



UNIVERSAL ROBOTS

Joint Replacement Manual

UR Series



UNIVERSAL ROBOTS



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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

Universal Robots A/S
Energivej 51
DK-5260 Odense Denmark
Tel.: +45 89 93 89 89
Fax: +45 38 79 89 89



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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**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**

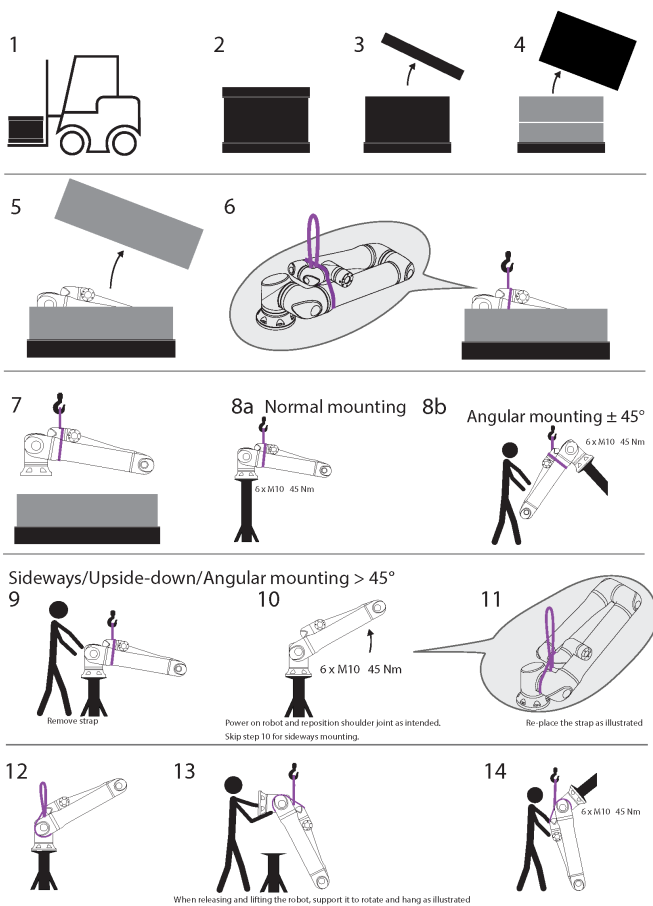
Very strong magnetic fields can damage the robot.

- 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 | Action | Detail |
|----|---|--|--|
| 1 | Transport | | |
| 2 | Opening the box | | |
| 3 | | | |
| 4 | | | |
| 5 | Removing robot arm from box using strap | | |
| 6 | | | |
| 7 | Lifting robot arm using strap and hook | | When releasing and lifting the robot, support it to rotate and hang as illustrated. |
| 8a | Mounting | a. Normal mounting | <ul style="list-style-type: none">• Fasten strap securely when using.• Remove and store strap when not using. |
| 8b | | b. Angular mounting +/-45 degrees | |
| 9 | Mounting preparation | Sideways/Upsidedown/Angular mounting >45 degrees | 1. Remove strap |
| 10 | | | 2. Power on robot and reposition shoulder joint as intended. |
| 11 | | | 3. Skip step 10 for sideways mounting. |
| | | | 4. Replace the strap as illustrated. |
| | | | 5. Move to mounting position. |
| | | | 6. Fasten securely. |
| | | | 7. Remove and store strap. |
| 12 | Mounting execution | Sideways/Upsidedown/Angular mounting >45 degrees | When releasing and lifting the robot, support it to rotate and hang as illustrated. |
| 13 | | | |
| 14 | | | |



WARNING

Lifting or movement of heavy parts can cause injury.

- Lifting apparatus/aid to lift can be required.



WARNING

Incorrect assembly of components and/or wiring can lead to injury.

- Personal protective gear (footwear, eyewear, gloves) can be required.



CAUTION

Failure to use an appropriate lifting device for the weight of the robot can lead to injury and property damage.

For UR20 and UR30:

- The lifting device shall be capable of lifting 64 kg - robot only.
- The lifting device shall be capable of lifting 84 kg - robot with payload.

For UR15:

- The lifting device shall be capable of lifting 41 kg - robot only.
- The lifting device shall be capable of lifting 58.5 kg - robot with payload.



NOTICE

There may be specific regulations for assembly lifting in your region.

- Follow the local regulations and guidelines for lifting.

For detailed mounting descriptions, see Assembly section.

5. Tool Kits

Description

To ensure an effective and safe replacement of the robot joint, Universal Robots always recommends using the correct and calibrated tools. If you do not already have the appropriate tool kit, you can procure it from your local sales representative.

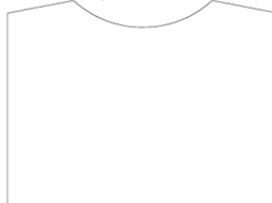


NOTICE

Click the torque tool a minimum of three times before use, to get the correct calibrated torque.



UR20 Clamp Screwdrivers Tool Kit



| No. | P/N | Description |
|-----|--------|----------------------------------|
| 6 | | ESD Wristband |
| 15 | 200121 | Screwdriver Hex Key 5mm, 5.5 Nm. |
| 16 | | Screwdriver Hex Key 6mm, 7.5 Nm. |



6. Torque Values

Description

| UR Series | | | | |
|-----------|---------------------|---------------------|---------|-----------|
| Tool | Connection | | Torque | Head Size |
| 7 | Base | [J0] Base joint | 7.5 Nm. | 6 mm. |
| 7 | [J0] Base joint | [J1] Shoulder joint | 7.5 Nm. | 6 mm. |
| 7 | [J1] Shoulder joint | Upper arm | 7.5 Nm. | 6 mm. |
| 13 | Upper arm | [J2] Elbow joint | 5.5 Nm. | 5 mm. |
| 13 | [J2] Elbow joint | Elbow counter part | 5.5 Nm. | 5 mm. |
| 13 | Elbow counter part | Lower arm | 5.5 Nm. | 5 mm. |
| 12 | Lower arm | [J3] Wrist 1 joint | 5.5 Nm. | 5 mm. |
| 12 | [J3] Wrist 1 joint | [J4] Wrist 2 | 5.5 Nm. | 5 mm. |
| 12 | [J4] Wrist 2 | [J5] Wrist 3 joint | 5.5 Nm. | 5 mm. |
| 12 | [J5] Wrist 3 joint | Tool | 5.5 Nm. | 5 mm. |
| | Tool mount M5 | | 8.0 Nm. | |



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.

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/>.



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.



7.1. Clamp Connection

Description

The following two sections describe how to disassemble and assemble a joint with a clamp connection.



NOTICE

When handling joints, consider the weight of each individual joint and observe the relevant safety rules.

| Joint Size | Joint mass |
|----------------|------------|
| Joint Size 5 | 15.8 Kg. |
| Joint Size 4 | 9.1 Kg. |
| Joint Size 3 | 5.0 Kg. |
| Joint Size 2.5 | 2.9 Kg. |
| Joint Size 2 | 2.2 Kg. |

7.2. Disassembly

Description



WARNING

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

- Support joints while clamps are being removed.



NOTICE

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

- Prevent the joint/s from falling while removing the clamp/s 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.

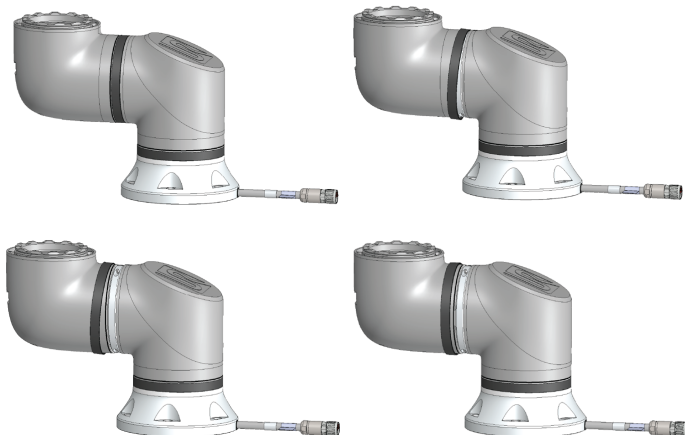
Failure to test the old joint before replacing it, can lead to damage to property and/or equipment.

Always perform a joint verification test before replacing a joint. See the Joint Verification section in the Service Manual for more information.

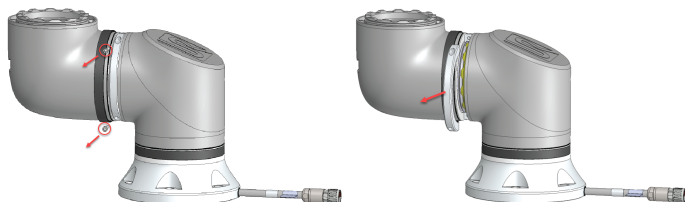


To Disassemble

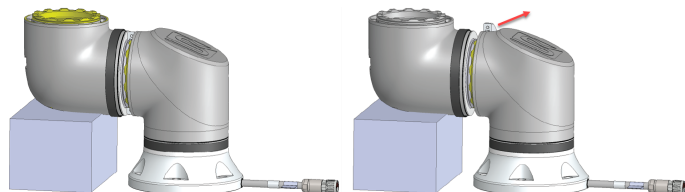
1. Attach the ESD wristband from the spare part package or tool kit to an electrical grounded surface.
2. Remove the black flat-ring.
You can use a pair of pointy tweezers or a small flathead screwdriver.



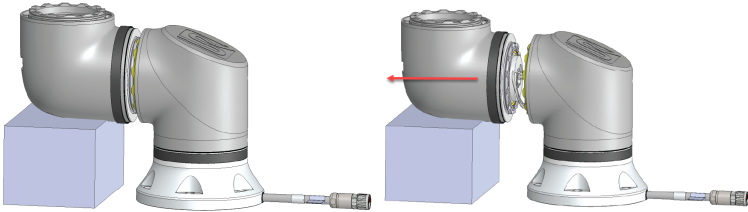
3. Remove the screws and the clamp on one side.



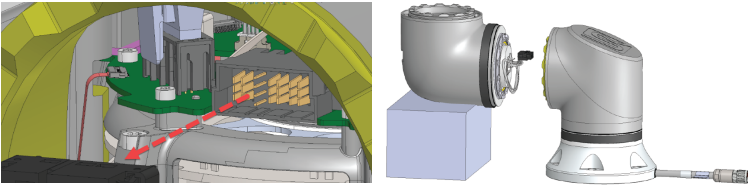
4. Support the joint as you remove the second side of the clamp.



5. The joint is now loose and can be removed.



6. Gently unplug the connector from the PCB on joint.



7. The joint has now been dismantled.
-



7.3. Assembly

Description

You can now reassemble the clamp connection with the new joint in reverse of the disassembly. However, be aware of the following before you start reassembling the clamp connection.



NOTICE

Failure to replace the black flat ring can lower the IP classification and cause damage to property and/or equipment.

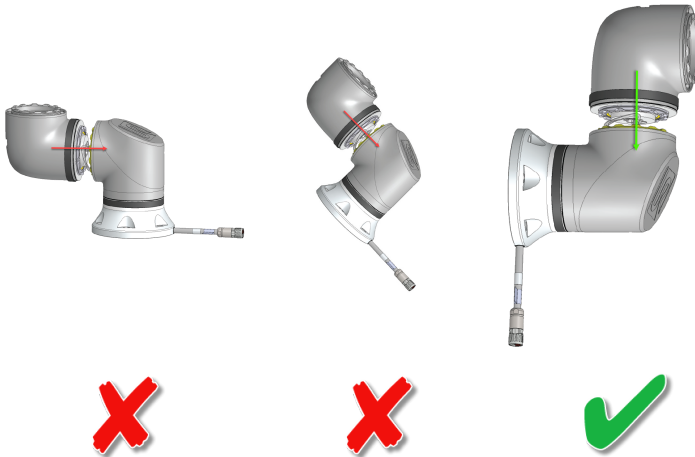
- Always replace the flat ring with a new one to maintain the IP classification. The dots must be aligned otherwise the connection cannot be made.



NOTICE

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

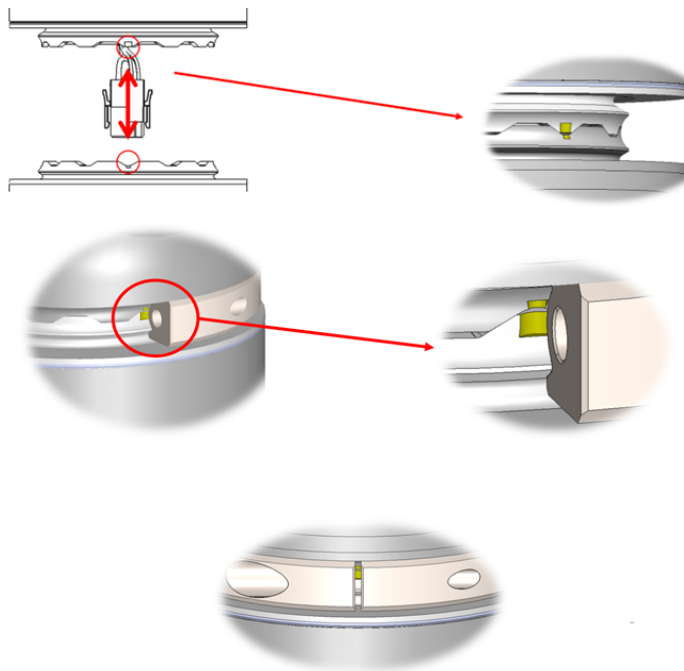
- Always perform a joint replacement test before using a new joint. See the Joint Verification section in the Service Manual for more information.
- Joints should be assembled in a vertical position to ensure proper mating between the joints.



NOTICE

Improper connection between the joints can lead to damage to property and/or equipment

- Assemble the joints in a vertical position to ensure proper connection.
- Ensure that the index marks are vertically aligned.
- The clamps must be assembled at the index marks as illustrated below.





CAUTION

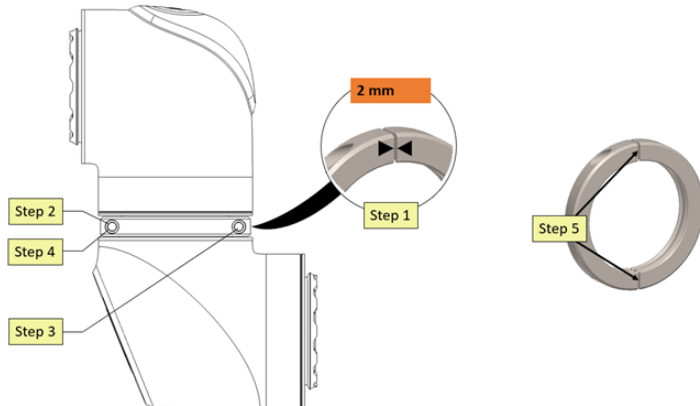
Ensure the screws are inserted in the correct clamp.



When tightening the clamp must be done in steps. Do not exceed recommended torque.

To assemble:

1. Tighten the bolt at one side so there is a 2 mm gap between the clamp ends.
2. Tighten the bolt at the other side with half the specified moment.
3. Tighten the bolt from step 1 with full moment.
4. Tighten the bolt from step 2 with full moment.
5. Ensure same gap at both ends.



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