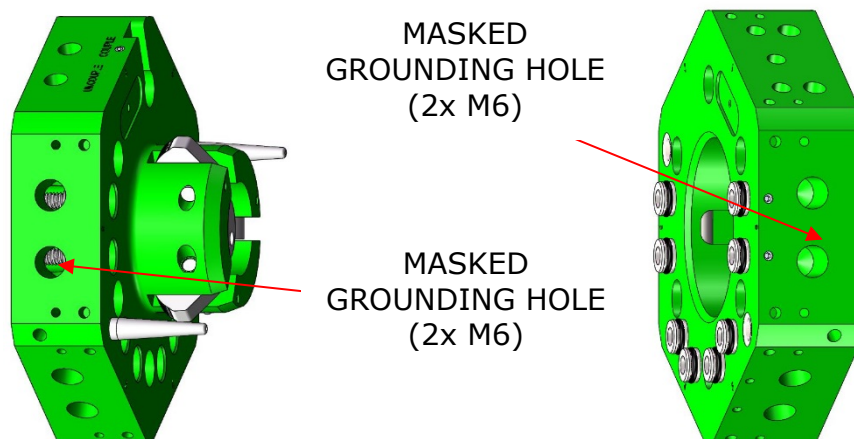
The E80 Tool Changer has eight (8) available user pneumatic ports to supply air through the tool changer to the specific tool being used. The robot side ports can be checked if a poppet valve is installed. For the ports to be operational, the tool changer must be coupled and be fitted with a valve fitting assembly (valve fitting (1506-C99N) and 2 O-rings (83908-P1134) per port). Air can be supplied via directly ported air fittings supplied by the customer (Figure 5.6-1).



**Figure 5.6-1. E80 User Pneumatic Ports**

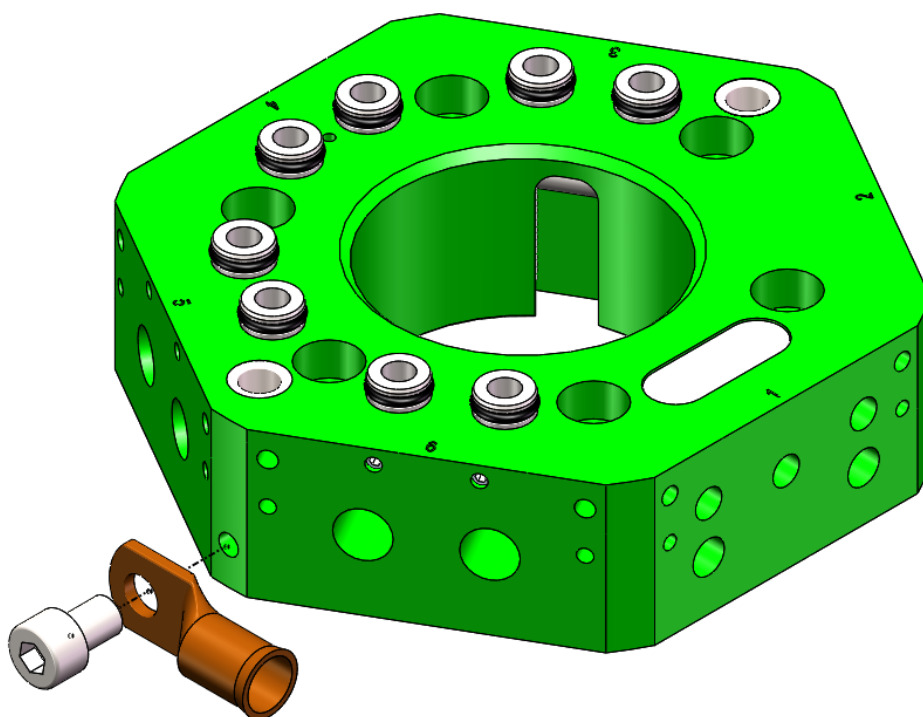
## 5.7 GROUNDING CONNECTION

The E100 Tool Changer has two (2) masked holes on opposite sides to attach an M6 lug as a grounding line (Figure 5.7-1 and Figure 5.7-2).



**Figure 5.7-1 ER80 Masked Grounding Holes**

**Figure 5.7-2 ET100 Masked Grounding Holes**



**Figure 5.7-3. Grounding M6 Lug Mounting**

## 6 GUIDE TO OPERATION

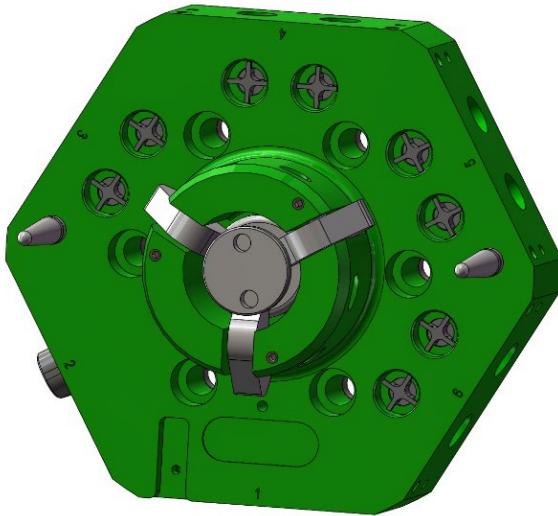
### 6.1 INITIAL TEST

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.

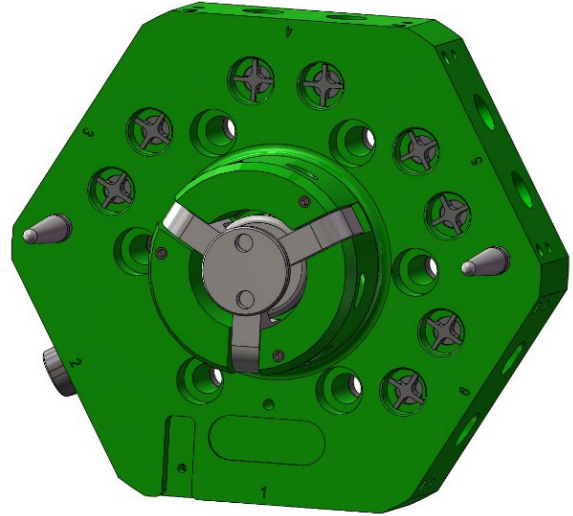


**DURING TESTING, KEEP YOUR FINGERS CLEAR OF THE MECHANICAL COUPLING MECHANISM AND THE COUPLING INTERFACE SURFACES. KEEP OUT OF THE ROBOT WORK ENVELOPE WHEN DRIVE POWER IS ON.**

1. Verify that the Robot Side is clear of any obstruction and not coupled to the Tool Side.
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 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 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 Side Coupled (Cams Extended)**



**Figure 6.1-2. Robot Side Uncoupled (Cams Retracted)**

## 6.2 PROGRAMMING THE COUPLE AND UNCOUPLE POINTS

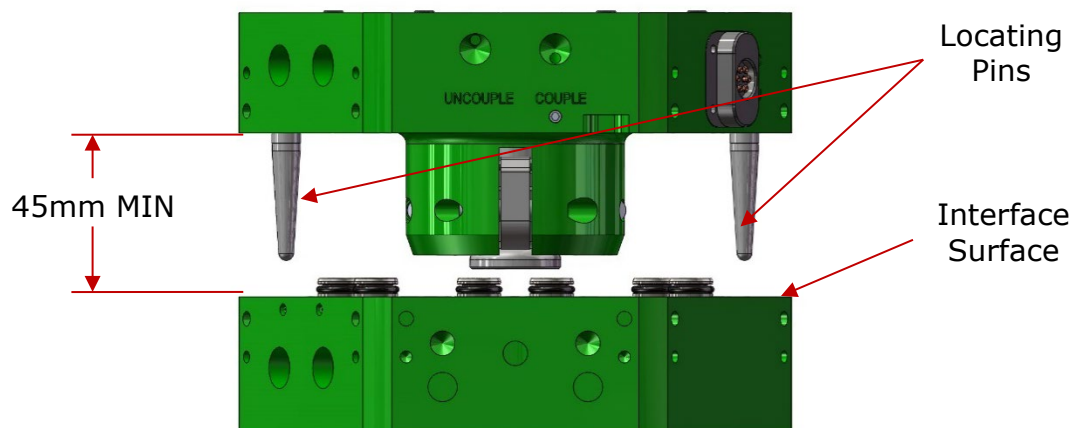


### **WARNING**

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

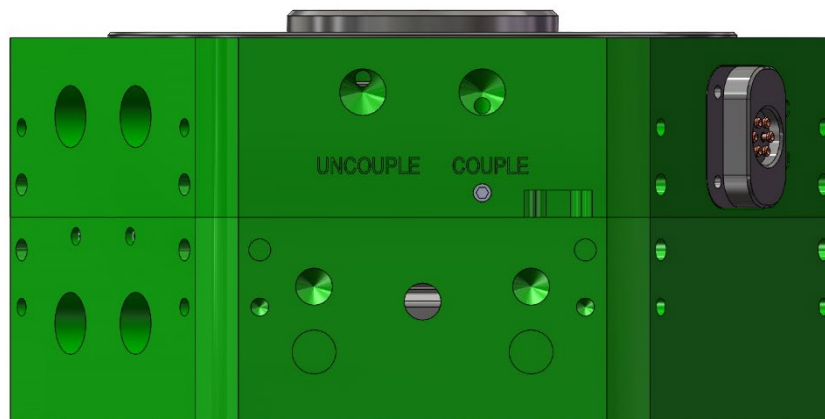
When programming the “dock” and “undock” points of each tooling, the following steps should be taken:

1. Orient the Robot Side and Tool Side so that the centerline axes are aligned and the interface surfaces are parallel. Maintain approximately 45mm minimum separation between the Robot Side and Tool Side interface surfaces (Figure 6.2-1).



**Figure 6.2-1. E80 Tool Changer – Docking Orientation**

2. Energize the solenoid, resulting in an uncoupled (cams retracted) state.
3. Rotate the Robot Side so that the locating pins are centered on the bushings in the Tool Side.
4. Start to bring the Robot and Tool Sides 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 Side interface surface and Tool Side 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 Side and Tool Side are in contact, the outer edge of the Sides should be touching (Figure 6.2-2).



**Figure 6.2-2. E80 Tool Changer – Docked Position**

## **NOTICE**

**MINIMIZING THE DISTANCE BETWEEN THE ROBOT SIDE AND TOOL SIDE 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 SIDE AND TOOL SIDE 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 Side with the Tool Side.
7. Cycle the cams by energizing and de-energizing the solenoid several times to verify that the Tool Side is properly connected and released from the Robot Side. If properly programmed, the Robot Side and Tool Side 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 Side. Depending on the docking station used, separate dock and undock positions may be required.
9. Repeat procedure for each Tool Side used in conjunction with the corresponding Robot Side.

### 6.3 TOOL DROP PREVENTION

Preventing accidental uncoupling of the Tool Changer is of utmost importance when setting up your Epsilon Tool Changer for operation. Various system options are available to ensure that the Tool Changer cams can only be moved into the Uncouple position when it is safe to do so (i.e., when the Tool Side is not coupled to the Robot Side OR when the tool is safely positioned in a docking station).

Unintentional tool drops can be prevented by using a programmable safety controller or an APPLIED ROBOTICS Tool Stand Monitoring (TSM) circuit. For further information, consult the manual for your particular system or contact APPLIED ROBOTICS Applications Engineering.

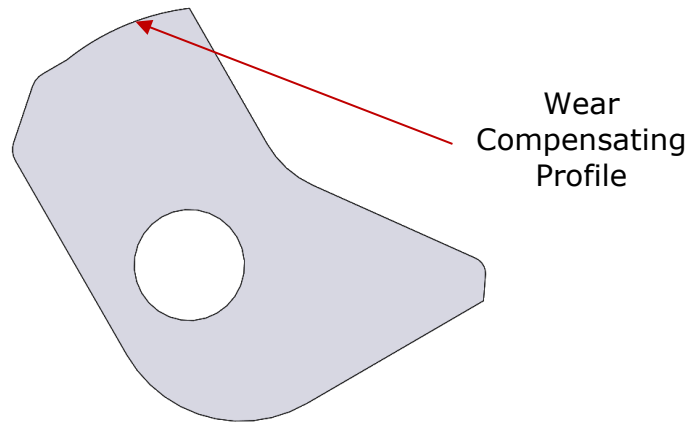
#### 6.3.1 Mechanical Lock Design Feature

The E80 Tool Changer is equipped with a mechanical locking feature (Figure 6.3.1-1) that prevents the cams from retracting when supply air pressure is lost. The mechanical locking feature is a “flat” cut into the profile of the cam and when air pressure is lost, the Tool Side will separate from the Robot Side slightly (~0.6mm) until the pickup dowel on the Tool Side locks into this feature (Figure 6.3.1-2). When the pickup dowel is locked into this feature, the Tool Changer is unable to separate. The spring in the E80 Robot Side piston chamber returns the cams to the extended position (coupled) when air supply to the Tool Changer is lost.

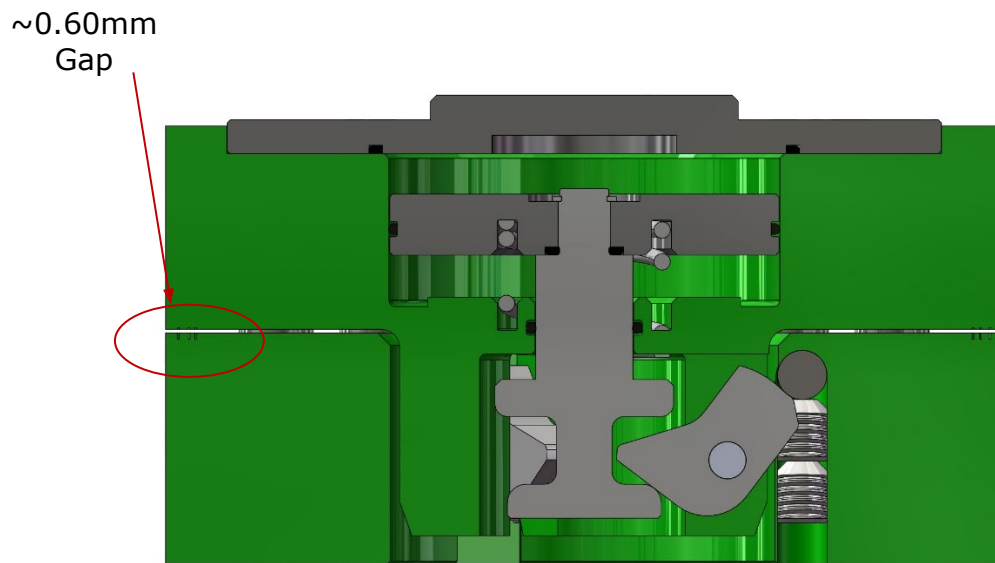
The E80 cam also contains a unique wear compensating profile with a progressive design, allowing for the mechanism to remain effective for the life of the Tool Changer.

Mechanical  
Lock Feature





**Figure 6.3.1-1. E80 Cam Mechanical Lock Feature**



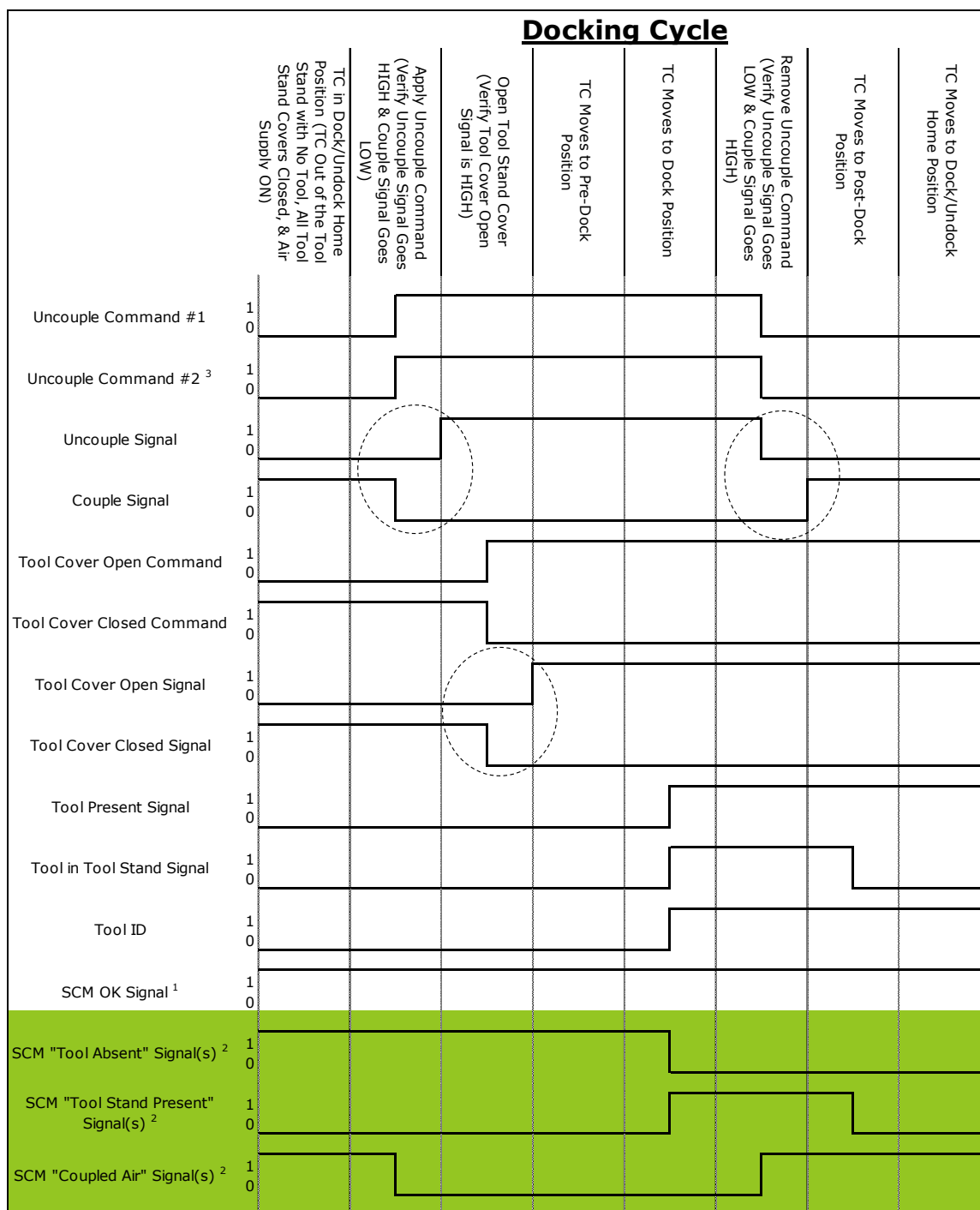
**Figure 6.3.1-2. E80 Robot & Tool Side – Loss of Air Mechanical Lock**

## 6.4 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 6.4-1 and Figure 6.4-2 for a graphical representation of this sequence.



<sup>1</sup> 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 of the SCM User Guide.

<sup>2</sup> Signals (dual channel) are only available via LED's on ARI's Safety Control Module (SCM). Not available for monitoring by the robot controller.

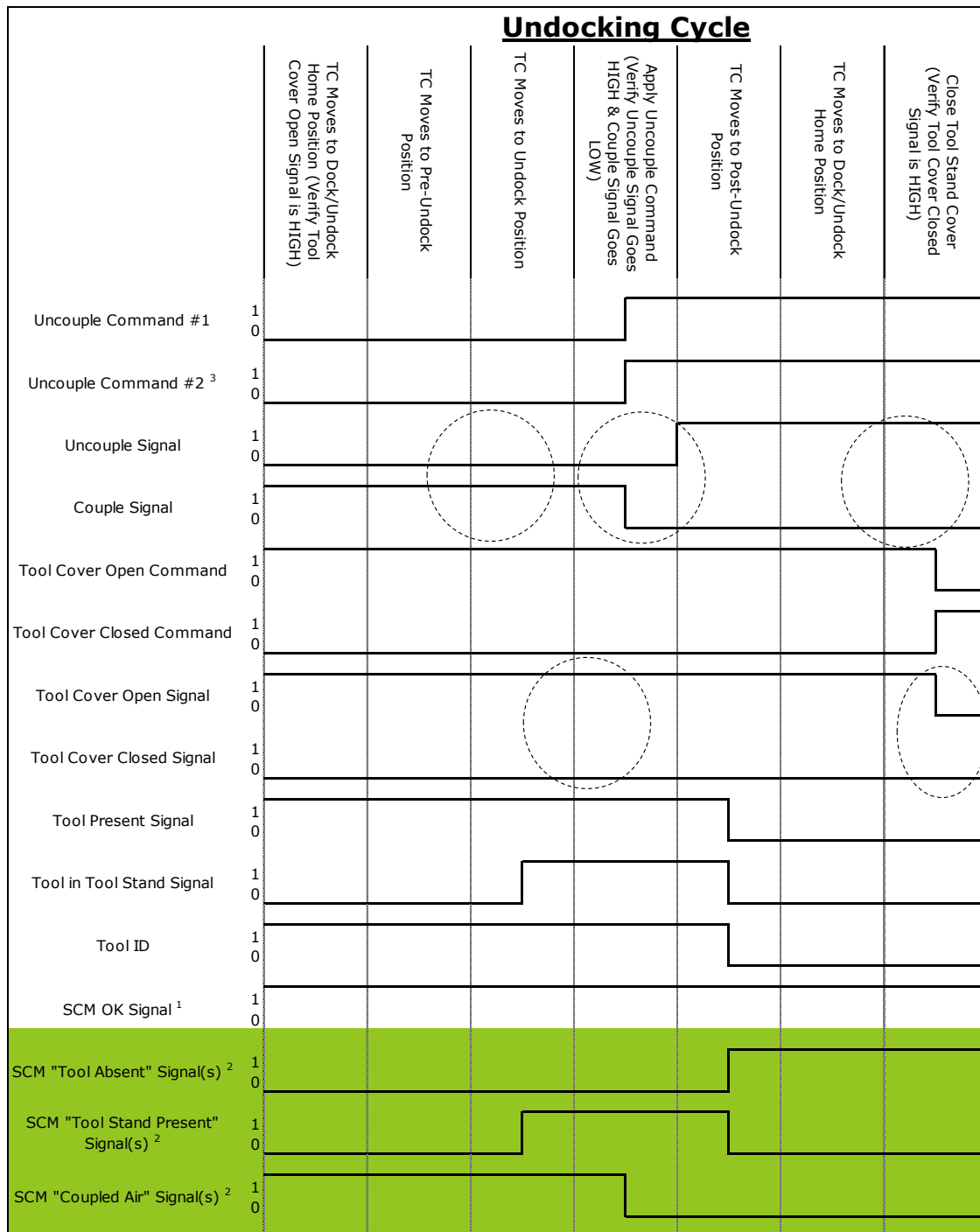
<sup>3</sup> Second Uncouple Command is required when using ARI's Safety Control Module (SCM) and should be applied simultaneously with the first Uncouple Command.

- 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.

**Figure 6.4-1. Sequence of Operations Diagram – Docking Cycle**



<sup>1</sup> 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 of the SCM User Guide.

<sup>2</sup> Signals (dual channel) are only available via LED's on ARI's Safety Control Module (SCM). Not available for monitoring by the robot controller.

<sup>3</sup> 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.

**Figure 6.4-2. Sequence of Operations Diagram – Undocking Cycle**

## 7 TROUBLESHOOTING

### 7.1 TROUBLESHOOTING GUIDE

**Table 7.1-1. 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 has failed                                                                        | Replace sensor puck (See Section 10.1.2)                                                           |
|                                                                   | Cable/Connections supplying signal failed                                                         | Inspect cables/connections and replace if necessary                                                |
| Tool Changer Uncouples, But No Uncoupled Signal is Being Received | Uncoupled sensing has failed                                                                      | Replace sensor puck (See Section 10.1.2)                                                           |
|                                                                   | Cable/Connections supplying signal failed                                                         | Inspect cables/connections and replace if necessary                                                |

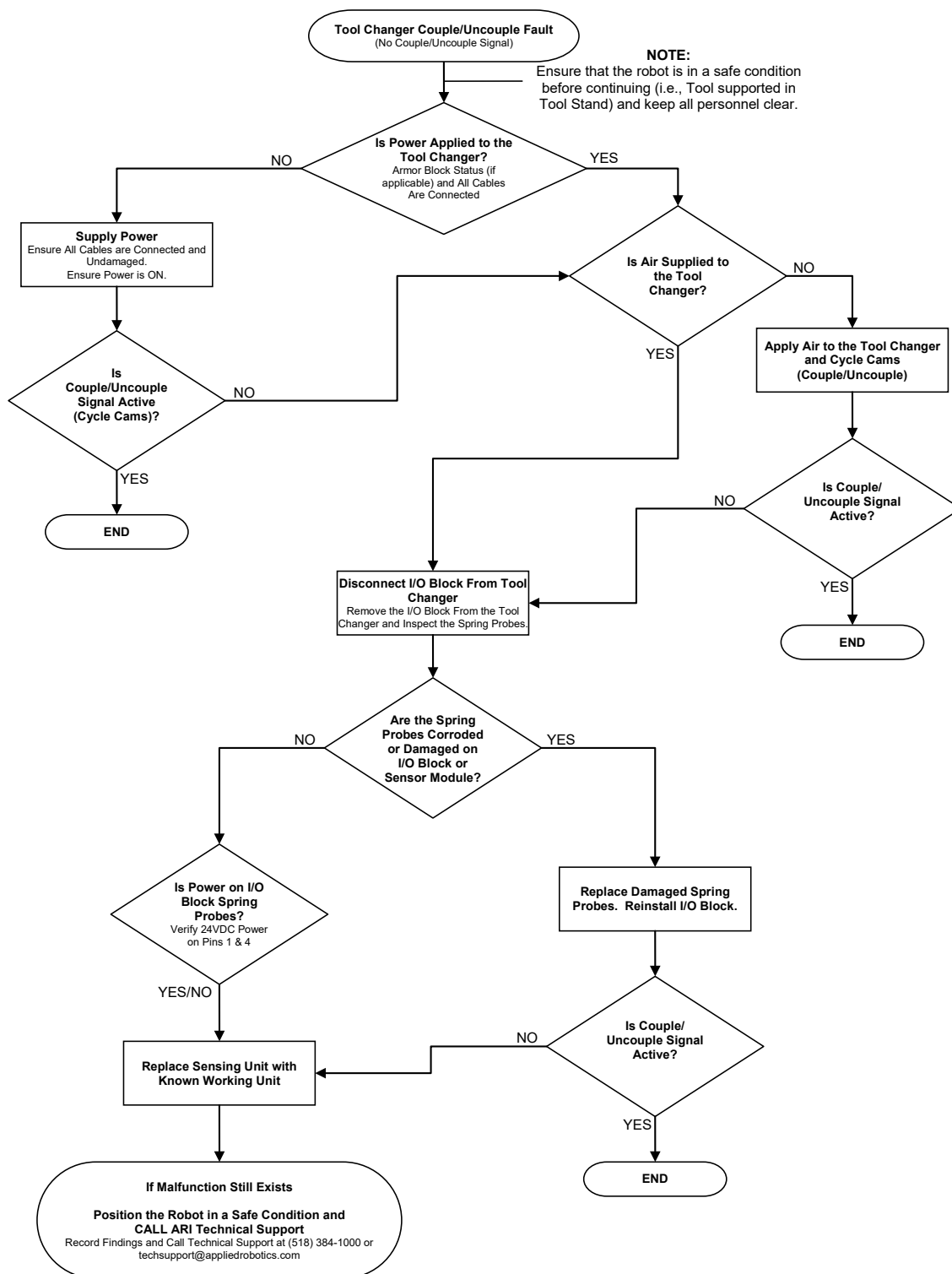
### 7.2 TECHNICAL SUPPORT

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

Phone: +1 518 384 1000  
E-mail: [techsupport@appliedrobotics.com](mailto:techsupport@appliedrobotics.com)

## 7.3 TROUBLESHOOTING FAULT TREE

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



## 7.4 MANUAL UNCOUPLE

A feature has been designed into the E80 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.



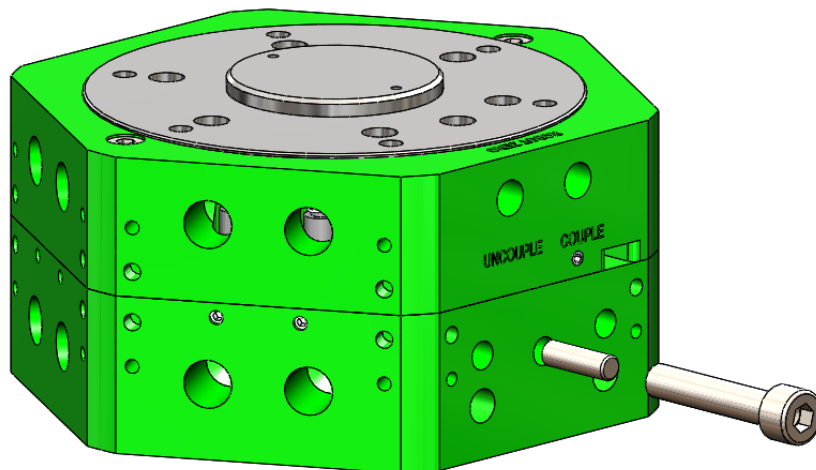
**ENSURE THAT THE ATTACHED TOOLING IS SAFELY SUPPORTED, PREFERABLY IN ITS TOOL STAND.**

The following steps must be followed to ensure that the E80 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.
1. Ensure that all unnecessary personnel are clear of the tooling before going further in this procedure.
2. Shut off the air supply to the actuating cylinder. The cylinder must not be pressurized for this operation to be performed successfully.
3. Insert a 6mm OD x 20mm long shaft followed by a M8x40mm long socket head cap screw in the hole located in the middle Position 1 of the Tool Side Housing as shown in Figure 7.4-1. This requires any tool side modules on Positions 1 to be removed.
4. Drive the M8 screw in until the cams are fully retracted. This action will allow the tool changer to uncouple.



**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**

## 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                                                                 |
| Robot Side | Visual Checks (Section 8.1.2.1) | Visual Checks (Section 8.1.2.1)                                 |                  |                  | 1,000,000 Cycles                                                               |
| Tool Side  | Visual Checks (Section 8.1.2.2) | Lubrication (Section 8.1.1.1) & Visual Checks (Section 8.1.2.2) |                  |                  | Visual Checks (Section 8.1.2.2) & 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                                                               |
| Robot Side | Visual Checks (Section 8.1.2.1) | Visual Checks (Section 8.1.2.1)                                 |                  |                  | 2,000,000 Cycles <sup>2</sup>                                                  |
| Tool Side  | Visual Checks (Section 8.1.2.2) | Lubrication (Section 8.1.1.1) & Visual Checks (Section 8.1.2.2) |                  |                  | Visual Checks (Section 8.1.2.2) & Replace Locating Bushings if Worn or Damaged |

<sup>1</sup> 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).

<sup>2</sup> 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

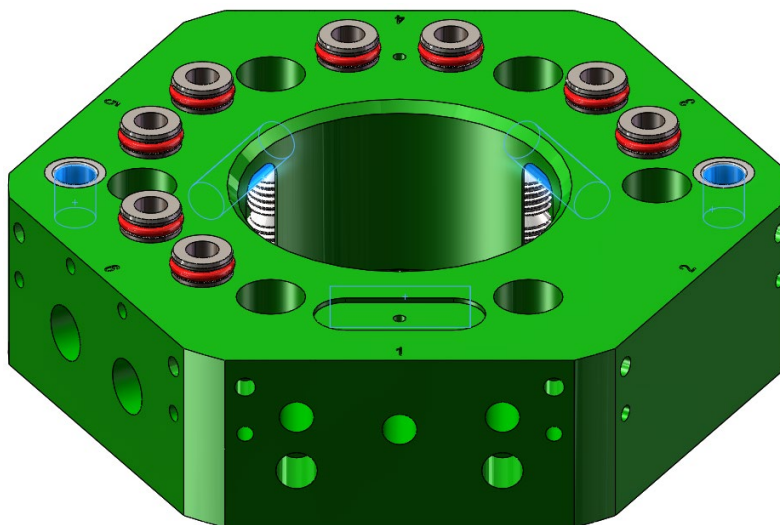
Proper lubrication of wear components is essential to maintaining the performance and prolonging the operational life of the E80 Tool Changer. Failure to apply proper lubrication could result in increased wear and shorten the life expectancy of the Tool Changer. The following lubricants are approved for use on the E80 Tool Changer.

**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 Tool Adapter

1. Clean the inner surface of the tool housing, 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 8.1.1.1-1 with the surfaces highlighted blue.
3. Apply a thin coating of Lub-A-Cyl to the O-ring surfaces on the valve fittings as shown in Figure 8.1.1.1-1 with the surfaces highlighted red.



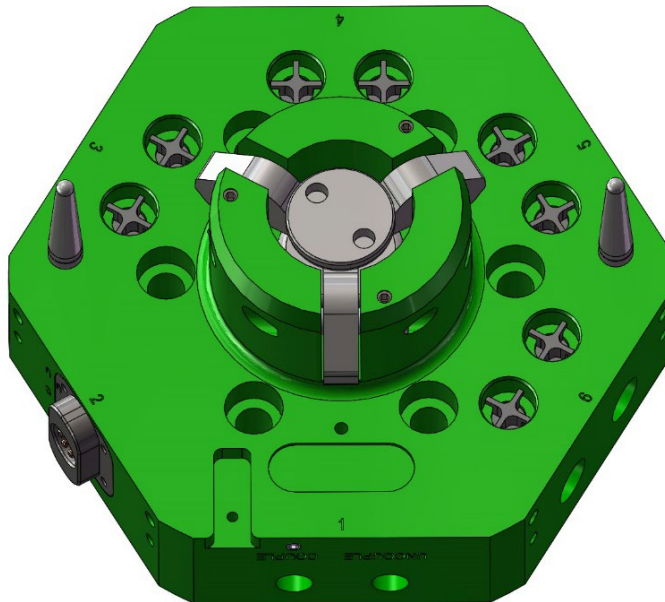
**Figure 8.1.1.1-1. ET100 Tool Side Lubrication**

### 8.1.2 Visual Checks

Periodic visual checks of the E80 Tool Changer provide early detection of breakage or wearing components.

#### 8.1.2.1 Robot Side

1. Inspect the latching cams and locating/alignment pins for rust, breakage, or wear<sup>3</sup>.
2. Inspect the Robot Side mating surface for raised material<sup>4</sup> or dings that could prevent proper mating to the Tool Side.
3. Uncouple the Robot Side from the Tool Side 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.
4. Inspect the poppet valves for damage and depress them to check for smooth operation.



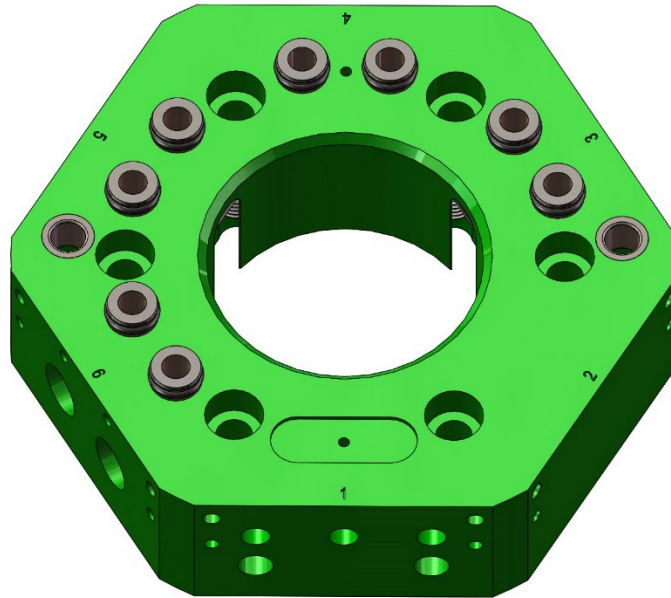
**Figure 8.1.2.1-1. E80 Robot Side Visual Inspection**

<sup>3</sup> If excessive wear is found on the locating/alignment pins, latching cams, or Robot Side mating surface, review the docking and undocking sequence of the robot program and adjust if necessary.

<sup>4</sup> All raised material should be filed smooth.

### 8.1.2.2 Tool Side

1. The locating/alignment bushings and the latching surfaces should be inspected for proper lubrication as defined in Section 8.1.1.1.
2. Inspect the latching surfaces and locating/alignment bushings for rust, breakage, or wear<sup>5</sup>.
3. Inspect the Tool Side mating surface for raised material<sup>6</sup> or dings that could prevent proper mating to the Robot Side.
4. Inspect the air valve fittings for damaged O-rings.



**Figure 8.1.2.2-1. ET100 Tool Side Visual Inspection**

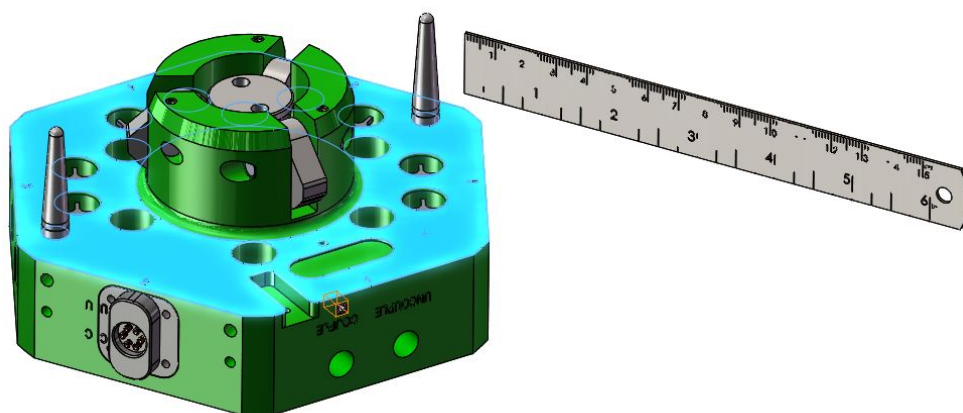
### 8.1.3 Checking Wear of the Cam Locking Mechanism

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 Side and Tool Side to lose repeatability and precision, the following can be used to check the wear of the locking mechanism.

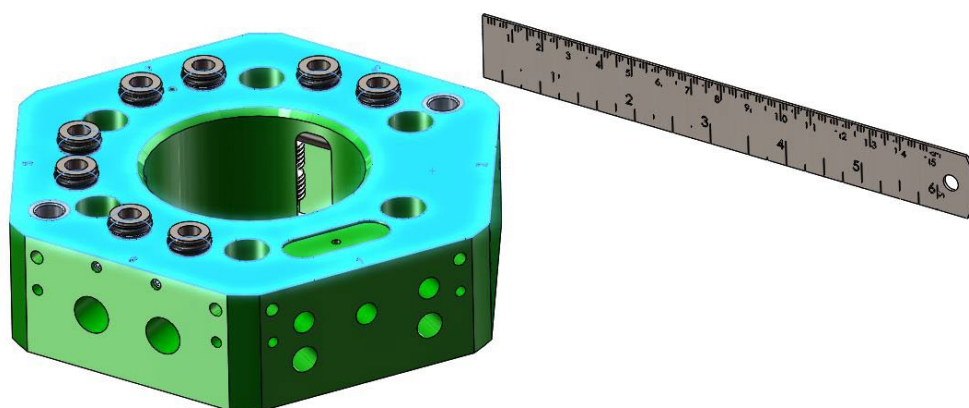
1. Remove the Robot Side from the Robot/Manipulator.
2. Remove the Tool Side from the Tool.
3. With the Sides positioned on a workbench, inspect the mating surfaces of the Robot (Figure 8.1.3-1) and Tool (Figure 8.1.3-2) Sides for any raised material. If any raised material is found, file it smooth before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

<sup>5</sup> If excessive wear is found on the locating/alignment bushings, latching surfaces, or Tool Side mating surface, review the docking and undocking sequence of the robot program and adjust if necessary.

<sup>6</sup> All raised material should be filed smooth.

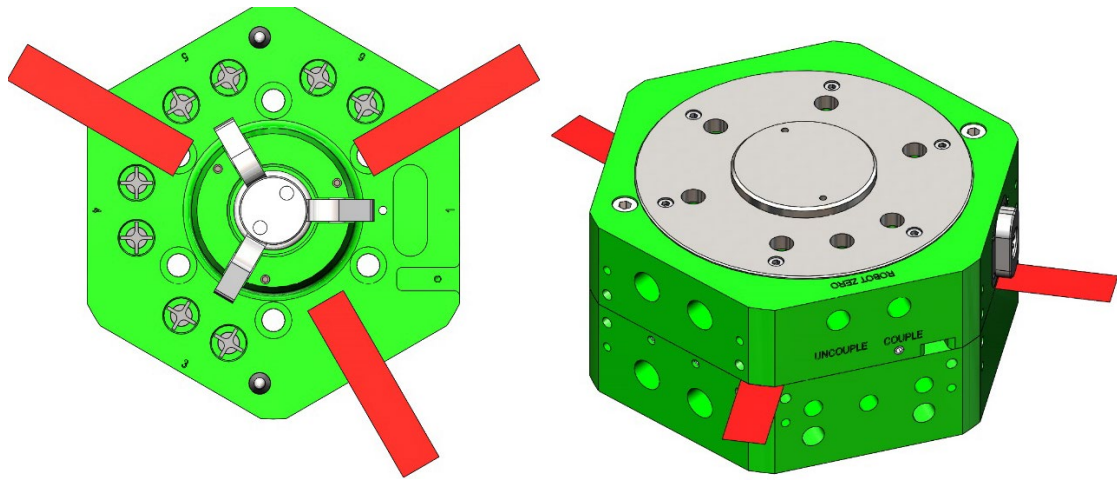


**Figure 8.1.3-1. Robot Side – Raised Material Inspection**



**Figure 8.1.3-2. Tool Side – Raised Material Inspection**

4. Connect the couple and uncouple actuation port lines (Figure 5.3-1) so that the locking mechanism can be manually actuated.
5. With the cams retracted (Figure 6.1-2), position the Robot Side and Tool Side so that they can be coupled together.
6. Place a 0.05mm piece of shim stock at the locations shown in Figure 8.1.3-3, one location at a time.
7. Actuate the cams to couple the Robot Side to the Tool Side (Figure 6.1-1).
8. With a slight tug, check if the piece of shim stock is securely clamped between the Robot Side and Tool Side interface surfaces.
9. Uncouple the Robot Side from the Tool Side.
10. 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 Side and Tool Side and contact APPLIED ROBOTICS Technical Support Department at +1 518 384 1000 or [techsupport@appliedrobotics.com](mailto: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 +1 518 384 1000 or [techsupport@appliedrobotics.com](mailto:techsupport@appliedrobotics.com) to determine the quantity of spares recommended for the size of your installation.

**Table 9-1. Robot Side Spare Parts**

| ROBOT SIDE                         |             |          |
|------------------------------------|-------------|----------|
| Description                        | Part Number | Quantity |
| PIN, LOCATING CXC30                | 96510-B1092 | 2        |
| SUBASSY, PNP MODULE ER80           | 1506-D56A   | 1        |
| POPPET VALVE, E80/100, RBT NYLON   | 1506-C55N   | 8        |
| SPRING, .234 OD X .75 LNG          | 97501-P1047 | 8        |
| O-RING, .208 ID X .07 75 VITON (P) | 86555-P1021 | 8        |

**Table 9-2. Tool Side Spare Parts**

| TOOL SIDE                    |             |          |
|------------------------------|-------------|----------|
| Description                  | Part Number | Quantity |
| DOWEL, M8 X 24 (HARD STL) m6 | 90509-P1038 | 3        |
| BUSHING, LOCATING            | 97501-P1050 | 2        |
| FITTING, KSV ET80/100        | 1506-C99N   | 8        |
| O-RING                       | 83908-P1134 | 16       |

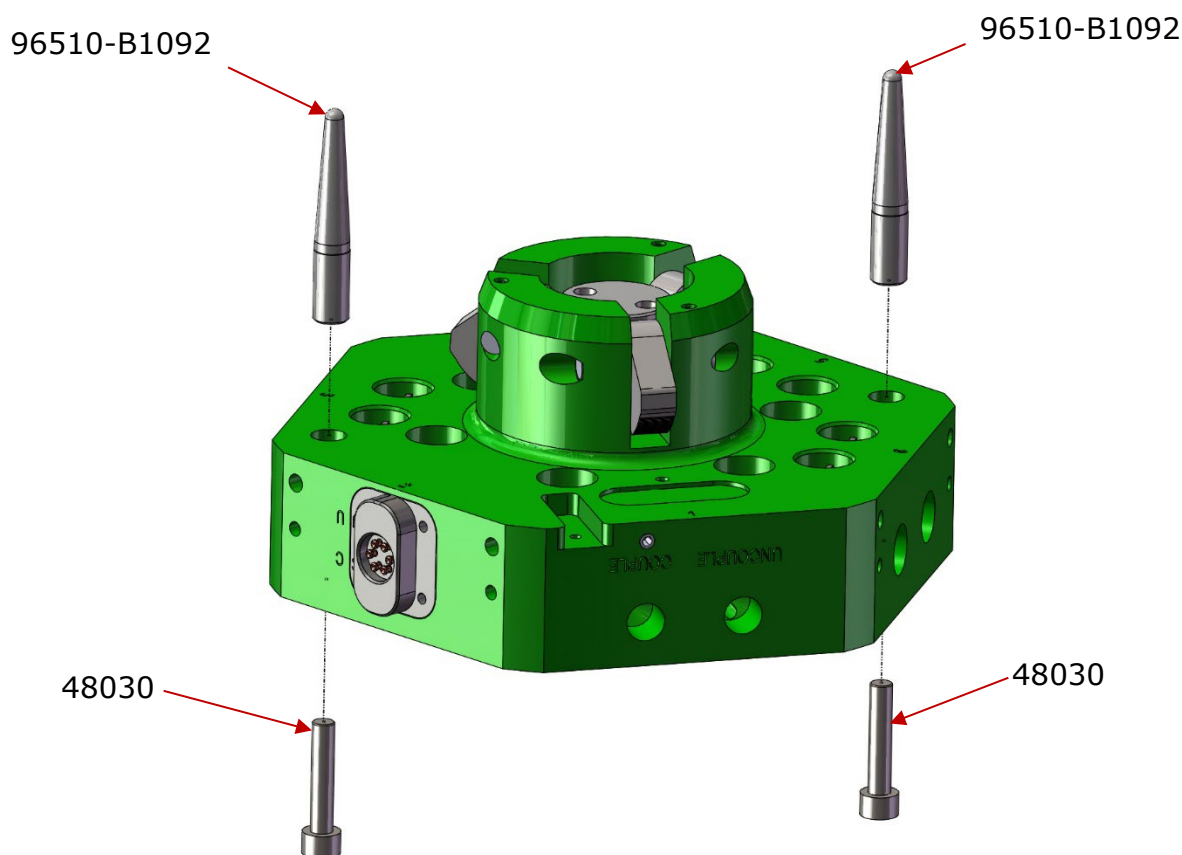
## 10 SPARE PARTS REPLACEMENT

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 SIDE

#### 10.1.1 Locating/Alignment Pins

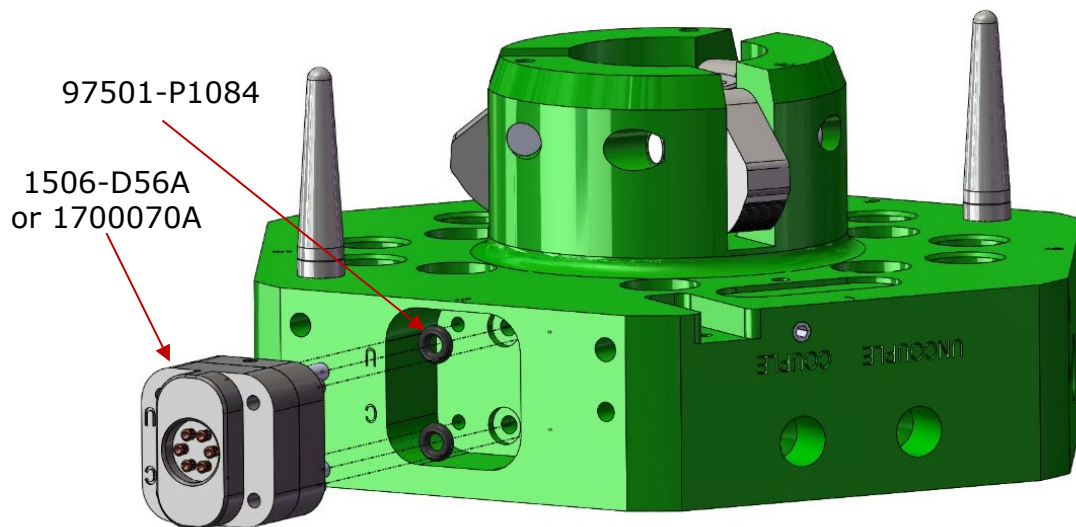
1. Remove the Robot Side from the Robot/Manipulator.
2. Remove the M5 socket head cap screw (48030) using a 4mm Allen wrench.
3. Remove round Locating Pin(s) (96510-B1092). Locating/Alignment Pins may need to be punched out.
4. Place new Locating Pin into the appropriate mounting hole (Figure 10.1.1-1).
5. Apply Loctite 242, or equivalent, to M5 socket head cap screws removed in Step 2 (Clean threads before applying thread locker) and thread it into the Locating Pin from the top side of the Robot Side Housing. Tighten until Locating Pins are no longer pulled into holes and do not rotate.



**Figure 10.1.1-1. Locating/Alignment Pin Replacement**

### 10.1.2 Couple/Uncouple Sensing Module

1. Remove the module from Side 2.
2. Loosen the captivated socket head cap screws holding the Sensing Module using a 2.5mm Allen wrench.
3. Remove the Sensing Module (1506-D56A or 1700070A) 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 Side 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 captivated socket head cap screws before installing.
8. Install the new Sensing Module using the captivated socket head cap screws.
9. Reinstall module removed from Side 2 in Step 1.
10. Prior to coupling the Tool Changer, cycle the actuating cylinder for the Robot Side several times to ensure that the sensors are working properly and the correct inputs are being received by the robot controller.



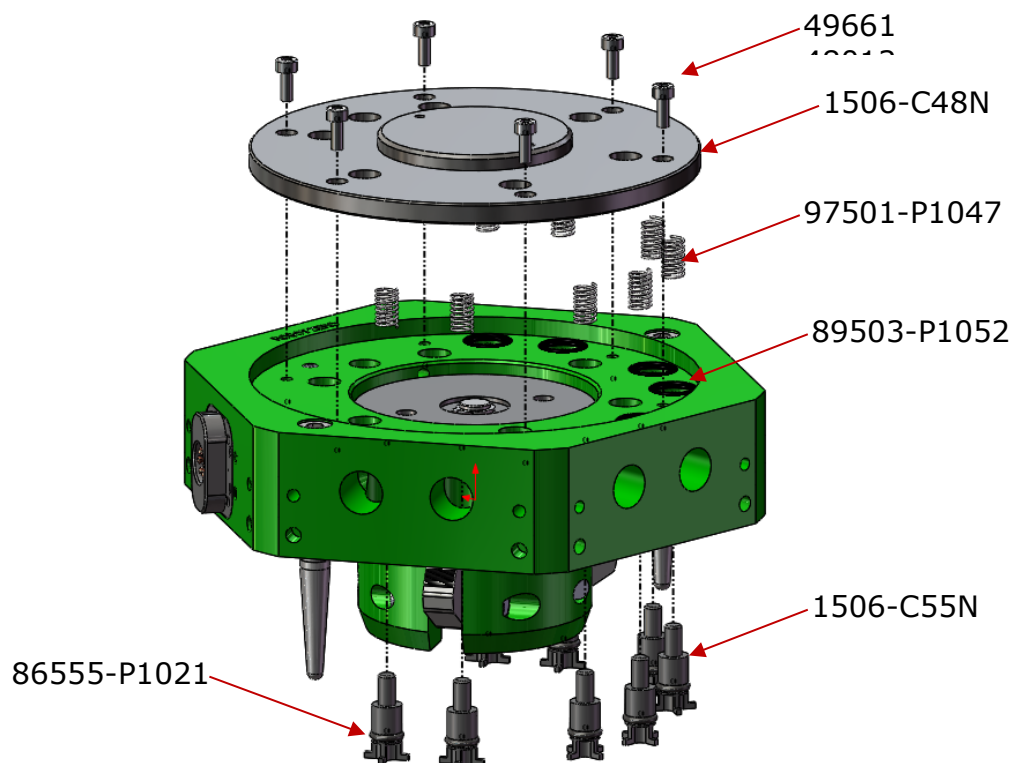
**Figure 10.1.2-1. Couple/Uncouple Sensing Module Replacement**

## 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.**

### 10.1.3 Poppet Valves

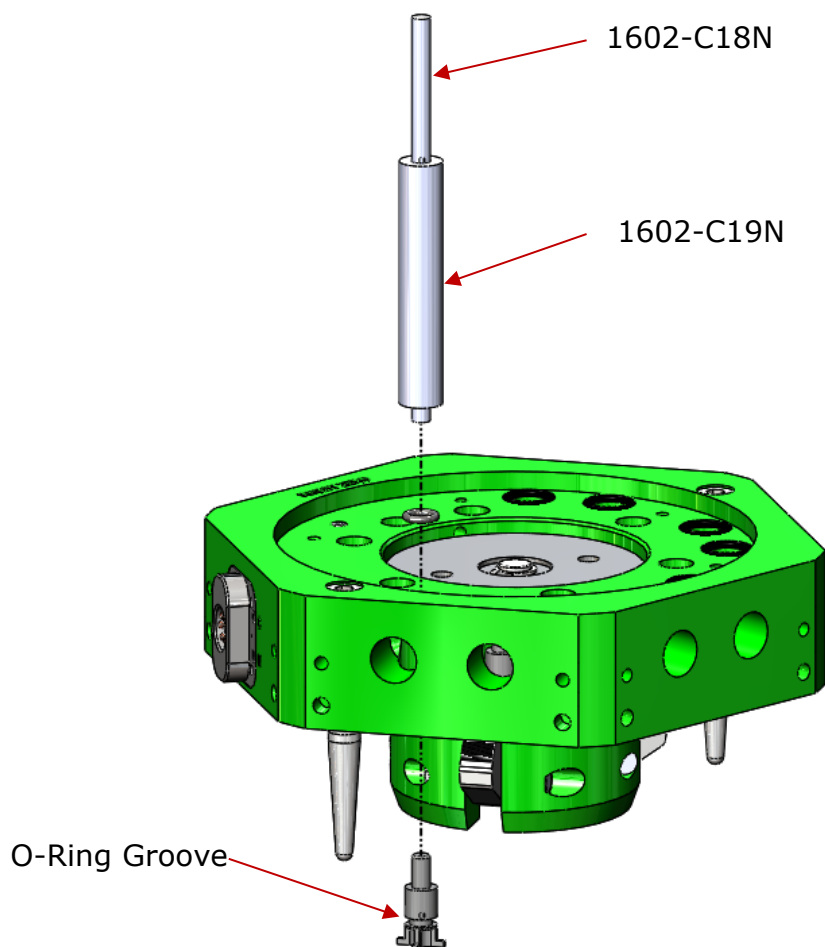
1. Remove the Robot Side from the Robot/Manipulator.
2. Remove the M3 socket head cap screws (48012) that hold the Robot Side Cap (1506-C48N) down, using a 2.5mm Allen wrench.
3. Remove the spring(s) (97501-P1047) and discard.
4. Using a punch, drive the Poppet Valve(s) (1506-C55N) through the front face of the Robot Side (Figure 10.1.3-1). Note that this step will likely destroy the Poppet Valve and O-ring (86555-P1021). Discard the valve and O-ring after removal.



**Figure 10.1.3-1. Poppet Valve Removal**

5. After the Poppet Valve(s) have been removed, install the new poppet valve(s) by inserting the Poppet Valve (1506-C55N) through the front face of the Robot Side.
6. To install the O-ring onto the Poppet Valve, use APPLIED ROBOTICS assembly tool (1602-C18N & 1602-C19N). Apply a thin layer of Lub-A-Cyl to the O-ring and place the O-ring over the assembly tool bar and slide it over the back side of the Poppet Valve.
7. Using the assembly tool tube, slide the O-ring off of the bar and onto the Poppet Valve. Ensure that the O-ring is properly installed in the O-ring groove of the Poppet Valve (Figure 10.1.3-2).
8. Place a new spring (97501-P1047) over the Poppet Valve.
9. Reinstall the Robot Side Cap. Apply a thin layer of Lub-A-Cyl to the O-ring (89503-P1052) and ensure that it is installed before installing the Robot Side Cap.

10. Apply Loctite 242, or equivalent, to M3 socket head cap screws removed in Step 2 (Clean threads before applying thread locker) and tighten.

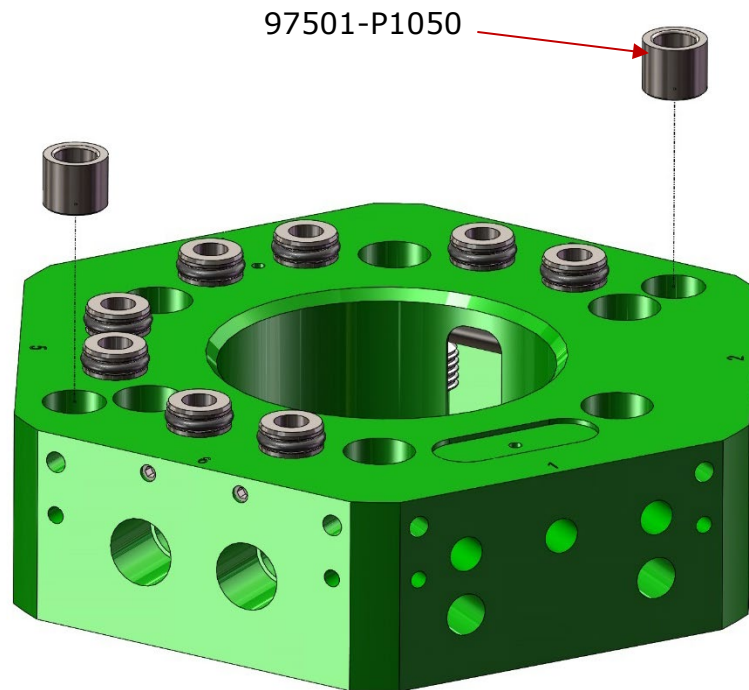


**Figure 10.1.3-2. Poppet Valve Installation**

## 10.2 TOOL SIDE

### 10.2.1 Locating Bushing

1. Remove the Tool Side from the Tool.
2. Press out the Locating Bushings (97501-P1050) from the bottom of the Tool Side Housing.
3. Press in new Locating Bushings from the top of the Tool Side Housing until it is just below the Tool Side Housing surface. Ensure that the rounded edge of the Locating Bushing faces the top surface of the Tool Side Housing.
4. Lubricate the Locating Bushing per Section 8.1.1.1.



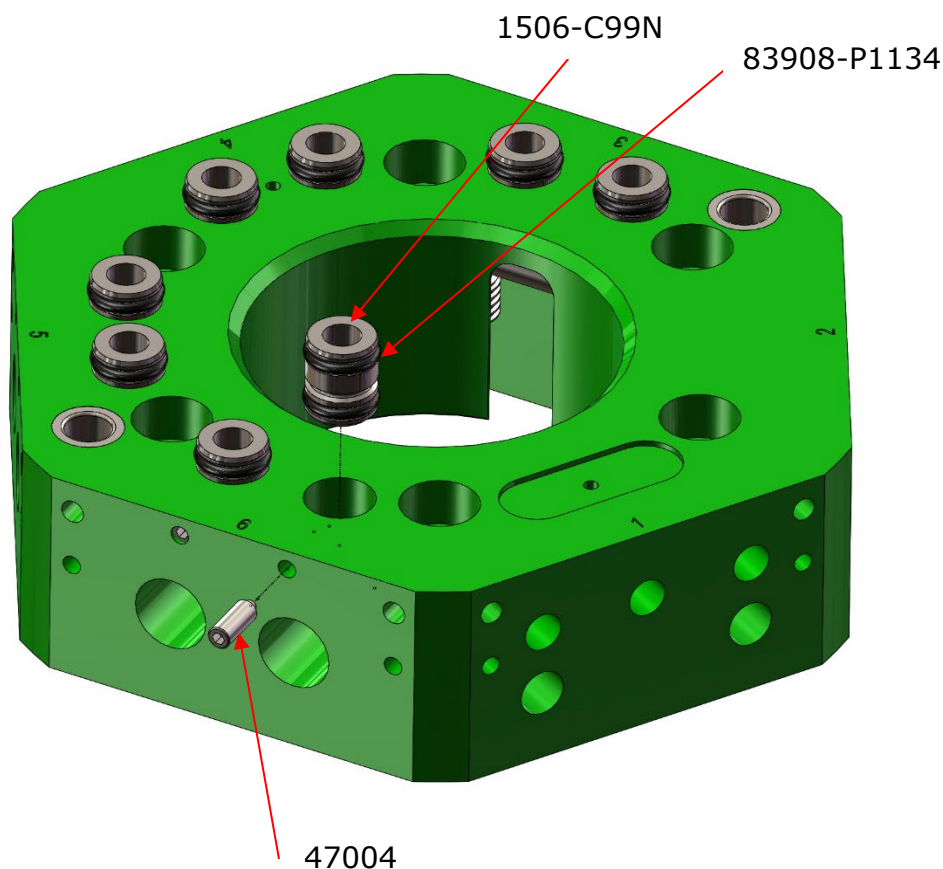
**Figure 10.2.1-1. Locating Bushing Replacement**

### 10.2.2 Air Valve Fitting

1. Remove the set screw (47004) and pull out the valve fitting (1506-C99N).
2. Replace the (2) O-rings (83908-P1134), set screw and or valve fitting if necessary.
3. Apply a thin layer of Lub-A-Cyl to both O-rings.
4. Push the valve fitting assembly (valve fitting and O-rings) into the valve fitting hole by hand until it bottoms out in the hole. Ensure the proper orientation of the valve fitting as shown in Figure 10.2.2-1.
5. Apply Loctite 222, or equivalent, with primer to the set screw before installation.
6. Install set screw.

## NOTICE

**M4X12 SET SCREWS HAVE A  
RECOMMENDED TORQUE OF  
0.7 Nm (6 in-lb).**



**Figure 10.2.2-1. Air Valve Fitting Replacement**

## 11 INFORMATIONAL DOCUMENTS

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.

| DECLARATIONS                                                                                                  |
|---------------------------------------------------------------------------------------------------------------|
| <ul style="list-style-type: none"> <li>Declaration of Incorporation for Partly Completed Machinery</li> </ul> |

| DRAWINGS       |                            |
|----------------|----------------------------|
| DRAWING NUMBER | DESCRIPTION                |
| 1607-D08A      | ER80-N/A-050-N-0-C0000     |
| 1506-D45A      | ER80-PNP-050-N-0-C0000     |
| 1700070A       | ER80-PM12-050-N-0-C0000    |
| 1506-D59A      | ET100-063-N-C0000          |
| 1800885A       | ER80-N/A-050-N-0-PP-C0000  |
| 1800886A       | ER80-PNP-050-N-0-PP-C0000  |
| 1800887A       | ER80-PM12-050-N-0-PP-C0000 |
| 1800891A       | ET100-063-N-PP-C0000       |

## **Declaration of Incorporation of Partly Completed Machinery (Annex II 1 B of EC Machinery Directive 2006/42/EC)**

Description and identification of the partly completed machinery:

XChange – EPSILON Series Tool Changers & Utility Modules

Fulfills the following function:

Allows industrial robots (and other automated equipment) to automatically change their end of arm tooling under programmed control without the need of human intervention. These products are intended to be incorporated into machinery supplied by others.

The following essential requirements of EC Machinery Directive 2006/42/EC (Annex I) have been applied and fulfilled:

|                 |                                                                  |
|-----------------|------------------------------------------------------------------|
| Section 1.1.2.  | Principles of safety integration                                 |
| Section 1.1.3.  | Materials and products                                           |
| Section 1.1.5.  | Design of machinery to facilitate its handling                   |
| Section 1.2.1.  | Safety and reliability of control systems                        |
| Section 1.2.6.  | Failure of the power supply                                      |
| Section 1.3.2   | Risk of break-up during operation                                |
| Section 1.3.3.  | Risks due to falling or ejected objects                          |
| Section 1.3.4.  | Risks due to surfaces, edges or angles                           |
| Section 1.3.7.  | Risks related to moving parts                                    |
| Section 1.3.9.  | Risks of uncontrolled movements                                  |
| Section 1.5.1.  | Risks due to electricity supply                                  |
| Section 1.5.3.  | Risks due to energy supply other than electricity (air pressure) |
| Section 1.5.8.  | Risks due to noise                                               |
| Section 1.5.10. | Risks due to non-ionizing radiation                              |
| Section 1.6.4.  | Operator intervention                                            |
| Section 1.7.1.  | Information and warnings on the machinery                        |
| Section 1.7.2.  | Warning of residual risks                                        |
| Section 1.7.3.  | Marking of machinery                                             |
| Section 1.7.4.  | Instructions.                                                    |

The partly completed machinery has been designed and manufactured according to the following harmonized standards:

|                |                                                                                                            |
|----------------|------------------------------------------------------------------------------------------------------------|
| EN ISO 12100-1 | Safety of machinery - Basic concepts, general principles for design Part 1: Basic terminology, methodology |
| EN ISO 12100-2 | Safety of machinery - Basic concepts, general principles for design Part 2: technical principles           |

|                |                                                                                                                           |
|----------------|---------------------------------------------------------------------------------------------------------------------------|
| EN ISO 10218-2 | Robots and robotic devices — Safety requirements for industrial robots — Part 2: Robot systems and integration            |
| EN ISO 60204-1 | Safety of machinery. Electrical equipment of machines. General requirements                                               |
| EN 61000-6-2   | Electromagnetic compatibility (EMC) - Generic standards. Immunity for industrial environments                             |
| EN 61000-6-4   | Electromagnetic compatibility (EMC) - Generic standards. Emission standard for industrial environments                    |
| EN 61000-4-2   | Electromagnetic compatibility (EMC). Testing and measurement techniques. Electrostatic discharge immunity test            |
| EN 61010-1     | Safety requirements for electrical equipment for measurement, control, and laboratory use -- Part 1: General requirements |

The relevant technical documentation has been compiled in accordance with Annex VII, Part B of EC Machinery Directive 2006/42/EC. We undertake, in response to a reasoned request, to supply it in electronic form to the market surveillance authorities within a reasonable period.

The party authorized to compile the technical documentation is:

Giovanni Patrini, at Effecto Group SpA

The partly completed machinery must not be put into service until the final machinery into which it is to be incorporated has been declared in conformity with the provisions of the Machinery Directive.

  
Stefan Casey  
Vice President, Engineering

APRIL 20, 2018  
Date

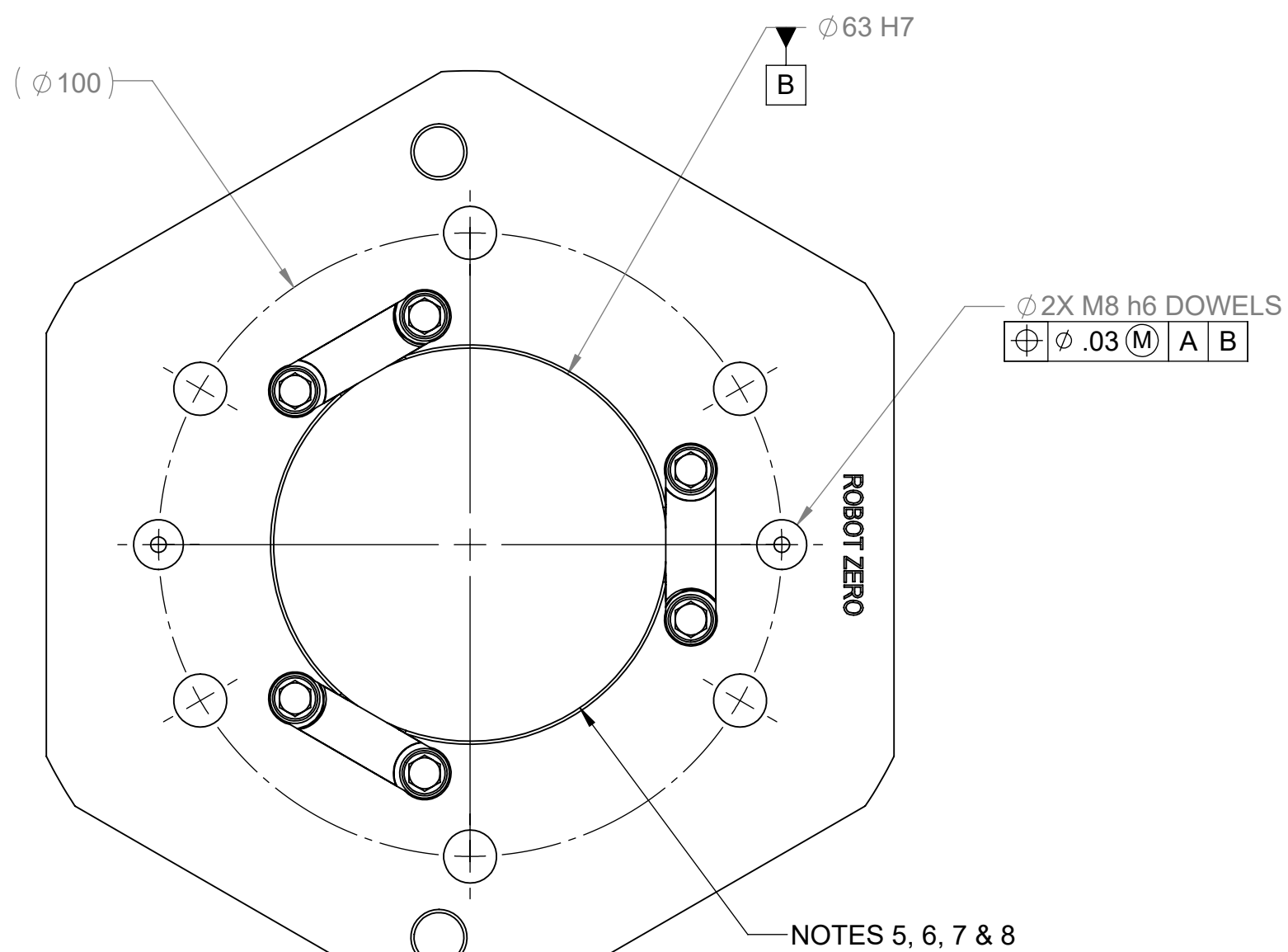
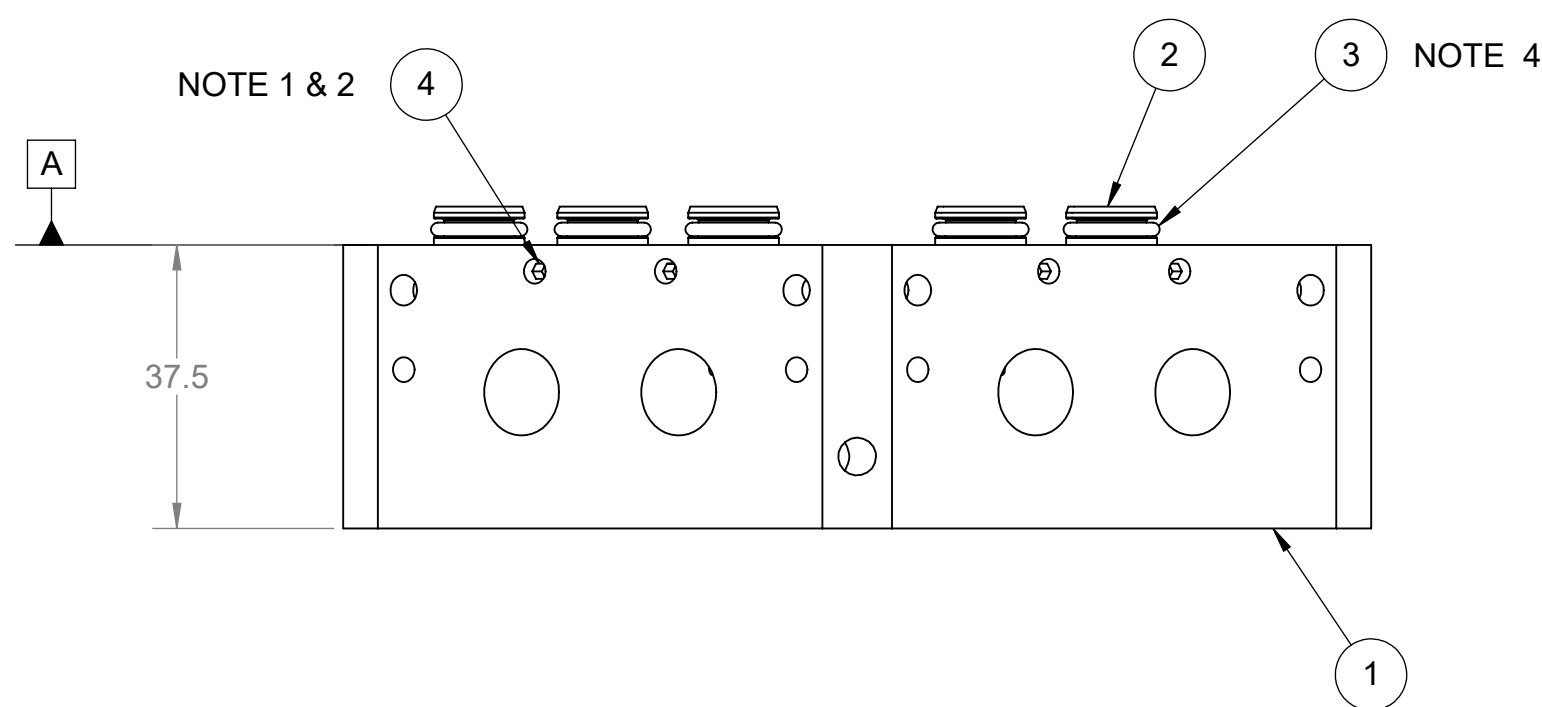
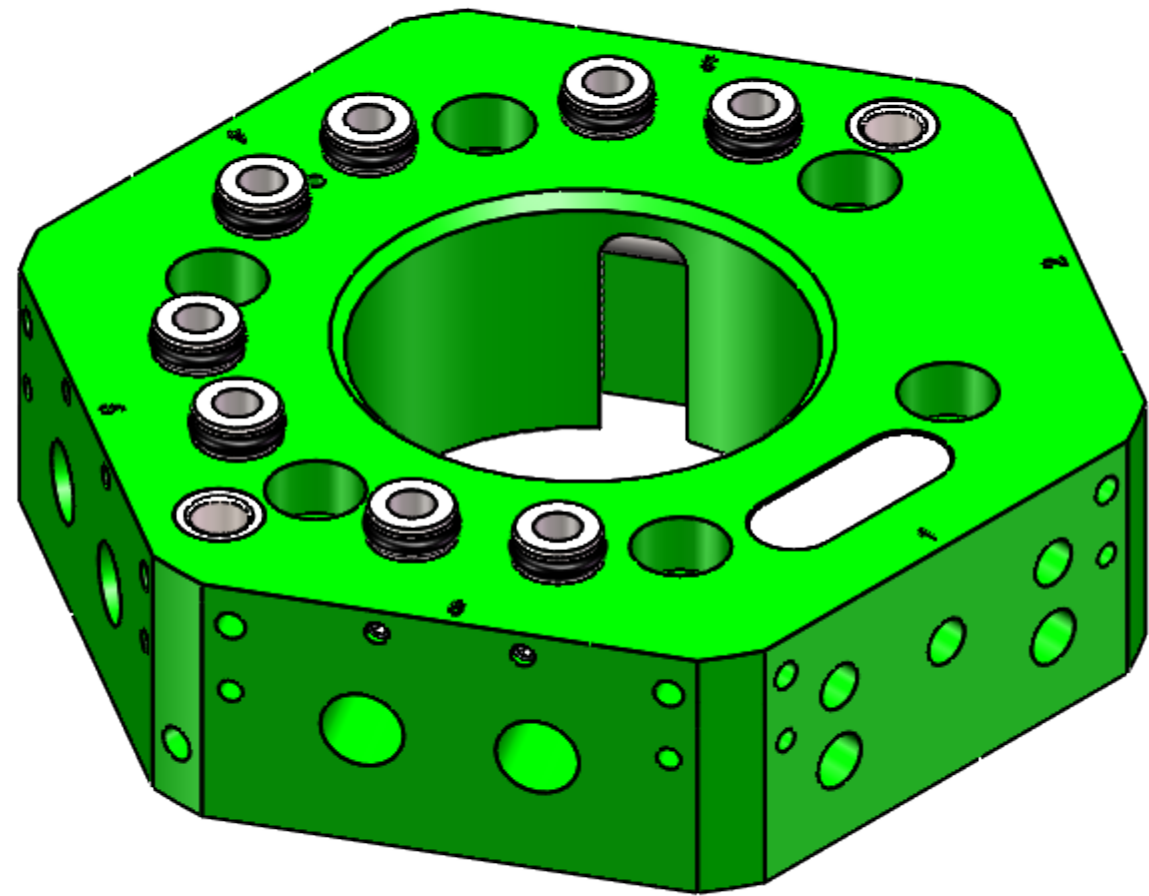
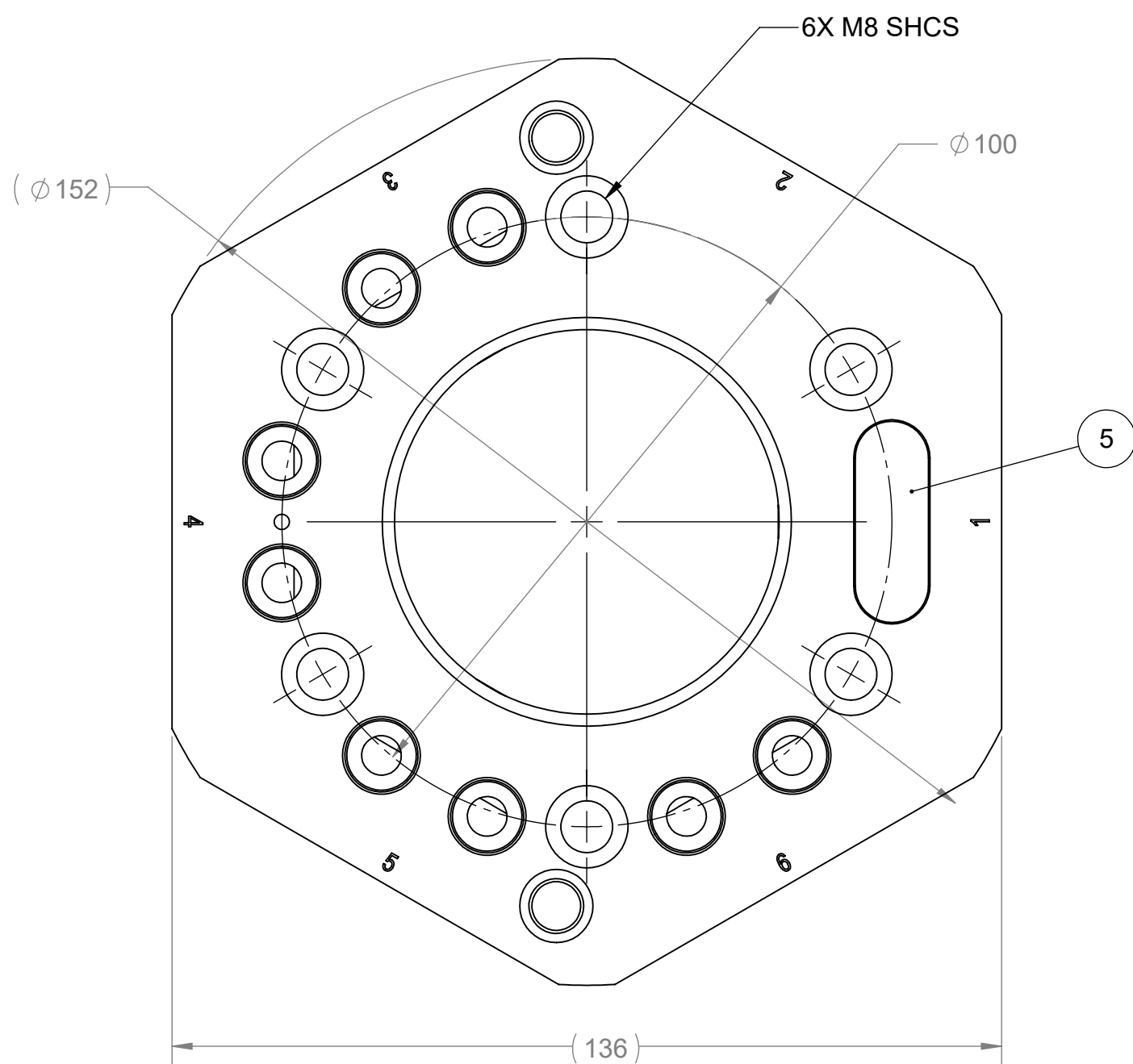






|                  |                                    |                  |
|------------------|------------------------------------|------------------|
| SIZE<br><b>D</b> | DRAWING NUMBER<br><b>1506-D59A</b> | REV<br><b>01</b> |
|------------------|------------------------------------|------------------|

| REVISIONS |     |                             |    |     |            |             |
|-----------|-----|-----------------------------|----|-----|------------|-------------|
| ZONE      | REV | DESCRIPTION                 | DR | CHK | DATE       | ECR/ESR NO. |
|           | 00  | RELEASE FOR MANUFACTURE.    | JV | SA  | 3/30/2016  | EMIN-87JKUZ |
|           | 01  | UPDATED 1601-D26A TO REV 02 | PS | JV  | 10/10/2018 | PSLI-B46MYF |



|          |     |             |                                      |
|----------|-----|-------------|--------------------------------------|
| 5        | 1   | 1600-P57N   | LABEL, ARI NAMEPLATE 12X33           |
| 4        | 8   | 47004       | SCR, SOC SET M4 X 12 (SS) CONE POINT |
| 3        | 16  | 83908-P1134 | O-RING, .364 ID X .07 75 VITON       |
| 2        | 8   | 1506-C99N   | FITTING, KSV ET80/100,               |
| 1        | 1   | 1601-D26A   | SUBASSY, ET100                       |
| ITEM NO. | QTY | PART NO.    | DESCRIPTION                          |

|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |                                                                                                          |                                                     |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------|-----------------------------------------------------|
| THIRD ANGLE PROJECTION                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | METRIC                                                                                                   | DR: J. VALLELUNGA                                   |
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|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | UNTOLERANCED DIMS ARE BASIC:                                                                             | ENG: J. DELMONACO                                   |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | $\pm .025 \text{ A B C}$                                                                                 | QC: C. BEST                                         |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | $\pm .025 \text{ M A B C}$                                                                               | MFG: M. DUDNATH                                     |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | ALL HOLE DIAMETERS +0 -0.25<br>INTERNAL RADII & BROKEN EDGES TO BE .13-.38<br>ALL SURFACE FINISHES 1.6Ra | TITLE:<br><br>ET100-063-N-C0000                     |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | MAT'L:<br>Material <not specified>                                                                       | SCALE: 1:1<br>DO NOT SCALE DRAWING                  |
| SURFACE TREATMENT:<br>-                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | ISO 9001 REGISTERED                                                                                      | SIZE D<br>DRAWING NUMBER 1506-D59A<br>REV 01        |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |                                                                                                          | WEIGHT: 1.24 kg    RoHS COMPLIANT: -    SHT. 1 OF 1 |

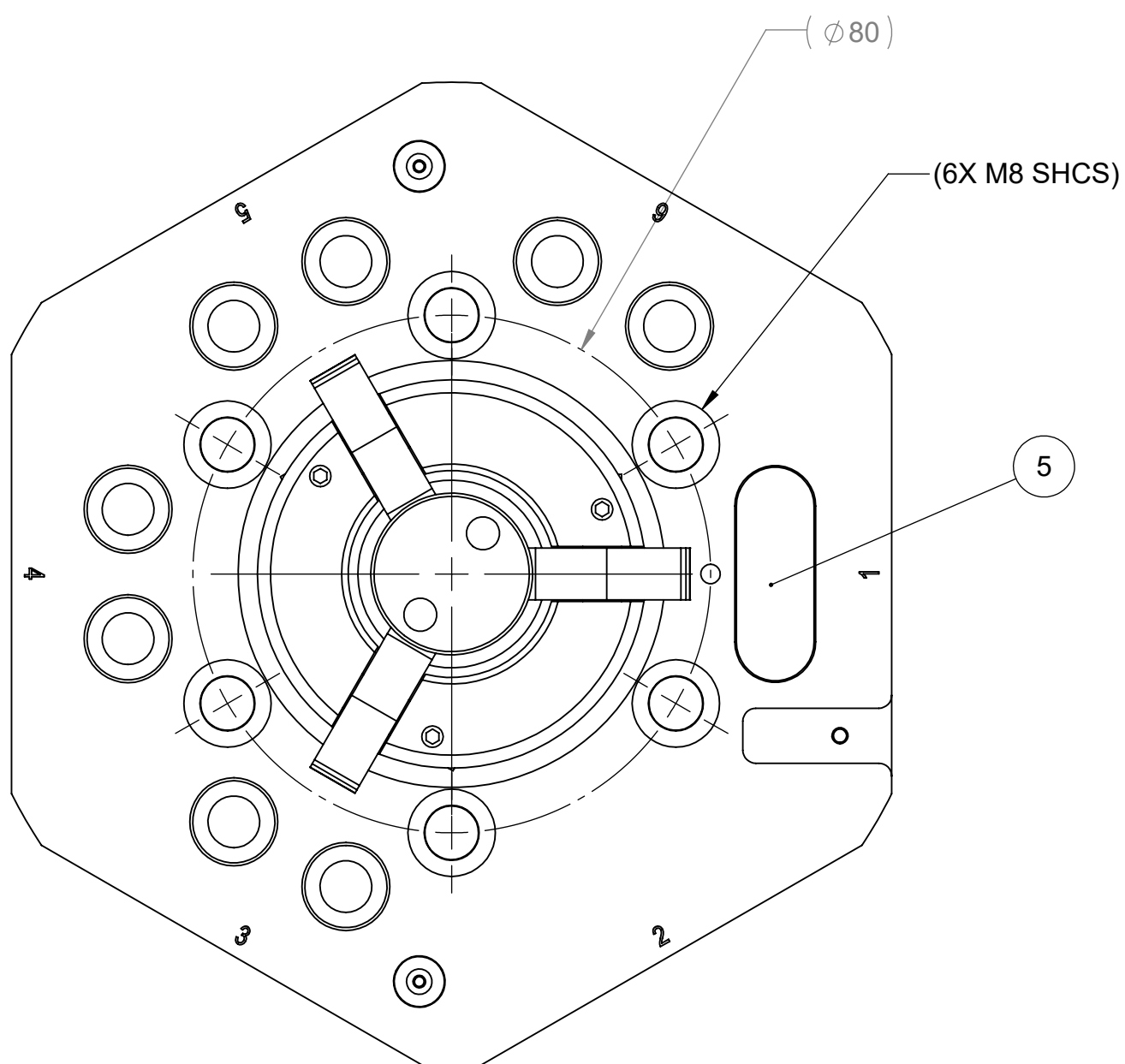
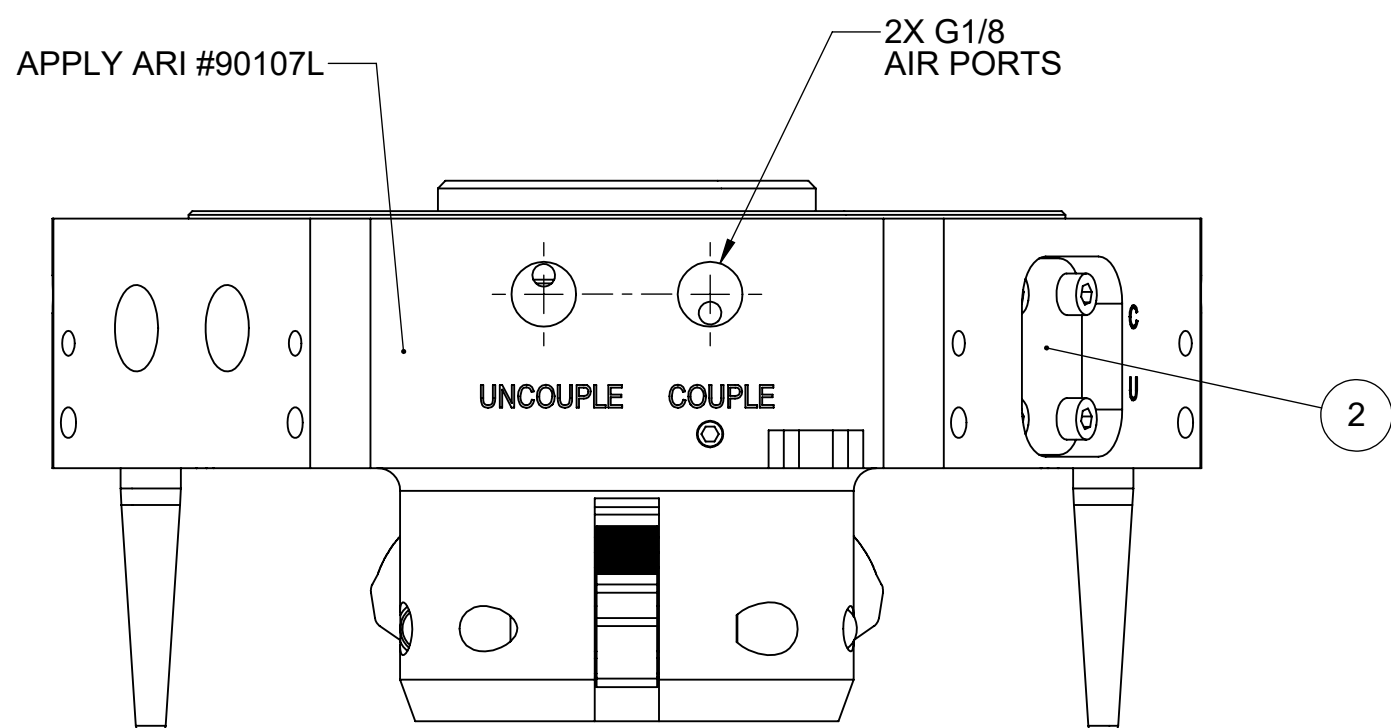
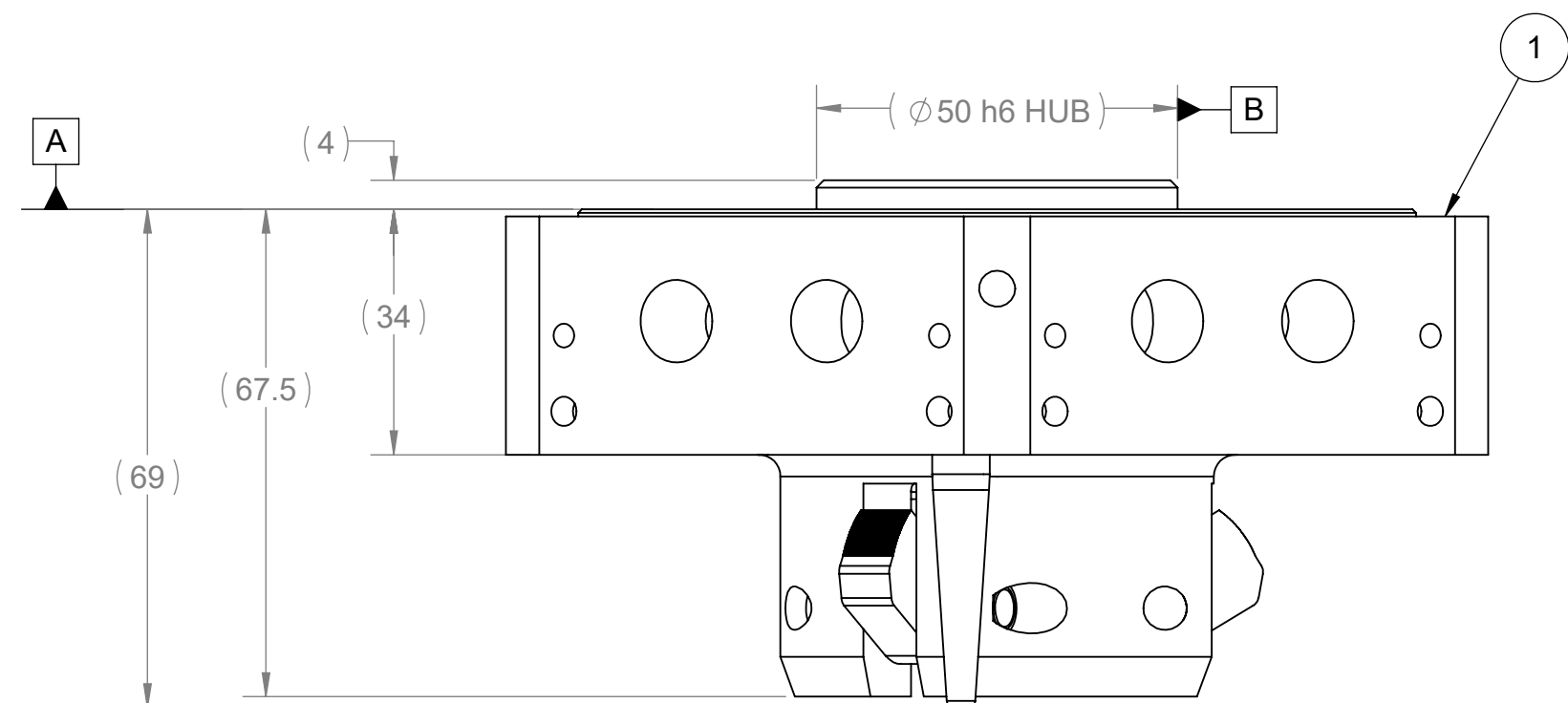
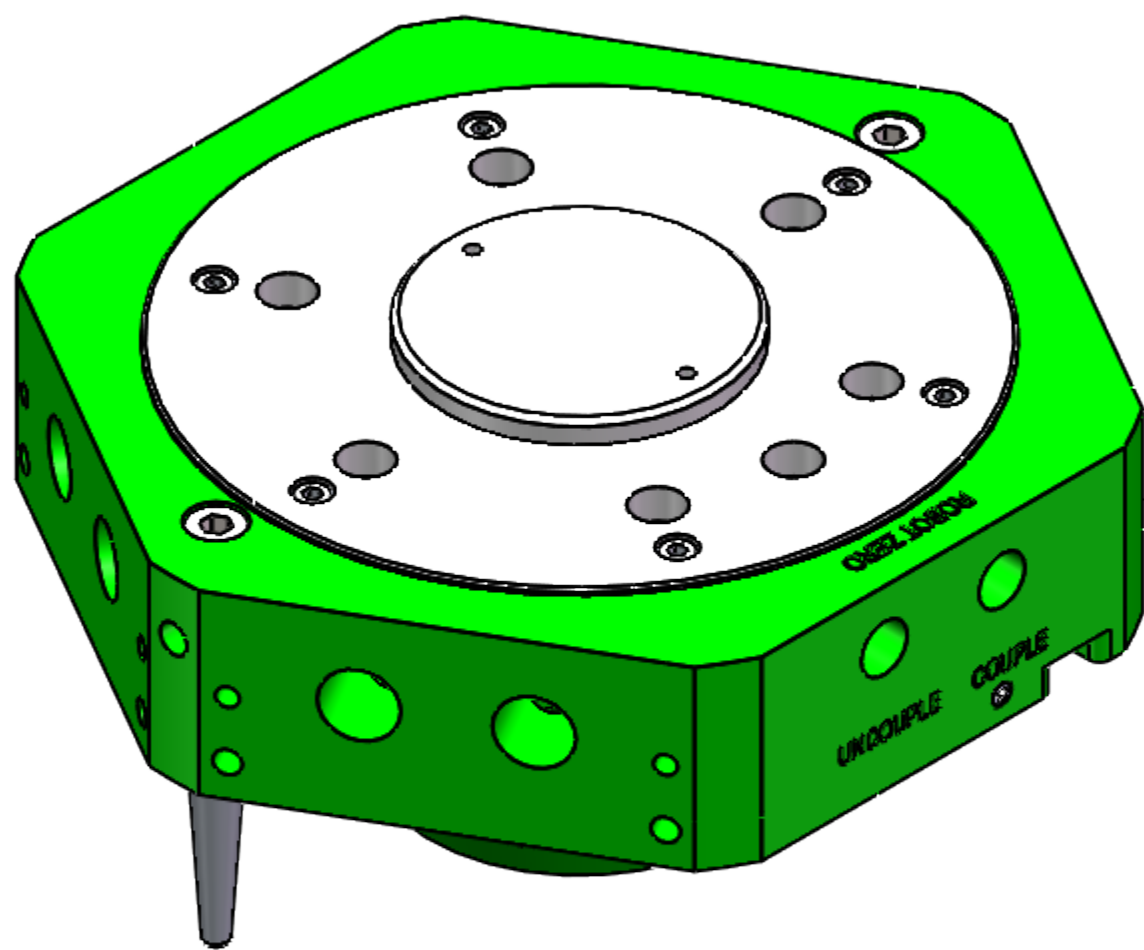
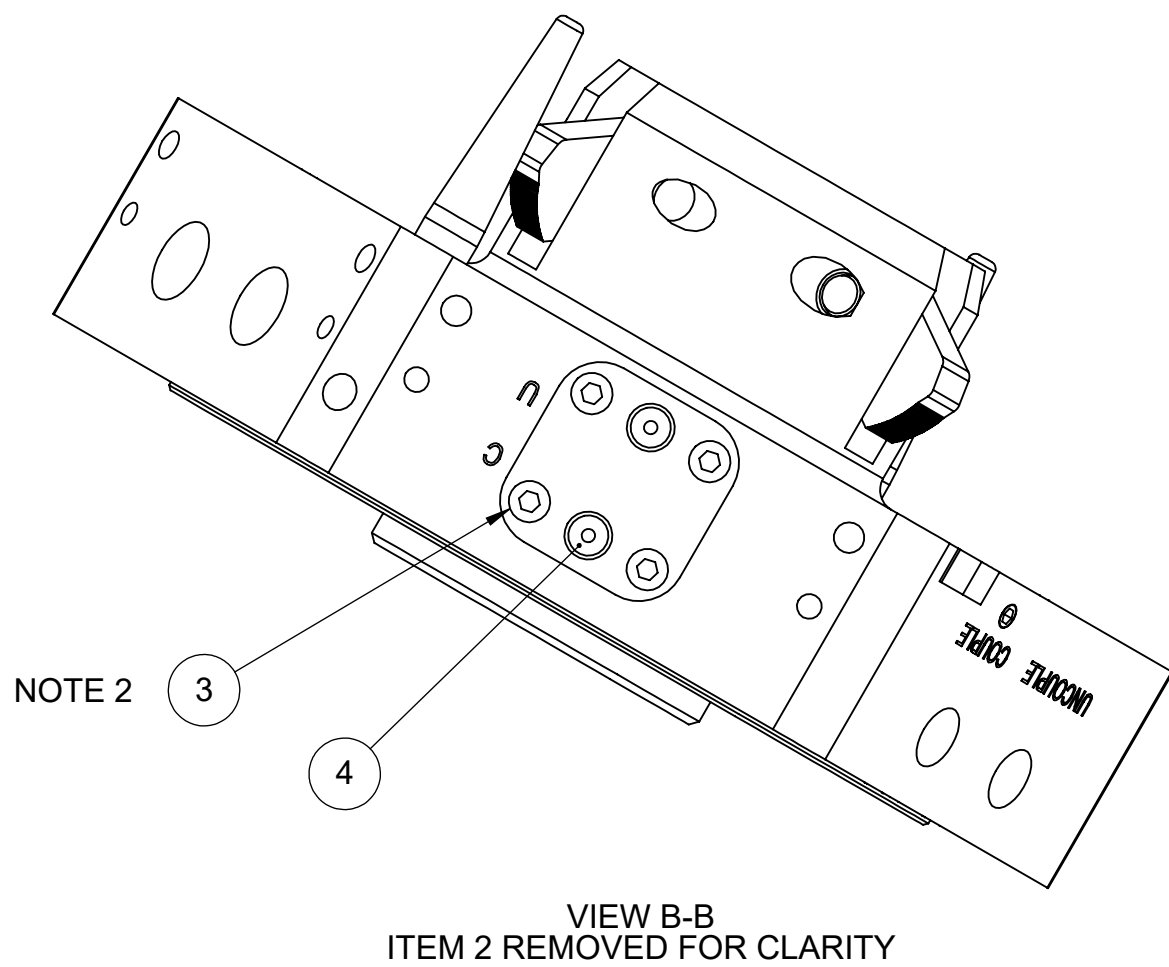
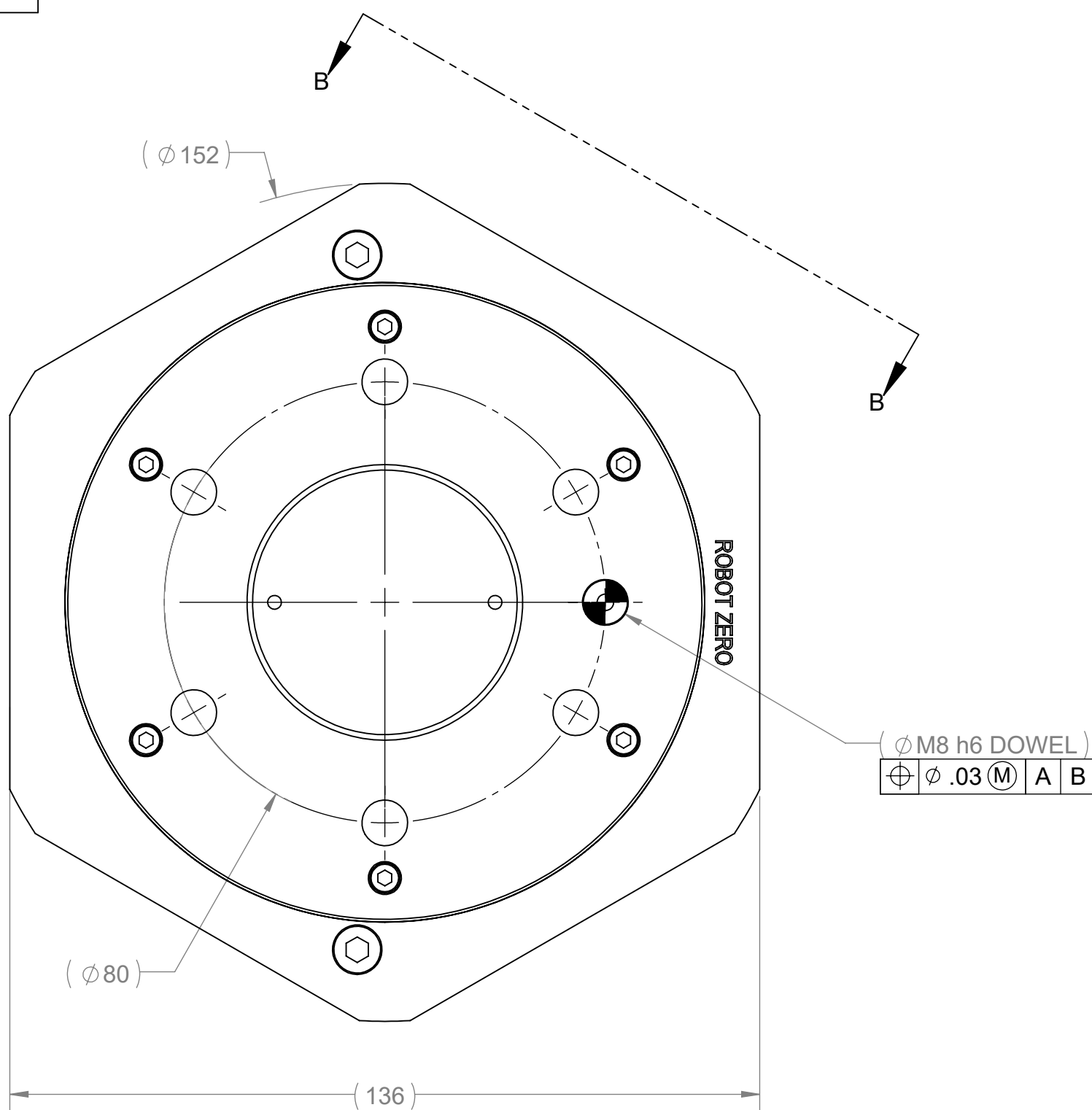
NOTES:

1. ALL ITEMS TO RECIEVE LOCTITE ARE TO BE THOROUGHLY CLEANED FROM GREASE AND OIL. USE PRIMER "N" (ARI P/N 51172) BEFORE APPLYING ANY LOCTITE THREAD LOCKERS.
2. APPLY LOCTITE 222 (ARI P/N 86005-P1020).
3. APPLY GREASE (ARI P/N 91504-P1037) TO BUSHING SURFACES
4. APPLY LUBE-A-CYL (ARI P/N 51120).
5. APPLY LABEL (ARI P/N 90114L).
6. APPLY LABEL (ARI P/N 90994) ADDRESS LABEL.
7. APPLY LABEL (ARI P/N 0708-P74N).
8. APPLY LABEL (ARI P/N 0708-P75N).

PRINT DATE  
10/11/2018

|                  |                                   |                  |
|------------------|-----------------------------------|------------------|
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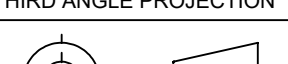
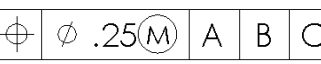
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| ZONE      | REV | DESCRIPTION             | DR | CHK | DATE       | ECR/ESR NO. |
|           | 00  | RELEASE FOR MANUFACTURE | PS | TM  | 01/11/2019 | DSCZ-B7DMAY |



NOTES:

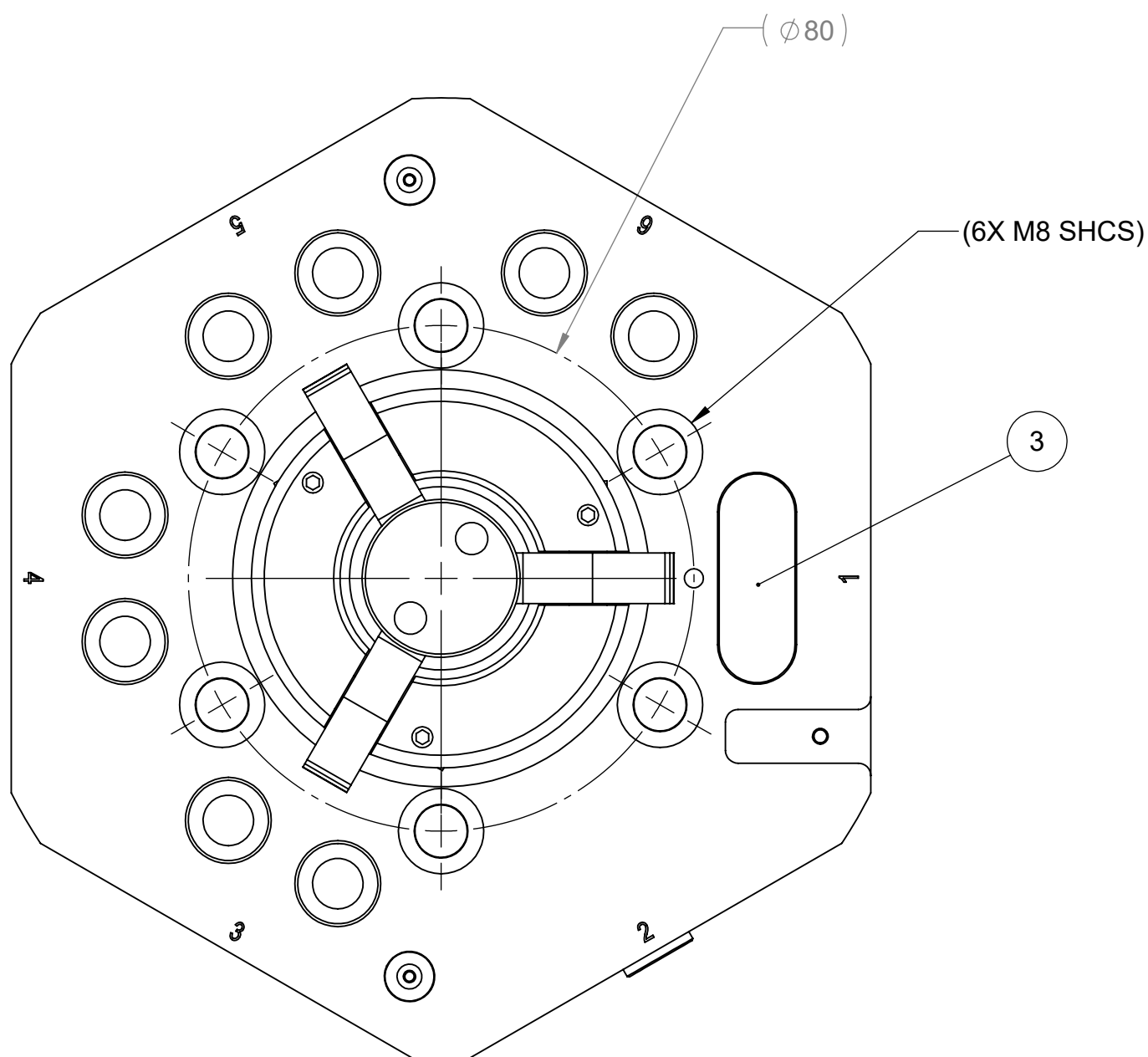
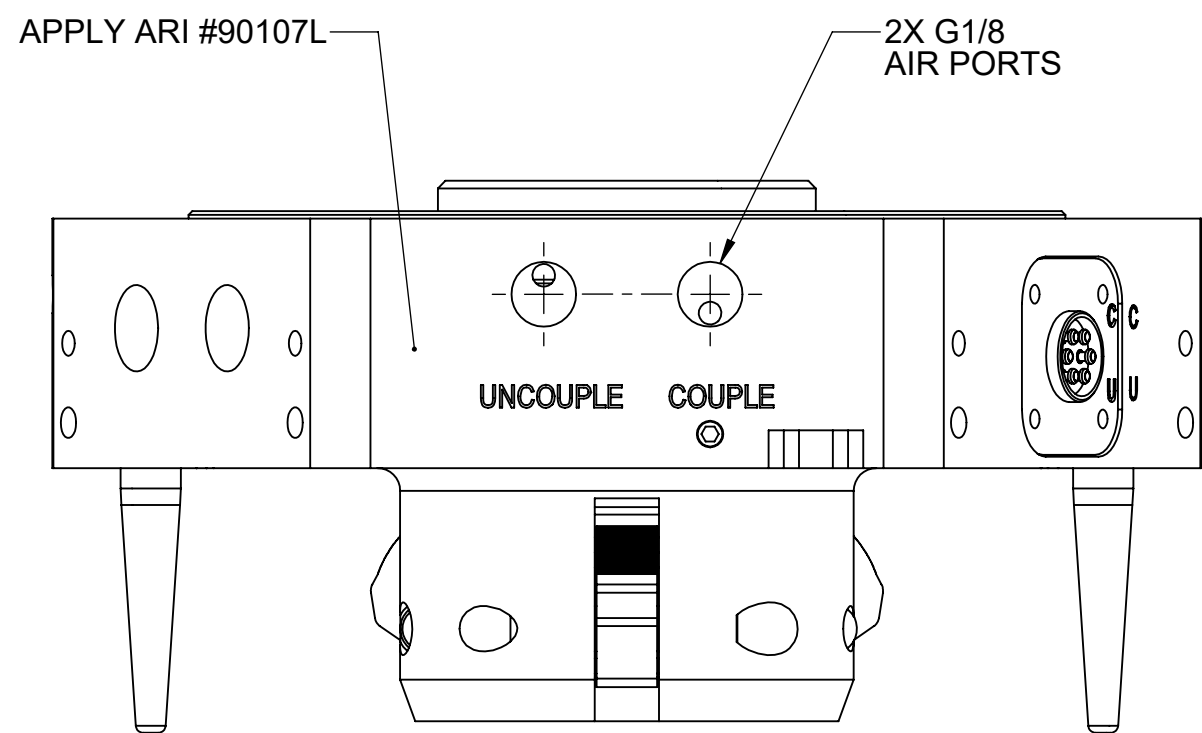
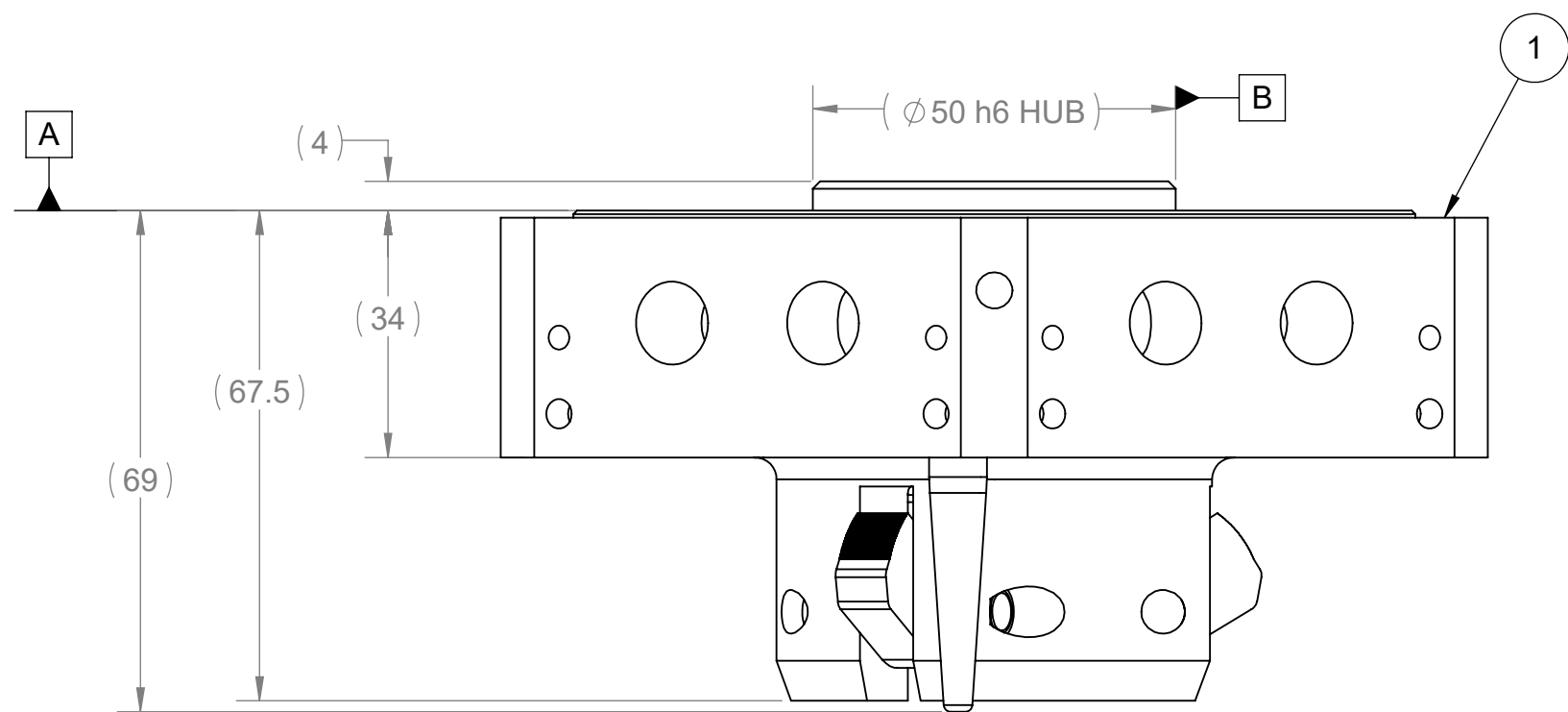
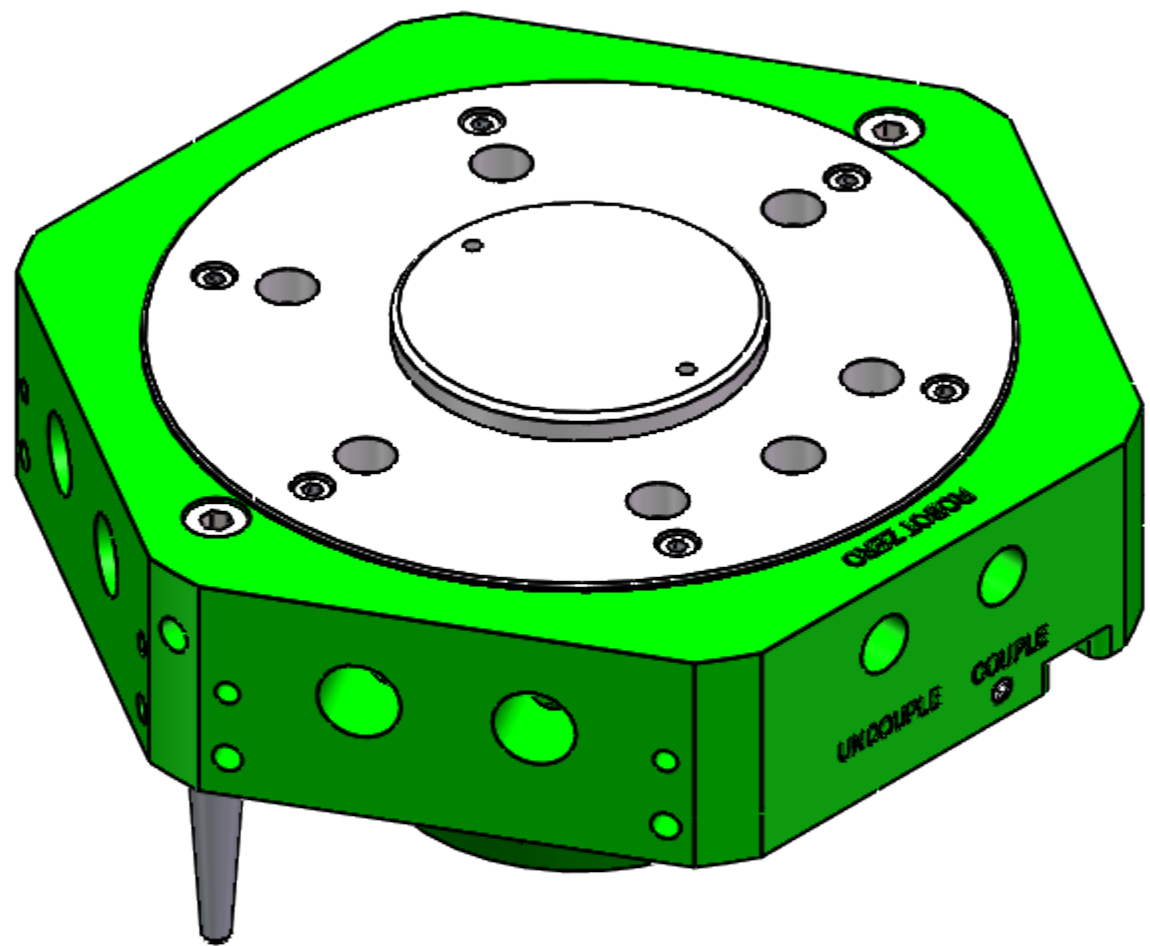
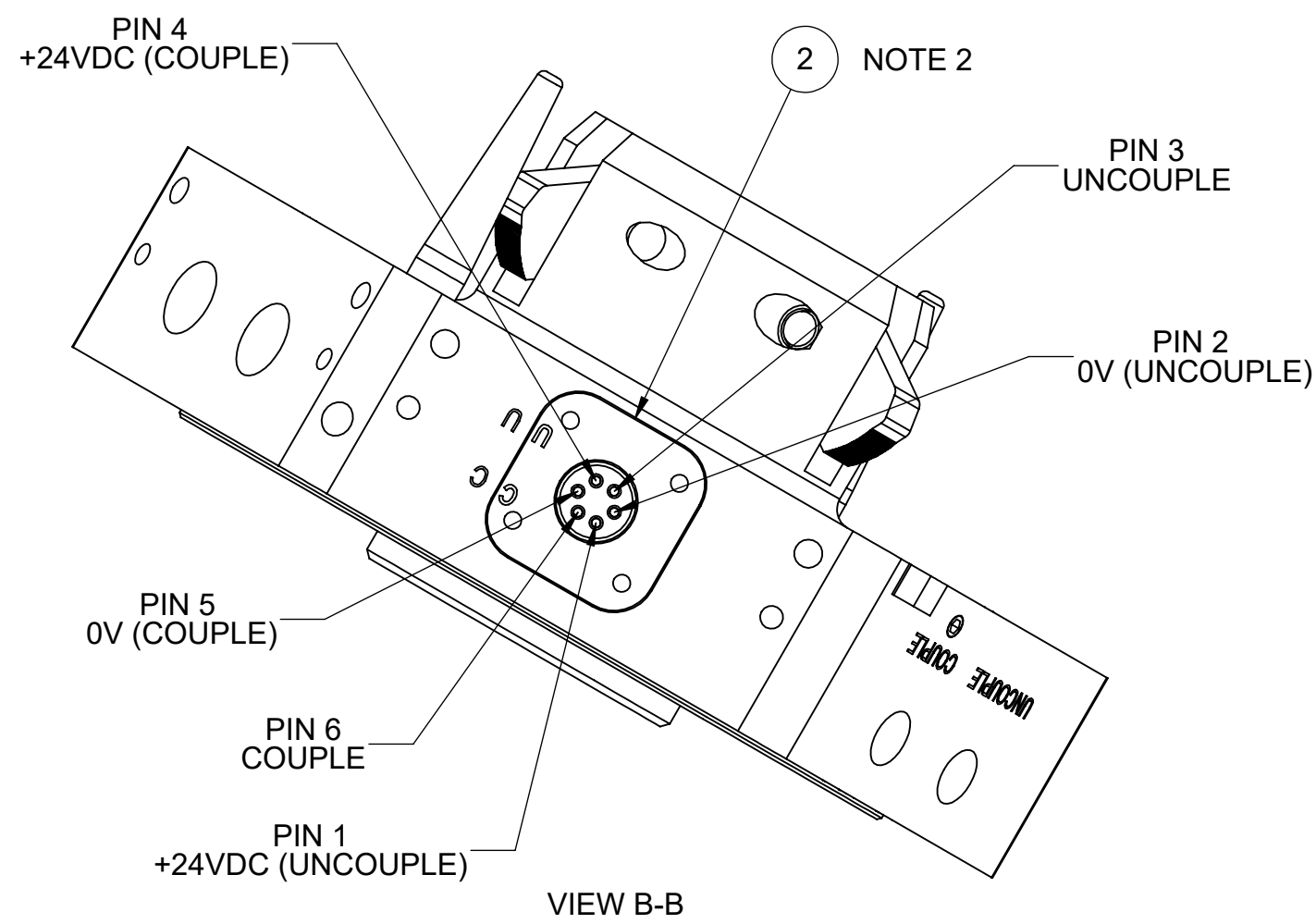
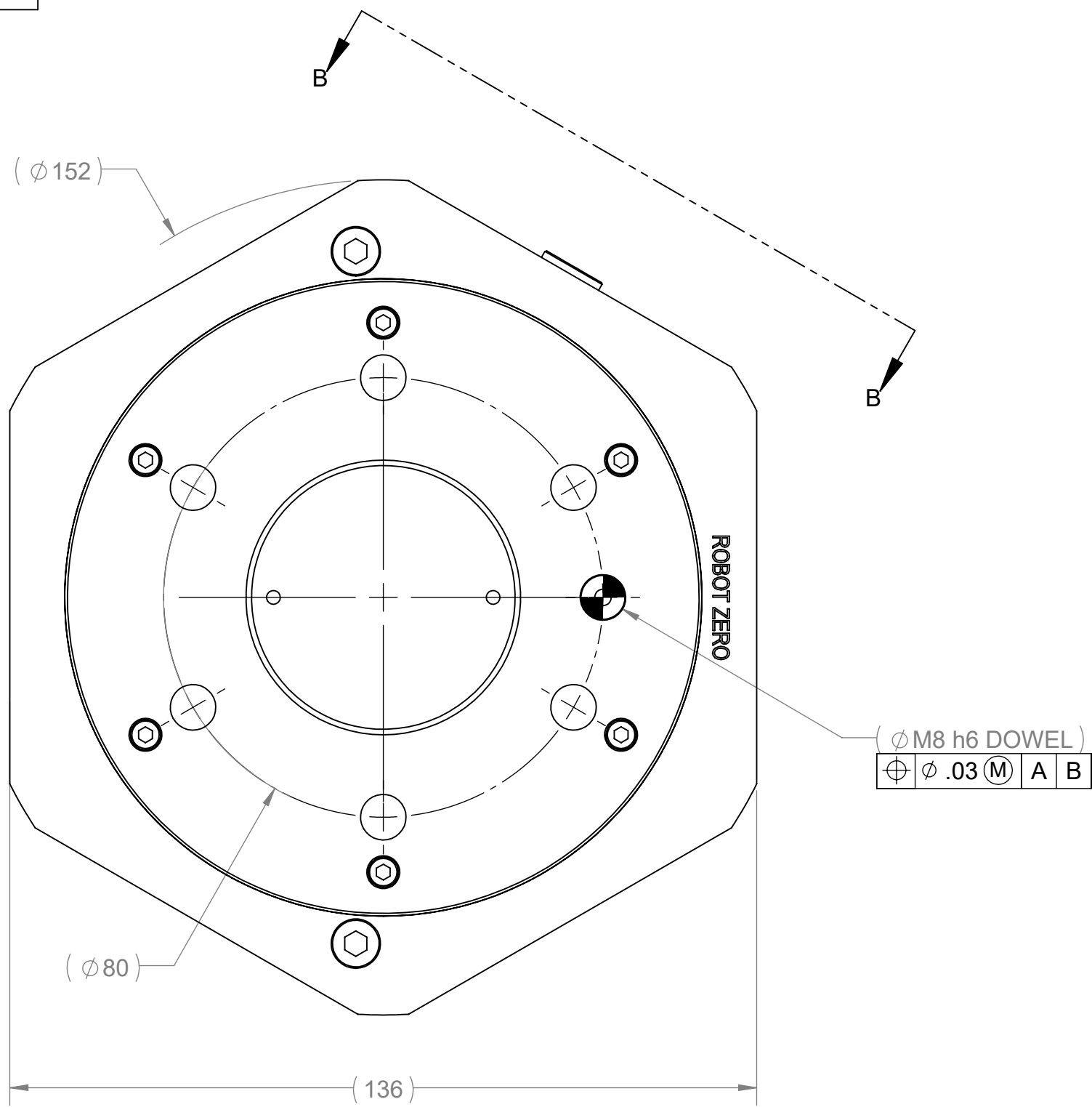
1. ALL ITEMS TO RECEIVE LOCTITE ARE TO BE THOROUGHLY CLEANED FROM GREASE AND OIL.
2. APPLY LOCTITE 222, ARI #86005-P1020.

|          |     |             |                              |
|----------|-----|-------------|------------------------------|
| 5        | 1   | 1600-P57N   | LABEL, ARI NAMEPLATE 12X33   |
| 4        | 2   | 97501-P1084 | O-RING, .070 ID X .070 (P)   |
| 3        | 4   | 89504-P1063 | SCR, SOC HD CAP M3 X 20 (SS) |
| 2        | 1   | 1607-C10N   | COVER, SENSING ER80/100      |
| 1        | 1   | 1601-D25A   | SUBASSY, ER80                |
| ITEM NO. | QTY | PART NO.    | DESCRIPTION                  |

|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |                                                                                       |  |                                                                                                                                      |  |                                                                                                |  |                                                                                       |  |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------|--|--------------------------------------------------------------------------------------------------------------------------------------|--|------------------------------------------------------------------------------------------------|--|---------------------------------------------------------------------------------------|--|
| THIRD ANGLE PROJECTION                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |  |  | <b>METRIC</b><br><b>UNLESS OTHERWISE SPECIFIED:</b><br>UNTOLERANCED DIMS ARE BASIC                                                   |  | DR: P. SLAVINSKI<br>CHK: T. MARCELLA<br>ENG: P. SLAVINSKI<br>MFG: M. DUDNATH<br>QC: M. DUDNATH |  |  |  |
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|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | MAT'L:<br>Material <not specified>                                                    |  | SCALE: 1:1<br>DO NOT SCALE DRAWING                                                                                                   |  | TITLE:<br>ER80-N/A-050-N-0-PP-C0000                                                            |  |                                                                                       |  |
| DIM. AND TOLERANCING IN ACCORDANCE WITH ANSI Y14.5M-1994                                                                                                                                                                                                                                                                                                                                                                                                                                                            | SURFACE TREATMENT:<br>-                                                               |  | ISO 9001<br>REGISTERED                                                                                                               |  | SIZE<br>D                                                                                      |  | DRAWING NUMBER<br>1800885A                                                            |  |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |                                                                                       |  |                                                                                                                                      |  | WEIGHT: 1.50 kg                                                                                |  | RoHS COMPLIANT: -                                                                     |  |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |                                                                                       |  |                                                                                                                                      |  | SHT. 1                                                                                         |  | OF 1                                                                                  |  |

|                  |                                   |                  |
|------------------|-----------------------------------|------------------|
| SIZE<br><b>D</b> | DRAWING NUMBER<br><b>1800886A</b> | REV<br><b>00</b> |
|------------------|-----------------------------------|------------------|

| REVISIONS |     |                         |    |     |            |             |
|-----------|-----|-------------------------|----|-----|------------|-------------|
| ZONE      | REV | DESCRIPTION             | DR | CHK | DATE       | ECR/ESR NO. |
|           | 00  | RELEASE FOR MANUFACTURE | PS | TM  | 01/11/2019 | DSCZ-B7DMAY |



NOTES:

1. ALL ITEMS TO RECEIVE LOCTITE ARE TO BE THOROUGHLY CLEANED FROM GREASE AND OIL.
2. APPLY LOCTITE 222, ARI #86005-P1020.

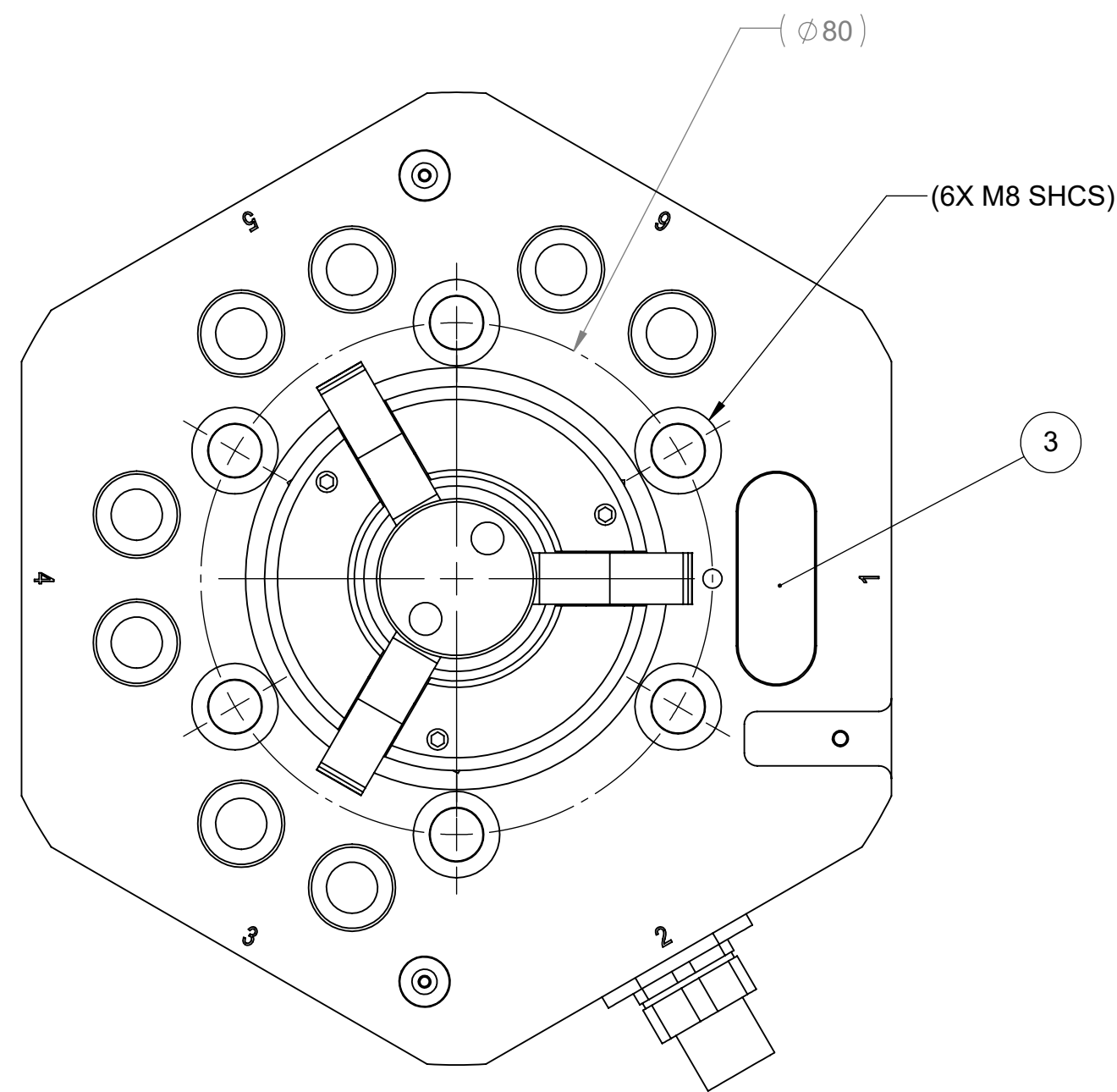
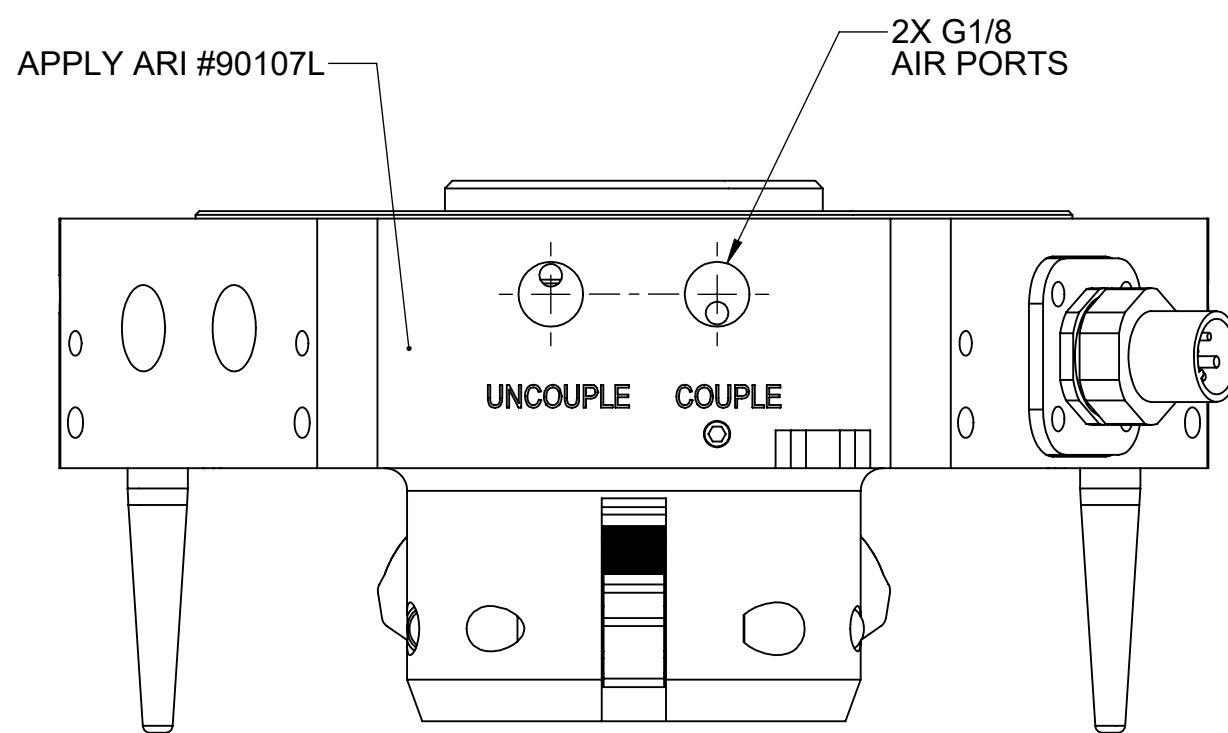
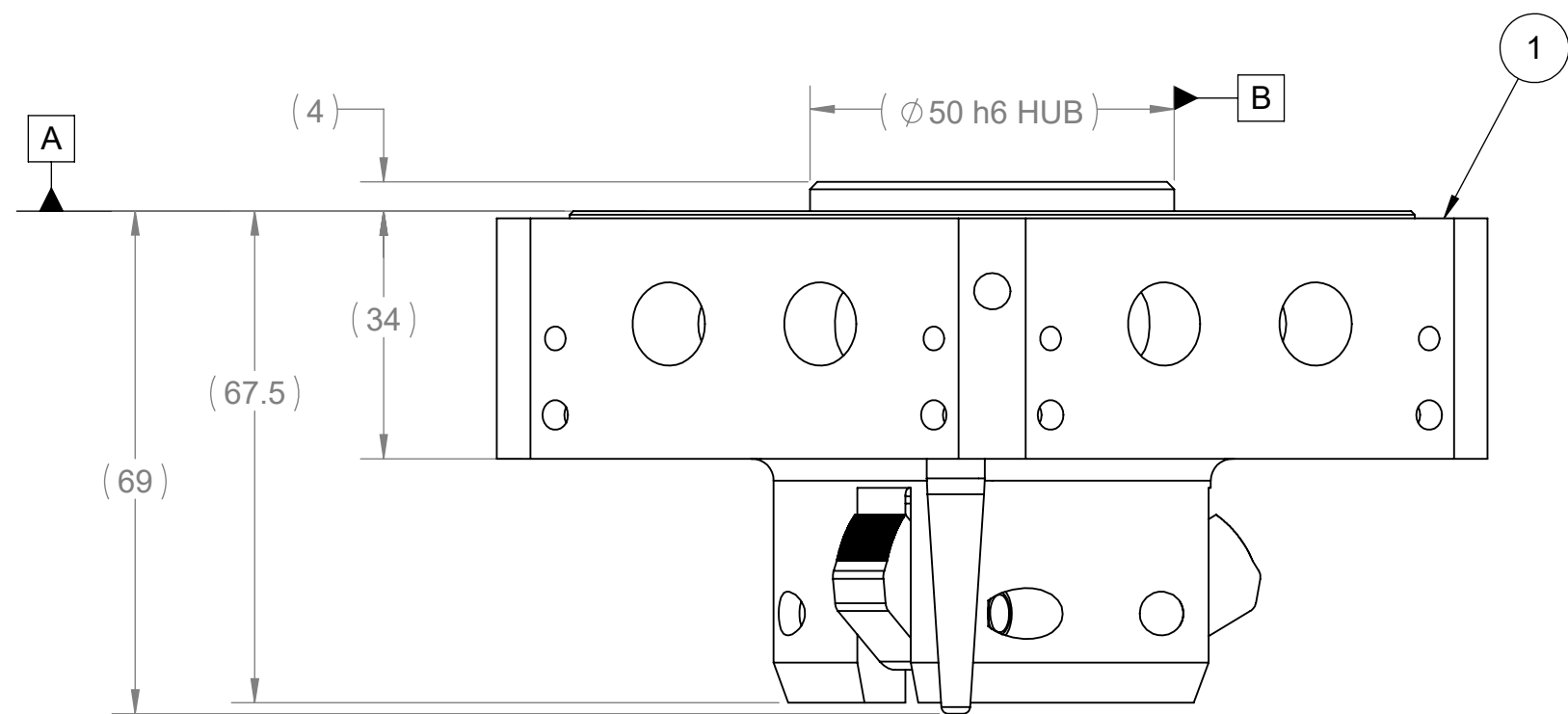
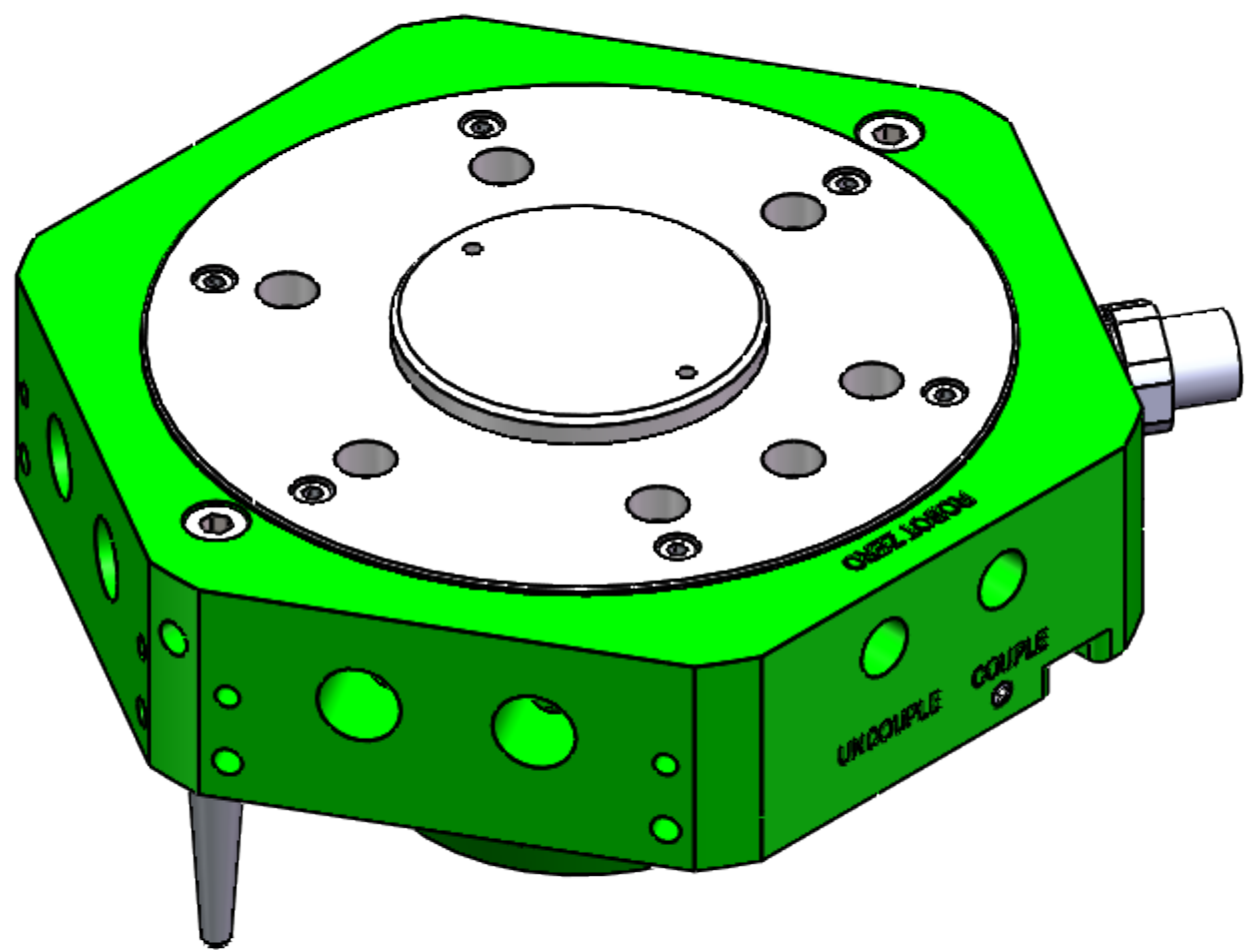
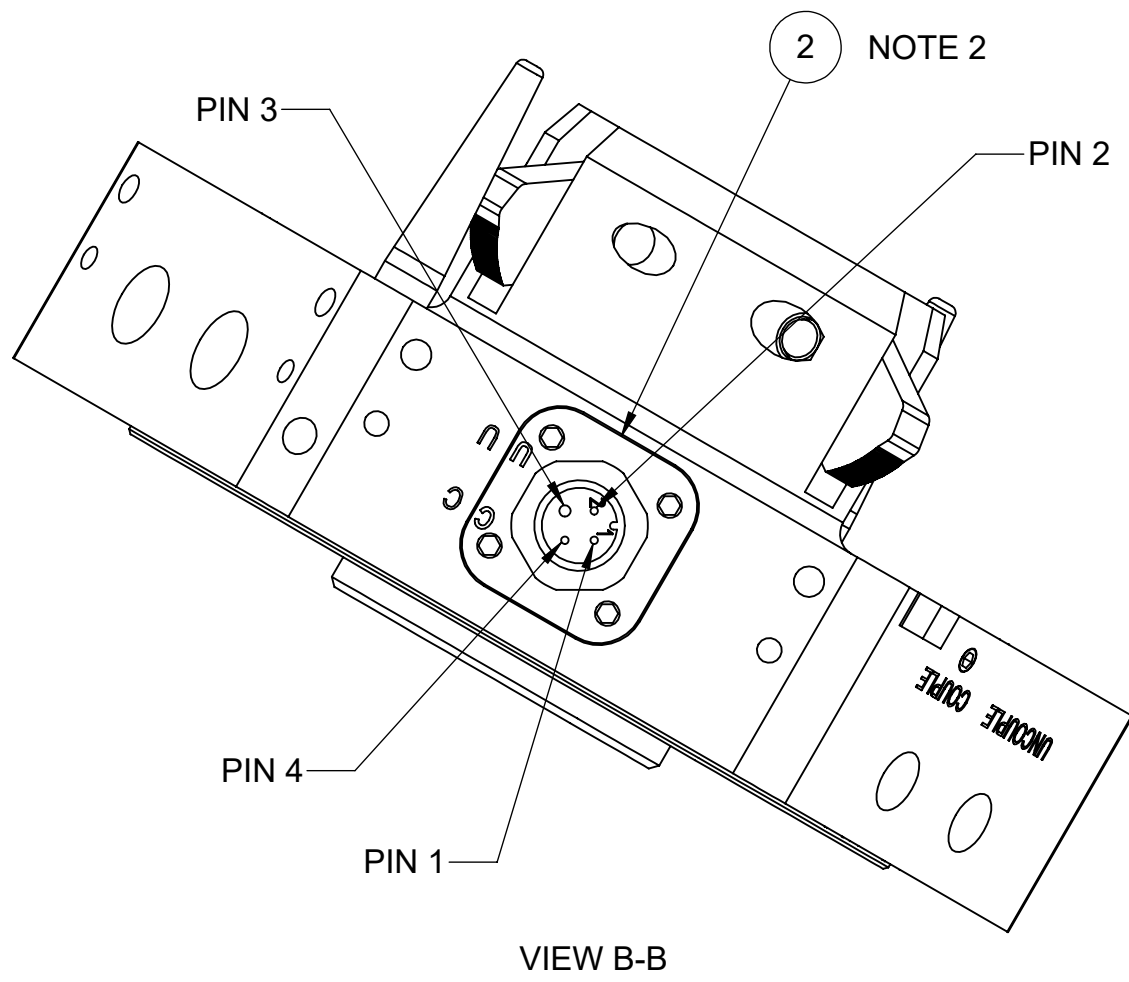
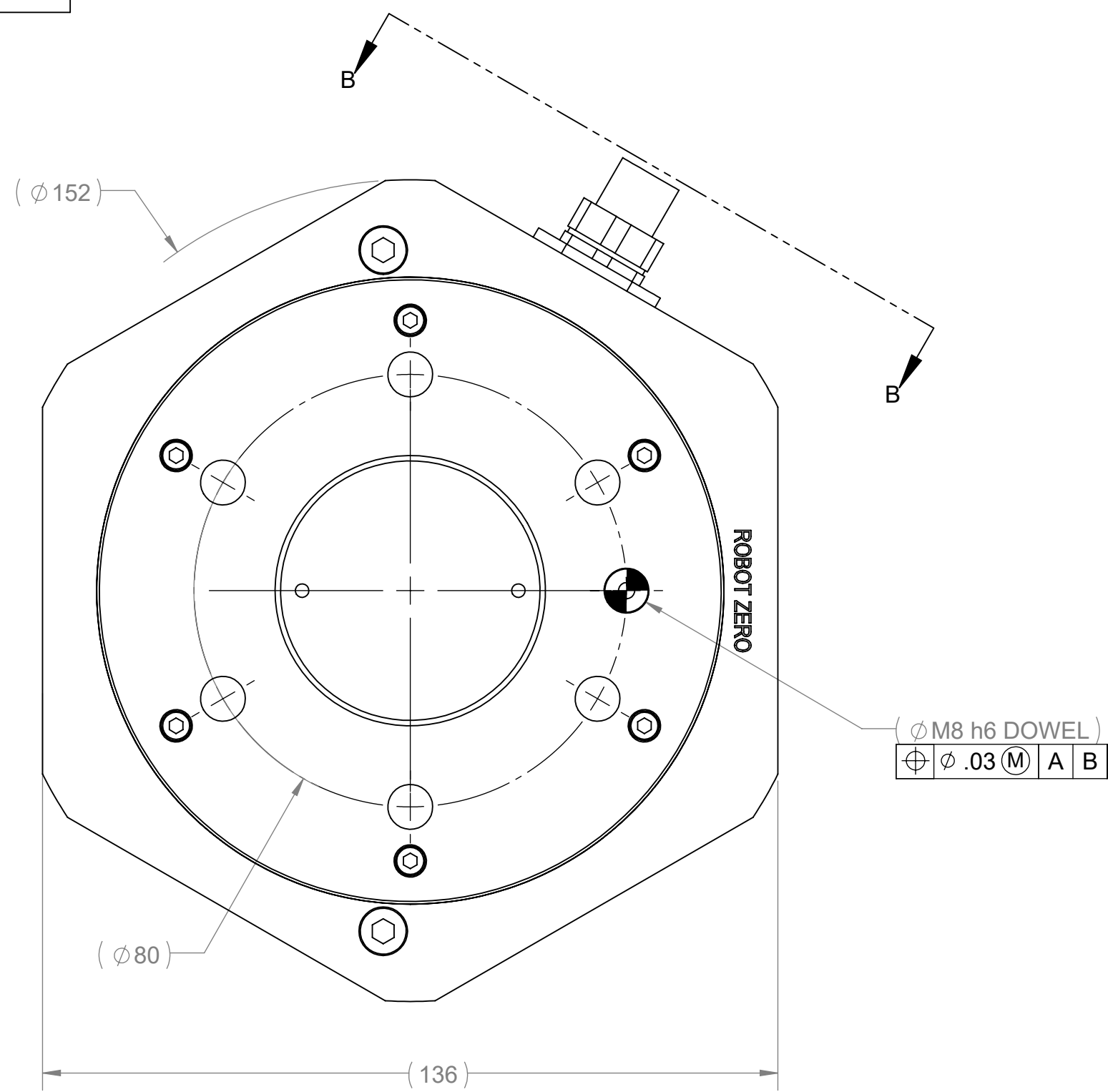
|          |     |           |                            |
|----------|-----|-----------|----------------------------|
| 3        | 1   | 1600-P57N | LABEL, ARI NAMEPLATE 12X33 |
| 2        | 1   | 1506-D56A | SUBASSY, PNP MODULE ER80   |
| 1        | 1   | 1601-D25A | SUBASSY, ER80              |
| ITEM NO. | QTY | PART NO.  | DESCRIPTION                |

|                        |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               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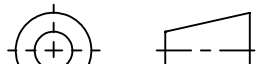
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|------------------|-----------------------------------|------------------|
| SIZE<br><b>D</b> | DRAWING NUMBER<br><b>1800887A</b> | REV<br><b>00</b> |
|------------------|-----------------------------------|------------------|

| REVISIONS |     |                         |    |     |            |             |
|-----------|-----|-------------------------|----|-----|------------|-------------|
| ZONE      | REV | DESCRIPTION             | DR | CHK | DATE       | ECR/ESR NO. |
|           | 00  | RELEASE FOR MANUFACTURE | PS | TM  | 01/11/2019 | DSCZ-B7DMAY |



- NOTES:
1. ALL ITEMS TO RECEIVE LOCTITE ARE TO BE THOROUGHLY CLEANED FROM GREASE AND OIL.
  2. APPLY LOCTITE 222, ARI #86005-P1020.

|          |     |           |                            |
|----------|-----|-----------|----------------------------|
| 3        | 1   | 1600-P57N | LABEL, ARI NAMEPLATE 12X33 |
| 2        | 1   | 1700033A  | SUBASSY, PNP MOD. ER80,    |
| 1        | 1   | 1601-D25A | SUBASSY, ER80              |
| ITEM NO. | QTY | PART NO.  | DESCRIPTION                |

| <div>THIRD ANGLE PROJECTION</div> <div></div> <div>THE INFORMATION CONTAINED HERE IN IS THE SOLE PROPERTY OF APPLIED ROBOTICS INC. THE INFORMATION IN THE DOCUMENT FILE IS SUBJECT TO CHANGE WITHOUT NOTICE. APPLIED ROBOTICS MAKES NO WARRANTY OF ANY KIND WITH REGARD TO THIS DOCUMENT FILE, INCLUDING, BUT NOT LIMITED TO IMPLIED WARRANTIES OR FITNESS FOR A PARTICULAR PURPOSE. APPLIED ROBOTICS INC. SHALL NOT BE LIABLE FOR ANY ERRORS CONTAINED HERE IN OR FOR INCIDENTAL OR CONSEQUENTIAL DAMAGES IN CONNECTION WITH THE PERFORMANCE OR USE OF THIS DOCUMENT FILE.</div> <div>DIM. AND TOLERANCING IN ACCORDANCE WITH ANSI Y14.5M-1994</div> |                | <div>METRIC</div> <div>UNLESS OTHERWISE SPECIFIED:</div> <div>UNTOLERANCED DIMS ARE BASIC</div> <div></div> <div>  .25    </div> <div>ALL HOLE DIAMETERS +/- 0.25</div> <div>INTERNAL RADII &amp; BROKEN EDGES TO BE: 1:3-38</div> <div>ALL SURFACE FINISHES 1.6Ra</div> <div>MAT'L:<br/>Material &lt;not specified&gt;</div> <div>SURFACE TREATMENT:<br/>-</div> |  | <div>DR: P. SLAVINSKI</div> <div>CHK: T. MARCELLA</div> <div>ENG: P. SLAVINSKI</div> <div>MFG: M. DUDNATH</div> <div>QC: M. DUDNATH</div> <div>3D MODEL NUMBER:<br/>1800887A</div> <div>SCALE: 1:1<br/>DO NOT SCALE DRAWING</div> <div>ISO 9001<br/>REGISTERED</div> |  | <div> <b>Applied Robotics™</b></div> <div>Solutions in reach</div> <div>648 Saratoga Rd. Glenville, NY 12032<br/>www.appliedrobotics.com</div> <div>TITLE:<br/><br/>ER80-PM12-050-N-0-PP-C0000</div> <table><tr><th>SIZE</th><th>DRAWING NUMBER</th><th>REV</th></tr><tr><td>D</td><td>1800887A</td><td>00</td></tr></table> <div>WEIGHT: 1.51 kg    RoHS COMPLIANT: -    SHT. 1 OF 1</div> |  |  | SIZE | DRAWING NUMBER | REV | D | 1800887A | 00 |
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| SIZE                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | DRAWING NUMBER | REV                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |  |                                                                                                                                                                                                                                                                      |  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |  |  |      |                |     |   |          |    |
| D                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | 1800887A       | 00                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |  |                                                                                                                                                                                                                                                                      |  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |  |  |      |                |     |   |          |    |

NOTES:

1. APPLY LABEL (ARI P/N 90114L).
2. APPLY LABEL (ARI P/N 90394) ADDRESS LABEL.
3. APPLY LABEL (ARI P/N 0708-P74N).
4. APPLY LABEL (ARI P/N 0708-P75N).
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6. APPLY LOCTITE 222, ARI #86005-P1020.

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