

CXC 30 Tool Change System USER'S GUIDE 92904 Rev 04

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APPLIED ROBOTICS INCORPORATED GLENVILLE, NEW YORK

XChange CXC30

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OMEGA	OMEGĂ III
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This product is covered by the following patents:

U.S. Pat. No. 4,664,588 JP Patent No. 1660259 U.S. Pat. No. 5,417,595

1. PRECAUTIONS

DANGER NOTICE - Indicates an imminently hazardous situation which, if not avoided, will result in serious injury or death.

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

CAUTION NOTICE - Indicates a potentially hazardous situation which, if not avoided, will or could result in minor or moderate injury; also used where the risk applies to only property damages.

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 MANUFACTURERS' EQUIPMENT WARRANTY.

HEED ALL PRECAUTION NOTICES

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2. XCHANGE SYSTEM DESCRIPTION

There are three (3) components in the basic system:

• The XChange Robot Adaptor Assembly

One assembly (Robot Adaptor and Robot Adaptor Plate) is needed for each robot or manipulator changing tools

• The XChange Tooling Adaptor Assemblies

One assembly (Tooling Adaptor and Tooling Adaptor Plate) is needed for each tool.

• The XChange Tool Storage Fixture

Standard and custom height models are available for supporting Tooling Adaptor Assemblies.

The XChange System provides a reliable method for the robot to pick up and release a number of Tooling Adaptor Assemblies (each equipped with different tooling). The XChange places **no load** on the robot arm during pick-up or release of Tooling Adaptor Assemblies. Attachment is through a mechanical linkage. To pick up, air is ported to an actuating cylinder in the Rob ot Adaptor Unit. A cam latching mechanism "pulls up" on hardened pins in the Tooling Adaptor Unit and couples the (2) Assemblies.

To release a Tooling Adaptor Assembly, air is ported to the other end of the actuating cylinder. The cams release and the Tooling Adaptor Assembly is pushed away from the Robot Adaptor Assembly, resting it in the XChange Tool Storage Fixture. The system does not rely on gravity for proper uncoupling action.

2.1. XChange System Components

2.1.1. XChange Robot Adaptor Assembly

This assembly consists of the Robot Adaptor Unit which contains the latching mechanism with sensing capabilities (in insulator blocks) and the Robot Adaptor Plate. You machine the Robot Adaptor Plate to match your robot's faceplate. Pre-machined Adaptor Plates are also available.

2.1.2. XChange Tooling Adaptor Assembly

This assembly consists of the Tooling Adaptor Unit and the Tooling Adaptor Plate.

Custom or workpiece dedicated tooling is attached via the Tooling Adaptor Plate.

2.1.3. Robot Adaptor Cable

The optional Robot Adaptor Cable has 22 conductors. It is hard-wired to the Robot Adaptor Electrical Block. The other end is unterminated.

2.1.4. XChange Tool Storage Fixtures

Designed to provide a stable base for maintaining tool position and orientation when tooling adaptors are not in use.

See drawing number 97505-D1002A in Informational Drawings Section.

Our standard fixtures are available with 15 cm of tool clearance and tool presence sensing.

3. ROBOT ADAPTOR INSTALLATION

PLEASE REVIEW THESE INSTRUCTIONS THOROUGHLY BEFORE INSTALLING YOUR XChange System.

Mount the XChange Robot Adaptor Assembly (consisting of Robot Adaptor Unit and Robot Adaptor Plate) onto your robot faceplate or other mounting surface as follows:

Note: If you have a pre-machined adaptor plate then go to step 2.

1. Drill and countersink the Universal Adaptor Plate from the side stamped with the plate part number.

See drawing number 97500-C1091A in the Informational Drawings Section.

2. **Mount** the Universal Adaptor Plate to your robot faceplate using flat head cap screws of the a ppropriate size and thread pitch to fit your faceplate. The robot faceplate must mate with the SIDE OPPOSITE the side stamped with the Adaptor Plate part number. The flat head mounting screws must be slightly below the Universal Adaptor Plate surface after mounting.

WARNING NOTICE

TIGHTEN FACEPLATE MOUNTING SCREWS TO ROBOT ANUFACTURER'S SPECIFICATIONS.

- 3. Attach the Robot Adaptor body to the Universal Adaptor Plate using the four (4) M6 x 25 mm socket head cap screws supplied with the Robot Adaptor Unit. The two (2) dowel pins must enter the mating holes in the Robot Adaptor Plate.
- 4. Install any electrical cable(s) and/or air lines along robot or manipulator arm as required. DO NOT affix permanently at this time.
- 5. Install coupling, uncoupling and user air fittings and air lines as the application requires.

See drawing number 97501-C1075A in the Informational Drawings Section for port locations and identification.

Both the coupling and uncoupling lines **must** be installed in order for the XChange System to function properly. Use a **single solenoid spring-return 4-way pneumatic valve** to connect air to the couple and uncouple ports on the Robot Adaptor Assembly.

See drawing number 87517-B1060A in the Informational Drawings Section for SUGGESTED COUPLING/UNCOUPLING PLUMBING schematic for proper valve plumbing.

If plumbed per this schematic, the Robot and Tooling Adaptor Assemblies will stay coupled in the event of a power failure. Holding force up to the rated payload of the Robot Adaptor Assembly is provided in the event of all pneumatic pressure loss. The (3) Coupling Cams should be in the coupled position when system air is applied and the valve is de energized.

See drawing number 97507-D1000A in the Informational Drawings Section for VALVE DE-ENERGIZED and VALVE ENERGIZED diagrams.

The "VALVE ENERGIZED" diagram depicts the position of the Coupling Cams when the valve is energized. It **must be** in this position before and during uncoupling of the Robot and Tooling Adaptor Assemblies.

4. TOOLING ADAPTOR INSTALLATION

4.1. Attach Tooling to the Tooling Adaptor Assemblies

1. **Mount** tooling to a second Universal Adaptor Plate on the side with the stamped part number. If you choose to mount your tooling by using clearance holes in the Tooling Adaptor Plate, drill and countersink the plate from the opposite side of the stamped part number. The countersunk holes must be deep enough to insure that the screw heads will not protrude above the plate surface.

See drawing number 97500-C1091A in the Informational Drawings Section for Adaptor Plate information.

If you choose to mount your tooling by tapping holes into the Universal Adaptor Plate, we advise using thread inserts.

CAUTION NOTICE

THE ENDS OF INSERTS AND MOUNTING SCREWS MUST NOT PROTRUDE BEYOND THE TOOLING ADAPTOR PLATE SURFACE FACING THE TOOLING ADAPTOR BODY.

- 2. Attach the Universal Adaptor Plate using (4) M6 x 25 mm socket head cap screws supplied with the Tooling Adaptor Unit. The Universal Adaptor Plate can be manually pushed into place on the Tooling Adaptor Unit dowels.
- 3. Wire your tooling to the Tooling Adaptor's color coded electrical leads.
- 4. **Plumb** tooling to the Tooling Adaptor Assembly ports located on the Tooling Adaptor Assembly Housing.

4.2. Install Tooling Adaptor Assemblies into Tool Storage Fixtures

Place Applied Robotics Tool Storage Fixtures in the robot work area, but do not permanently fasten them in place until you have verified the robot can access all tools.

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If you are supplying your own Tool Storage Fixtures proceed as follows; otherwise go to step 6.

- 1. **Design and fabricate** fixtures so that any Tooling Adaptor Assembly tooling, plumbing or wiring will **not** interfere with the fixture during use.
- 2. **Include** Tool Presence Sensors to indicate to your controller whether or not a tooling support position is occupied.
- 3. Allow for approximately 0.8 mm (0.03 in) of horizontal float for each Tooling Adaptor Assembly on its fixture rest surface. The repeatability and accuracy of your robot will determine actual float required.

Some float and lead-in are recommended on whatever locating components are used (i.e. pins and holes, or rest buttons and shallow flat bottom pockets, etc.). This facilitates proper return of the Tooling Adaptor Assembly to the fixture. Robot accuracy and repeatability determine the actual clearance required.

- 4. **Position** fixtures in your robot work area after they are constructed. Do not permanently fasten them in place until you have verified that the robot can access all tools.
- 5. **Place** each of your Tooling Adaptor Assemblies into the fixtures. Check for obstructions b y manually removing and replacing the Tooling Adaptor Assemblies in a manner similar to your planned sequence.
- 6. **Complete** plumbing and wiring as required by your application. Interface the XChange Tool Storage Fixture Sensor(s) to your control as required.

See drawing number 97505-D1002A in the Informational Drawings Section for the electrical characteristics of the fixture's sensor.

5. INITIAL TESTS

CAUTION NOTICE

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

5.1. Robot Adaptor Assembly Valving

See drawing number 97507-D1000A in the Informational Drawings Section for VALVE DE-ENERGIZED diagram.

- 1. With the Tooling Adaptor Assembly uncoupled from the Robot Adaptor Assembly, **apply air** (no electrical power) to your system:
 - The Robot Adaptor coupling cams should be in a "coupled" position.
 - No air should be blowing out of the XChange User Air Ports at the Robot Adaptor interface surface.
- 2. Apply system air and power.
 - No change in the above conditions should occur.
 - The Robot Adaptor coupling cams should be in a "coupled" position.
 - No air should be blowing out of the XChange User Air Ports at the Robot Adaptor interface surface.
- 3. Energize the solenoid which controls the coupling mechanism.
 - The coupling cams should move to the "uncoupled" position.
- 4. Alternately **de-energize** and **energize** the solenoid several times.
 - The cam action should be smooth and quick.

5.2. Fixture Sensor Communication

If you are using the sensors on your fixtures, check for proper communication with your control system.

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6. GUIDE TO OPERATIONS

6.1. Programming Considerations

Programs should be written with all XChange Tooling Adaptor Assemblies resting in support fixtures during start-up and manipulator calibration (if applicable).

6.1.1. Identify and Record Pick-up & Replacement Point

CAUTION NOTICE

THE COUPLING CAMS SHOULD BE IN THE "UNCOUPLED" POSITION (COUPLING SOLENOID ENERGIZED). COUPLING CAMS RETRACTED INPUT SHOULD BE ON.

To identify the pick-up point of each Tooling Adaptor Assembly during the teaching phase, the Robot Adaptor Assembly should be brought to a point directly over the Tooling Adaptor Assembly. **Align the flats on the Robot and Tooling Housing on which the Electrical Blocks mount.** The Robot Adaptor Assembly's face should be parallel to the Tooling Adaptor Assembly's face. The taper pins should enter the bushings in the Tooling Adaptor Assembly when the Robot Adaptor Assembly is slowly brought down vertically.

- 1. **Move** the Robot Adaptor Assembly slowly downward while visually checking the alignment of the taper pins and their bushings. Make whatever lateral corrections necessary to center the pins in the bushings. Exact alignment in either the horizontal or lateral positions is not required, alth ough the pins should not interfere with the bushing's inside diameters during the downward movement.
- 2. **Center** the Tooling Adaptor in the horizontal float range in the tool fixture nest. To center, use temporary shim stock between the nest wall and the Toolin g Adaptor's outside diameter. This will assure that the tapered pins will enter the bushings in the Tooling Adaptor during normal operation; even if the Tooling Adaptor is at the limit of the fixture's float range.
- 3. **Stop** the downward motion when the distance between the Robot Adaptor Face and the Tooling Adaptor Face is approximately 1.5 to 2.5 mm (.06 to .098 in).

CAUTION NOTICE

THERE MUST BE APPROXIMATELY 1.5 TO 2.5 MM BETWEEN THE ROBOT AND TOOLING ADAPTOR ASSEMBLIES; OTHERWISE, THE MECHANISM THAT OPERATES THE COUPLING CAMS MAY INTERFERE WITH THE TOOLING ADAPTOR BOTTOM PLATE. THE TWO UNITS ARE PULLED TOGETHER WHEN THE COUPLING MECHANISM IS OPERATED.

4. **De-energize** the solenoid that controls the air pressure to the XChange coupling mechanism. This will pick-up the Tooling Adaptor Assembly from the storage fixture and couple it with the Robot Adaptor Assembly. The electrical and pneumatic connections are made at this time.

Note: For coupled sensing a contact closure is provided to verify that the tooling adaptor assembly has been coupled with the robot adaptor assembly.

See drawing number 97500-D1062A.

- 5. **Remove** shim stock that was used to center the Tooling Adaptor in the rack nest.
- 6. **Energize and de-energize** the coupling solenoid several times to verify that the Tooling Adaptor Assembly is properly placed and removed from the fixture.
- 7. Record the robot coordinates from Step 3 as the "pick-up" & "replacement" coordinates for this Tooling Adaptor Assembly. The Tooling Adaptor Assembly must not be in contact with the fixture before uncoupling. The Robot Adaptor Assembly will push the Tooling Adaptor Assembly into the fixture upon uncoupling.

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- 6.1.2. Identify and Record Approach & Departure Point
 - Note: These points are not the same points as the "Pick-up" & "Replacement" points identified above.
 - Uncouple the Tooling Adaptor Assembly and place it into the Tool Storage Fixture. Note: For uncoupled sensing a reed switch is provided to verify that the Tooling Adaptor Assembly has uncoupled from the Robot Adaptor Assembly.

See drawing number 97500-D1062A.

- 2. **Move** the Robot Adaptor Assembly in a straight upward movement until the tapered pins are clear of the Tooling Adaptor Assembly.
- 3. **Record** this point as the "approach" and "departure" point. It is the point where the robot can begin lateral movement without hitting the Tooling Adaptor Assembly.

6.1.3. Other Programming Considerations

Tooling Adaptors may be coded to verify pick-up of the correct tool. It is recommended that you short some of the Tooling Adaptor electrical leads to produce a binary code (which can be read using your robot controller inputs). The number of leads needed to allow a unique code for each Tooling Adaptor will depend upon the number of Tooling Adaptors used in your application.

CAUTION NOTICE

AIR PRESSURE TO THE "UNCOUPLING" PORT SHOULD BE AT LEAST 5.5 BAR (80 PSIG) TO INSURE QUICK UNCOUPLING.

6.2. Pneumatic and Electrical

Check valves for controlling user pneumatics are incorporated in the robot adaptor housing. Air to the user lines does not need to be turned off before uncoupling.

CAUTION NOTICE

POWER ABOVE NORMAL SIGNAL LEVEL VALUES TO ANY USER ELECTRICAL LINES SHOULD BE APPLIED ONLY AFTER COUPLING IS COMPLETE. POWER MUST BE DISCONTINUED BEFORE UNCOUPLING (TO AVOID DAMAGE TO ELECTRICAL PIN CONTACT SURFACES DUE TO ARCING). SEE "TROUBLESHOOTING" IF PINS ARE ACCIDENTALLY DAMAGED.

7. TROUBLESHOOTING

7.1. Assistance

If you require assistance contact our Technical Support Department at (518) 384 -1000.

7.2. Electrical Contacts - Robot and Tooling Adaptors

There are spring loaded electrical contacts in the Robot and Tooling Adaptor Assemblies. They are protected from physical damage during normal use by the contact housing design. Average life is one million cycles. If contacts are damaged, they are easily replaced.

See section 11 in the Informational Drawing section for Replacement Parts.

To Change a Contact:

- 1. **Grasp** the damaged contact with needle nose pliers, small tweezers or a similar tool and pull it out of its receptacle. Do not apply an excessive side load because the pin may break in its receptacle. If this occurs, replacement/repair of the entire electric block is needed.
- 2. **Install** a new pin (available from Applied Robotics Inc.) by pushing the pin completely into its receptacle. The spring contact pin is friction fit into the pin receptacle.

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7.3. O-Rings

If the air port interface O-rings are damaged, they can be easily replaced with new O-rings available from Applied Robotics Inc.

Note: These are special precision O-Rings.

7.4. Replacement Parts

See section 11 in the Informational Drawing section for Replacement Parts.

8. MAINTENANCE

8.1. Bi-Weekly Inspections

The following inspections/maintenance should be performed bi -weekly or at 5000 tool change cycle intervals, whichever comes first. Refer to drawings in this User Guide for replacement components.

CAUTION NOTICE

BE SURE TO INTERRUPT AND LOCK OUT ALL POWER (ENERGY) SOURCES TO THE TOOL CHANGE SYSTEM PRIOR TO PERFORMING ANY SERVICE. FAILURE TO DO SO MAY RESULT IN PERSONAL INJURY.

Robot Adaptor Unit:

- Wipe clean any existing lubrication or contaminants from Robot Adaptor unit.
- Inspect interface surface for damaged or raised portions. File smooth any such areas.
- Inspect pneumatic check valves for damaged or missing components. Replace as necessary.
- Inspect Alignment Pins for excessive wear or damage. Replace if necessary. If excessive wear exists, the manipulator program may need to be adjusted to compensate for misalignment of components during the coupling process.
- Using a spanner and applying light force, inspect center retention stud for free rotational movement. If movement exists, contact your ARI representative for instructions and assistance.
- Inspect electrical signal interface pins to ensure there are no bent pins or pitted interface surfaces and that all pins move freely. Replace as necessary.
- Using the chart below as reference, apply a thin film of lubrication on the outer cam surfaces and on the outer surfaces of the alignment pins. Excessive lubrication may migrate throughout the tool changer and inhibit performance.

Tool Adaptor Unit:

- Wipe clean any existing lubrication or contaminants from Tool Adaptor unit, including the pick -up pins located inside the cavity of the Tool Adaptor Unit.
- Inspect interface surface for damaged or raised portions. File smooth any such areas.
- Inspect pneumatic fittings for damage or missing/damaged o-rings. Replace as necessary.
- Inspect Alignment Bushings for excessive wear or damage. Replace if necessary. If excessive wear exists, the manipulator program may need to be adjusted to compensate for misalignment of components during the coupling process.
- Inspect electrical signal interface pins to ensure there are no bent pins or pitted interface surfaces and that all pins move freely. Replace as necessary.
- Using the chart below as reference, apply a thin film of lubricati on on the pick-up pins and in the bore of the alignment bushings, along with the pneumatic o-ring fittings. Excessive lubrication may migrate throughout the tool changer and inhibit performance.

8.2. Lubrication

To extend the life expectancy of the XChange System, apply the following lubricants according to the chart.

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		Cleanroom	Non-Cleanroom
Wear	Metal to Metal Parts	Apiezon – L or Equivalent	Multi-Purpose Grease
Surfaces	O-Rings	Apiezon – L or Equivalent	Parker Lube-A-Cyl Lubricant

9. ENGINEERING DATA - XCHANGE CXC30

	Perform	ance			
Moment	Mx and My	Mx and My 226 Nm 2000 in-Ib		00 in-lb	2304.25 kg-
(nominal)	-				cm
Moment	Mz	338 Nm	30	00 in-lb	3456 kg-cm
Position Repeatability	X , Y & Z axes	<u>+</u> 0.025 mm		<u>+</u> 0.001 ir	า
Center of Mass (from R	obot Faceplate)	41.15 mm			1.62 in
Mass				1.88 k	g
Weight				4.14	b
(Robot & Tooling Adaptor with Universal plates)					
Coupling Direction		Axial			
Nominal Payload Capacity					
(Fail-safe at air loss through internal spring)		30 kg		66 lb	
Maximum Axial Tensile Force		8896 N @ 0 bar couple port input pressure	psi po	0 lb @ 0 couple rt input essure	907 kgf @ 0 bar couple port input pressure
Maximum allowable rotational offset during coupling		± 0.052 radia	ns		± 3.0°
Maximum allowable lateral offset during coupling		± 1.4 mm ± 0.0		0.055 in	
Nominal Operating Temperature		5° C - 60° C 41° F -		F - 140° F	

Robot To Tool Interfaces

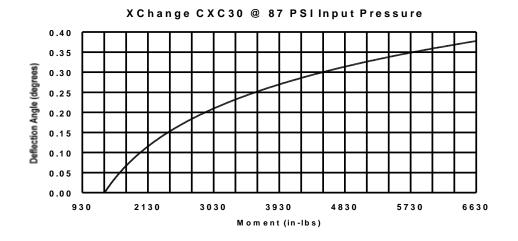
User Electrical Lines	22 @ 5	amps each
Iser Pneumatic Ports (8) 1/8" NPT or BS		NPT or BSPT
Normal Working Pressure Range	4 - 8.5 bar	56-123 psi

Actuation & Sensing			
Couple & Uncouple Ports	(2) 1/8" NPT or BSPT		
Nominal Working pressure Range	6 bar ± 1 87 psi ± 15		
Actuation Mechanism Position Sensor - UNCOUPLED	Permanent Magnetic Operated Reed Switch. 200 Volts DC Max. 10 Watts (500 mA Max Switching Current)		
Actuation Mechanism Position Sensor - COUPLED	Dry Contact Closure 30 VDC Max.		
	200 mA Max.		

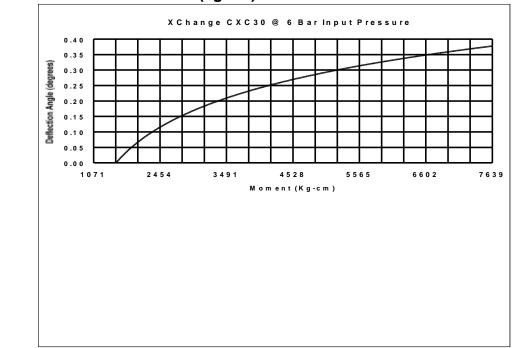
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9.1. CXC30 Moment Chart (in-lb)



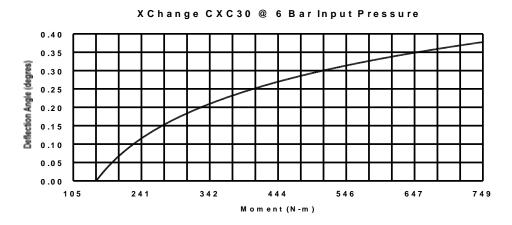
9.2. CXC30 Moment Chart (kg-cm)



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9.3. CXC30 Moment Chart (N-m)

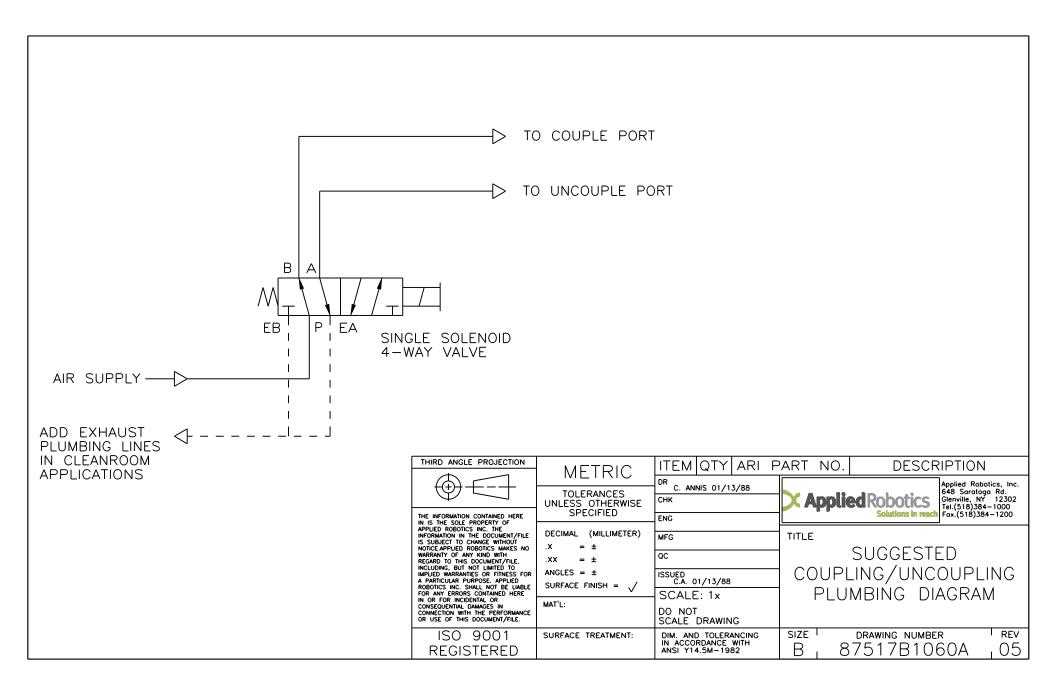


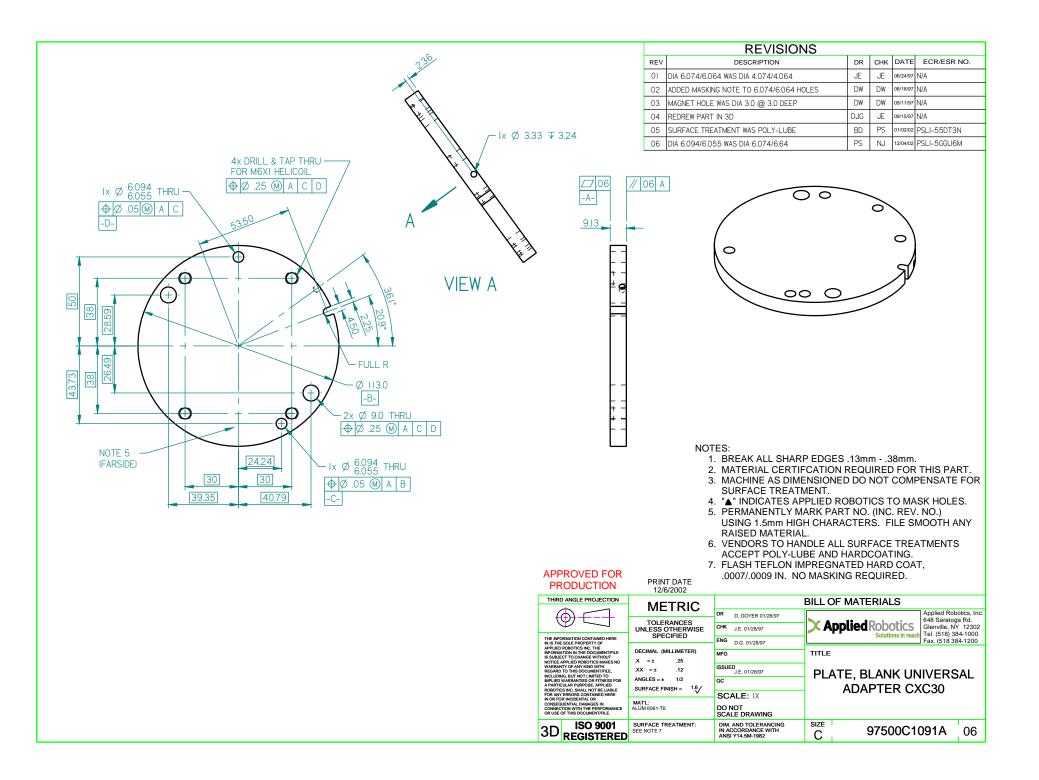
10. INFORMATIONAL DRAWINGS

The drawings in this section can assist with installation, use and identification of replacement parts for CXC30 systems. The following drawings are included in this User's Guide. Drawings are arranged alpha-numerically by Drawing Number.

DRAWING NUMBER	DESCRIPTION
87517-B1060A	Plumbing Diagram (Coupling/Uncoupling)
97500-C1091A	Blank Adaptor Plate CXC30
97500-D1062A	Electrical Schematic
97501-C1075A	Outline Drawing CXC30 with Electrical Modules
97505-D1002A	Tool Storage Fixture CXC30F-22-150-S
97507-C1003A	Replacement Parts - CXC30 Robot Electrical Module
97507-C1006A	Replacement Parts - Tool Storage Fixture
97507-C1010A	Replacement Parts - CXC30 Tooling Electrical Module
97507-C1013A	Replacement Parts - CXC30 Robot Adaptor
97507-C1018A	Replacement Parts - CXC30 Tooling Adaptor
97507-D1000A	CXC30 Coupling Sequence

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ROBOT ADAPTOR	XChange SPRING PIN	TOOLING ADAPTOR	
OLFLEX CABLE UNITRONIC-FD 890: #892425 ROBOT 900: #28116	INTERFACE	OLFLEX CABLE UNITRONIC-FD 890: #892425 ROBOT 900: #28116	
WHITE			
BROWN		BROWN	
GREEN		GREEN	
YELLOW		YELLOW	
GRAY		GRAY	
PINK		PINK	
BLUE		BLUE	
RED		RED	
BLACK		BLACK	
VIOLET		VIOLET	
GRAY/PINK		GRAY/PINK	
RED/BLUE		RED/BLUE	
WHITE/GREEN		WHITE/GREEN	
BROWN/GREEN		BROWN/GREEN	
WHITE/YELLOW		WHITE/YELLOW	
YELLOW/BROWN		YELLOW/BROWN	
WHITE/GRAY		WHITE/GRAY	
GRAY/BROWN		GRAY/BROWN	
WHITE/PINK		WHITE/PINK	
PINK/BROWN		PINK/BROWN	
BROWN/BLUE		BROWN/BLUE	Approved for
WHITE/RED(COMMON)		WHITE/RED	PRODUCTION
BROWN/RED (COUPLED)		BROWN/RED	METRIC ITEM QTY ARI PART NO. DESCRIPTION
WHITE/BLACK (UNCOUPLED)		WHITE/BLACK	COLLET ALLOS C
(ACTUATED BY PISTON MAGNET) 200 VOLTS DC MAX. 10 WATTS 500 mg MAX-SWITCHING			
			SCALE DRAWING ISO 9001 SUMPACE TREATMENT: DRAWING TOLERANCING REGISTERED SUMPACE TREATMENT: DRAWING TOLERANCING MAD VISA-1982 D , 97500D1062A

