UNIVERSAL ROBOTS

# Joint Replacement Manual

## e-Series

Original instructions (en)

e-Series

# Contents

# 1. General Information

## 1.1. Purpose

The purpose of this manual is to help Universal Robots (UR) users and integrators to safely perform service-related operations and troubleshooting.
Universal Robots industrial robots are designed using high quality components to ensure a long lifetime. However, improper use of a robot or robot parts can potentially cause failures. If, for example, the robot is overloaded, dropped during relocation, damaged by collision, or any other improper usage, the warranty will be void.
Universal Robots recommends the user does not attempt repair, adjustment, or make other interventions in the mechanical or electrical systems of the robot without first consulting an UR certified service engineer. Any unauthorized intervention voids the warranty. Service- related operations and troubleshooting should only be performed by qualified personnel.
Before performing service-related operations, stop the robot program and disconnect the main power to any potentially dangerous tool on the robot or in the surroundings.
In the event of a defect, Universal Robots recommends ordering new parts from the Universal Robot distributor where the robot was originally purchased. Alternatively, parts can be ordered from the nearest distributor, details of which can be obtained from Universal Robots official website at www.universal-robots.com

## 1.2. Company Details

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Tel.: +45 89 93 89 89
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## 1.3. Disclaimer

Universal Robots continues to improve reliability and performance of its products, and therefore reserves the right to upgrade the product without prior warning. Universal Robots takes every care that the contents of this manual are precise and correct but takes no responsibility for any errors or missing information.

# 2. Intended Use

**Description**

**NOTICE**

Universal Robots takes no responsibility and assumes no liability for unapproved uses of its robots or uses for which its robots are not intended and Universal Robots will provide no support for unintended uses.

**READ MANUAL**

Failure to use the robot in accordance with the intended use can result in hazardous situations.

- Read and follow the recommendations for intended use and the specifications provided in the User Manual.

Universal Robots robots are intended for industrial use, to handle tools/end effectors and fixtures, or to process or transfer components or products.

All UR robots are equipped with safety functions, which are purposely designed to enable collaborative applications, where the robot application operates together with a human. The safety function settings must be set to the appropriate values as determined by the robot application risk assessment.

The robot and Control Box are intended for inside use where, normally, only non-conductive pollution occurs i.e. Pollution degree 2 environments.

Collaborative applications are only intended for non-hazardous applications, where the complete application, including tool/end effector, work piece, obstacles and other machines, is low risk according to the risk assessment of the specific application.

**WARNING**

Using UR robots or UR products outside of the intended uses can result in injuries, death and/or property damage. Do not use the UR robot or products for any of the below unintended uses and applications:

- Medical use, i.e. uses relating to disease, injury or disability in humans including the following purposes:
  - Rehabilitation
  - Assessment
  - Compensation or alleviation
  - Diagnostic
  - Treatment
  - Surgical
  - Healthcare
  - Prosthetics and other aids for the physically impaired
  - Any use in proximity to patient/s
- Handling, lifting, or transporting people
- Any application requiring compliance with specific hygienic and/or sanitation standards, such as proximity or direct contact with food, beverage, pharmaceutical, and /or cosmetic products.
  - UR joint grease leaks, and can also be released as vapor into the air.
  - UR joint grease is not “food grade”.
  - UR robots do not meet any food, National Sanitization Foundation (NSF), Food and Drug Administration (FDA), or hygienic design standards.

  Hygienic standards, for example ISO 14159 and EN 1672-2, require a hygiene risk assessment be conducted.
- Any use, or any application, deviating from the intended use, specifications, and certifications of UR robots or UR products.
- Misuse is prohibited as the result could be death, personal injury, and /or property damage

UNIVERSAL ROBOTS EXPRESSLY DISCLAIMS ANY EXPRESS OR IMPLIED WARRANTY OF FITNESS FOR ANY PARTICULAR USE.

**WARNING**

Failure to consider the added risks due to the reach, payloads, operating torques and speeds associated with robot application, can result in injury or death.

- Your application risk assessment shall include the risks associated with the application's reach, motion, payload and speed of the robot, end effector and workpiece.

# 3. Safety

**Description**

Read the safety information here to understand key safety guidelines, important safety messages and your responsibilities when working with the robot. System design and installation are not covered here.

## 3.1. General

**Description**

Read the general safety information and the instructions and guidance pertaining to risk assessment and the intended use. Subsequent sections describe and define safety-related functions particularly relevant for collaborative applications. Read and understand the specific engineering data relevant to mounting and installation, in order to understand the integration of UR robots before the robot is powered on for the first time.

It is essential to observe and follow all assembly instructions in the following sections of this manual.

**NOTICE**

Universal Robots disclaims any and all liability if the robot (arm Control Box with or without Teach Pendant) is damaged, changed or modified in any way. Universal Robots cannot be held responsible for any damages caused to the robot or any other equipment due to programming errors, unauthorized access to the UR robot and its contents, or malfunctioning of the robot.

## 3.2. Warnings Symbols

**Description**

Safety messages are used to emphasize important information. Read all the messages to help ensure safety and to prevent injury to personnel and product damage. The safety message types are defined below.

**WARNING**

Indicates a hazardous situation that, if not avoided, can result in death or serious injury.

**WARNING: ELECTRICITY**

Indicates a hazardous electrical situation that, if not avoided, can result in death or serious injury.

**WARNING: HOT SURFACE**

Indicates a hazardous hot surface where injury can result from contact and non-contact proximity.

**CAUTION**

Indicates a hazardous situation that, if not avoided, can result in injury.

**GROUND**

Indicates grounding.

**PROTECTIVE GROUND**

Indicates protective grounding.

**NOTICE**

Indicates the risk of damage to equipment and/or information to be noted.

**READ MANUAL**

Indicates more detailed information that should be consulted in the manual.

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**NOTICE**

Indicates the risk of damage to equipment and/or information to be noted.

**READ MANUAL**

Indicates more detailed information that should be consulted in the manual.

## 3.4. General Warnings and Cautions

**Description** The following warnings messages can be repeated, explained or detailed in subsequent sections.

**WARNING**

Failure to adhere to the general safety practices, listed below, can result in injury or death.

- Verify the robot arm and tool/end effector are properly and securely bolted in place.
- Verify the robot application has ample space to operate freely.
- Verify the personnel are protected during the lifetime of the robot application including transport, installation, commissioning, programming/ teaching, operation and use, dismantling and disposing.
- Verify robot safety configuration parameters are set to protect personnel, including those who can be within reach of the robot application.
- Avoid using the robot if it is damaged.
- Avoid wearing loose clothing or jewelry when working with the robot. Tie back long hair.
- Avoid placing any fingers behind the internal cover of the Control Box.
- Inform users of any hazardous situations and the protection that is provided, explain any limitations of the protection and the residual risks.
- Inform users of the location of the emergency stop button(s) and how to activate the emergency stop in case of an emergency or an abnormal situation.
- Warn people to keep outside the reach of the robot, including when the robot application is about to start-up.
- Be aware of robot orientation to understand the direction of movement when using the Teach Pendant.
- Adhere to the requirements in ISO 10218-2.

**WARNING**

Handling tools/end effectors with sharp edges and/or pinch points can result in injury.

- Make sure tools/end effectors have no sharp edges or pinch points.
- Protective gloves and/or protective eyeglasses could be required.

**WARNING: HOT SURFACE**

Prolonged contact with the heat generated by the robot arm and the Control Box, during operation, can lead to discomfort resulting in injury.

- Do not handle or touch the robot while in operation or immediately after operation.
- Check the temperature on the log screen before handling or touching the robot.
- Allow the robot to cool down by powering it off and waiting one hour.

**CAUTION**

Failure to perform a risk assessment prior to integration and operation can increase risk of injury.

- Perform a risk assessment and reduce risks prior to operation.
- If determined by the risk assessment, do not enter the range of the robot movement or touch the robot application during operation. Install safeguarding.
- Read the risk assessment information.

**CAUTION**

Using the robot with untested external machinery, or in an untested application, can increase the risk of injury to personnel.

- Test all functions and the robot program separately.
- Read the commissioning information.

**NOTICE**

Very strong magnetic fields can damage the robot.

- Do not expose the robot to permanent magnetic fields.

**READ MANUAL**

Verify all mechanical and electrical equipment is installed according to relevant specifications and warnings.

# 4. Lifting and Handling

**Description**

The robot arms come in different sizes and weights, so it is important to use the appropriate lifting and handling techniques for each model. Here you can find information on how to safely lift and handle the robot.

# 5. Tool Kits

**Description**

When replacing robot arm parts, Universal Robots are always recommending using correct and calibrated tools.
Universal Robots can also provide tool kit.
Contact your local Universal Robots sales representative if you need to procure a tool kit.

# 6. Torque Values

**Description**

**CAUTION**

Always refer to the newest version of the service manual when disassembling and assembling any part of the robot arm and the control box.

**CAUTION**

Always use the specified torque values for the joint connections.

**CAUTION**

Click the torque tools 2-3 times before use to get the correct torque.

| Connection | Head size | | Torque |
|---|---|---|---|
| Screw Connection | Torx T10 | 0.9Nm for countersunk screws<br>1.3Nm for non-countersunk screws | +0.10Nm<br>-0.10Nm |
| Screw Connection | Torx T20 | 2.0Nm for countersunk screws<br>1.3Nm for non-countersunk screws | +0.30Nm<br>-0.30Nm |
| Clamp Connection | Hex key 4 | 4.0Nm | +0.50Nm<br>-0.50Nm |
| Blue lid screws | Torx T10 | 0.4Nm | +0.05Nm<br>-0.05Nm |
| Tool Connector | No tools required | | |
| Tool mounting | | Max. 8.0Nm | |

# 7. Replacing Robot Arm Joints

**Description**

The replacement procedure applies to all joints, tool mounting brackets, and tool mounting brackets with force/torque sensor.
For detailed information on how to safely perform service-related operations and troubleshooting, refer to the Universal Robots service manuals at universal-robots.com/download.
For direct support, create a support ticket on our customer portal, MyUR @ https://myur.universal-robots.com/.

**Warnings**

**WARNING**

Unsupported joints can fall, or be dropped, resulting in injury

- Support joints while screws are being removed.

**NOTICE**

Failure to support the joint/s while screws are removed can result in damage to equipment.

- Prevent the joint/s from falling while removing clamps or screws by doing any of the following:
- Use something to support underneath the part that is coming off.
- Disassemble the joint while it is laying down.
- Support with lifting equipment.

**NOTICE**

Failure to test the new joint after replacement can lead to damage to property and/or equipment.

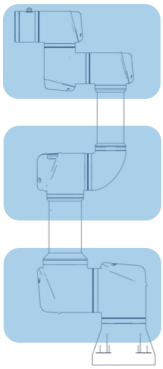
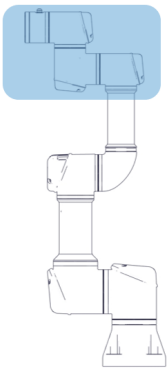
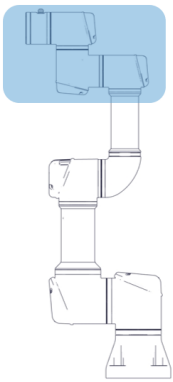
- Always perform a joint replacement test before using a new joint. See the Joint Verification section in the Service Manual for more information.
- Joints should be assembled in a vertical position to ensure proper mating between the joints.

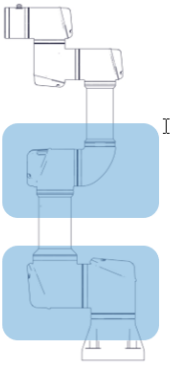
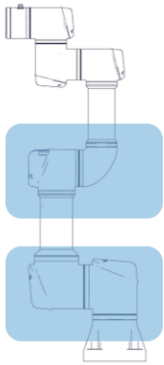
## Connections

There are two different ways the joints are assembled.

| Screw Connection | | | | Clamp Connection | | |
|---|---|---|---|---|---|---|
|  | | | |  | | |
| Head Size | Torque | | | Head Size | Torque | |
| Torx T10 | 0.9Nm for countersunk screws | +0,10Nm<br>-0.10Nm | | Hex key 4 | 4.0Nm | +0.50Nm<br>-0.50Nm |
| Torx T20 | 2.0Nm for countersunk screws | +0.30Nm<br>-0.30Nm | | | | |

**Robot Joints**

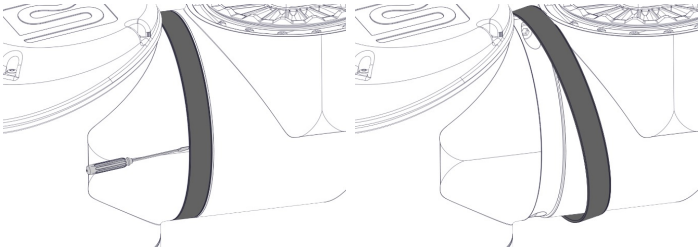
| Screw connection location | | |
|---|---|---|
| UR3e | UR5e | UR10e and UR16e |
|  |  |  |

| Clamp connection location | |
|---|---|
| UR5e | UR10e and UR16e |
|  |  |

# 7.1. Disassembly Clamp Connection

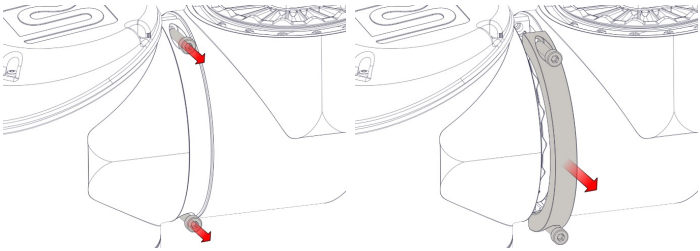
**Description** These are the steps that you need to take to disassemble a clamp connection.

1. Remove the screws in the blue lid, then remove the blue lid.
2. **Gently** remove the power and communications wires from the terminals.
3. Remove the black flat-ring. You can use a small flathead screwdriver.

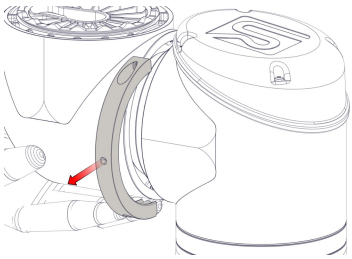


4. Remove the screws and the clamp on one side.

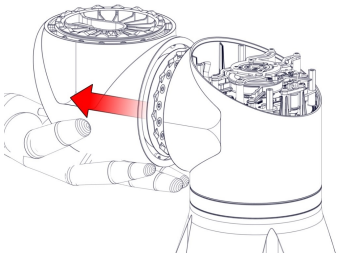
> **MANDATORY ACTION**
> The joint can fall off if not supported when removing the clamp.



5. Support the joint as you remove the second side of the clamp.



6. The joint is now loose and can be removed. Remember to pull the wires out as well.

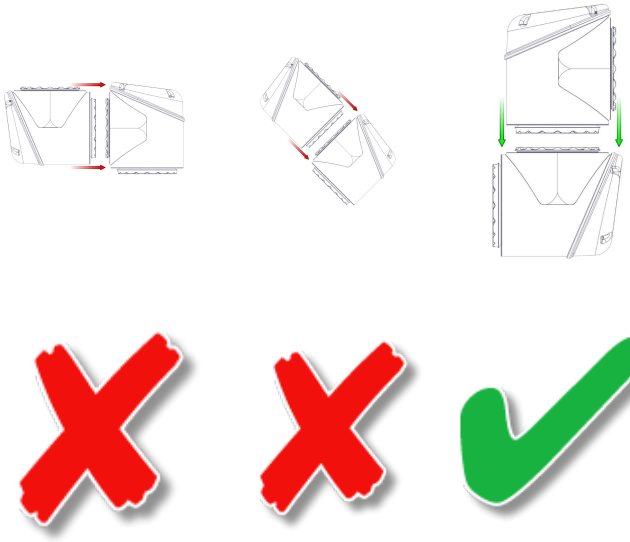


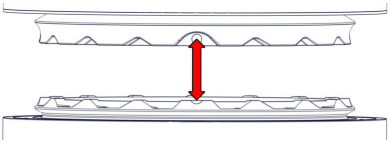
# 7.2. Assembly Clamp Connection

**Description** The assembly is done in reverse of the disassembly. However, a few things must be noted before assembly is begun.

**NOTICE**

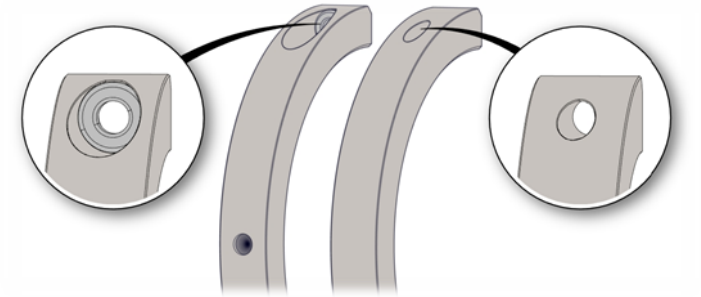
Always replace the black flexible flat ring with a new one to maintain the IP classification.
Replace the foam seal on the clamps if damaged to maintain the IP classification.
Replace the wear rings if extensive wear or damage is shown.
The dots must be aligned otherwise the connection cannot be made.





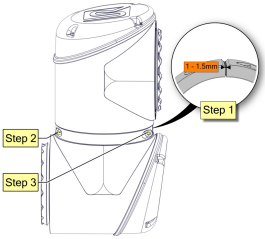
**CAUTION**

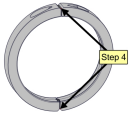
Joints should be assembled in a vertical position to ensure proper mating between the joints.
Ensure the screws are inserted in the correct clamp.
Only apply to early version of brackets where one side has a circular marker.



When tightening the clamps, it must be done in steps. Do not exceed recommended torque:

- Step 1: Tighten one side so there is a gap of 1.0mm to 1.5mm.
- Step 2: Tighten the other side completely with 4.0Nm. +/- 0.50 Nm.
- Step 3: Tighten the first side with 4.0Nm. +/- 0.50 Nm.
- Step 4: Ensure same gap at both ends.

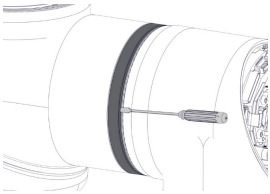


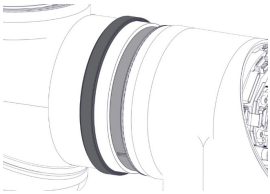



# 7.3. Disassembly Screw Connection

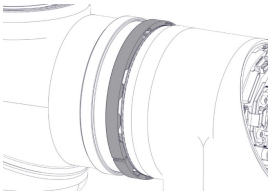
**Description**

1. Remove the screws in the blue lid, then remove the blue lid.
2. **Gently** remove the power and communications wires from the terminals.
3. You can use a small flathead screwdriver to push-off the flat-ring. Then slide the flat-ring over the joint.





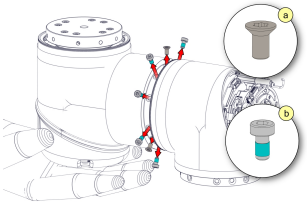
4. Remove Teflon-ring.



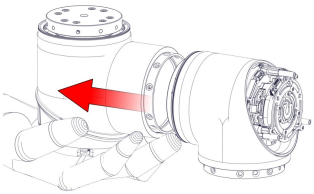
**MANDATORY ACTION**

The joint can fall off if not supported when removing the screws.

5. First remove the countersunk screws(a) then the remaining(b) screws.
6. **Note**: Be very careful when removing the screws. Always use a correct sized, and undamaged screwdriver. The screw head slots can easily be stripped.




7. The joint is now loose and can be removed. Remember to pull the wires out.



## 7.4. Assembly Screw Connection

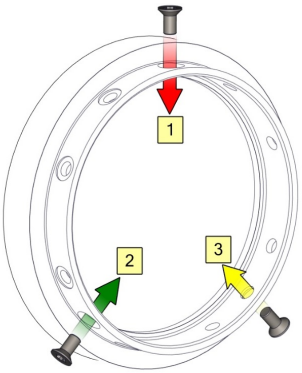
**Description**

The assembly is done in reverse of the disassembly. However, a few things must be noted before assembly is begun.

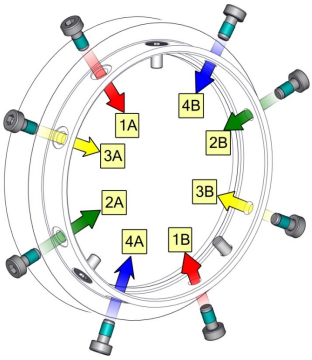
**NOTICE**

Remove old Loctite residue in the screw holes with a roll tap or forming tap (Size 2 M4 the rest M3) for threads before assembling the joint to get the correct torque on the new screws.
Always use new pre-coated screws when possible. If you must assemble with old screws, carefully clean the screws and add Loctite 243 to the screws before assembly.
Always replace the black flexible flat ring with a new one to maintain the IP classification.
Replace the wear rings if extensive wear or damage is shown

1. Orient the joints according to the marks (indicated by red arrows in the image below) and gently push the two joints together.
2. Insert and tighten the hex countersunk screws according to the image below. Do not exceed recommended torque.
   Example: 1, 2, 3




3. Insert and tighten the hex screws according to the image below. Do not exceed recommended torque.
   Example: 1A, 1B, 2A, 2B etc.



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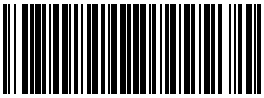
Software Name: PolyScope 5
Software Version: 5.20
Document Version: 10.13.273





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