



Product manual

IRB 360

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Product manual

IRB 360 - 1/800

IRB 360 - 1/1130

IRB 360 - 1/1600

IRB 360 - 3/1130

IRB 360 - 6/1600

IRB 360 - 8/1130

IRC5

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ABB AB, Robotics
Robotics and Motion
Se-721 68 Västerås
Sweden

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Overview of this manual

About this manual

This manual contains instructions for:

- mechanical and electrical installation of the robot
- maintenance of the robot
- mechanical and electrical repair of the robot.

The manual also contains reference information for all procedures detailed in the manual.

Usage

This manual should be used during:

- installation, from lifting the robot to its work site and securing it to the foundation, to making it ready for operation
- maintenance work
- repair work and calibration.

Who should read this manual?

This manual is intended for:

- installation personnel
- maintenance personnel
- repair personnel.

Prerequisites

Maintenance/repair/installation personnel working with an ABB Robot must:

- be trained by ABB and have the required knowledge of mechanical and electrical installation/repair/maintenance work.

Organization of chapters

The manual is organized in the following chapters:

| Chapter | Contents |
|--------------------------------|---|
| Safety | Safety information that must be read through before performing any installation or service work on the robot. Contains general safety aspects as well as more specific information on how to avoid personal injuries and damage to the product. |
| Installation and commissioning | Required information about lifting and installation of the robot. |
| Maintenance | Step-by-step procedures that describe how to perform maintenance of the robot. Based on a maintenance schedule that may be used to plan periodical maintenance. |
| Repair | Step-by-step procedures that describe how to perform repair activities of the robot. Based on available spare parts. |
| Calibration information | Procedures that do not require specific calibration equipment. General information about calibration. |
| Decommissioning | Environmental information about the robot and its components. |

Continues on next page

Overview of this manual

Continued

| Chapter | Contents |
|------------------------|---|
| Reference information | Useful information when performing installation, maintenance or repair work. Includes lists of necessary tools, additional documents, safety standards etc. |
| Spare part / part list | Complete spare part list and complete list of robot components, shown in exploded views. |
| Exploded views | Detailed illustrations of the robot with reference numbers to the part list. |
| Circuit diagram | Reference to circuit diagram for the robot. |

References

| Reference | Document ID |
|--|----------------|
| <i>Product specification - IRB 360</i> | 3HAC029963-001 |
| <i>Operating manual - General safety information</i> ⁱ | 3HAC031045-001 |
| <i>Product manual, spare parts - IRB 360</i> | 3HAC049101-001 |
| <i>Circuit diagram - IRB 360</i> | 3HAC028647-009 |
| <i>Product manual - IRC5</i> IRC5 with main computer DSQC 639. | 3HAC021313-001 |
| <i>Product manual - IRC5</i> IRC5 with main computer DSQC1000. | 3HAC047136-001 |
| <i>Operating manual - IRC5 with FlexPendant</i> | 3HAC050941-001 |
| <i>Operating manual - Calibration Pendulum</i> | 3HAC16578-1 |
| <i>Operating manual - Service Information System</i> | 3HAC050944-001 |
| <i>Application manual - Additional axes and stand alone controller</i> | 3HAC051016-001 |
| <i>Technical reference manual - Lubrication in gearboxes</i> | 3HAC042927-001 |
| <i>Technical reference manual - System parameters</i> | 3HAC050948-001 |
| <i>Application manual - Electronic Position Switches</i> | 3HAC050996-001 |

ⁱ This manual contains all safety instructions from the product manuals for the manipulators and the controllers.

Revisions

| Revision | Description |
|----------|---|
| - | First edition |
| A | This revision includes the following additions and/or changes: <ul style="list-style-type: none">• Section <i>What is an emergency stop?</i> added to chapter <i>Safety</i>.• Section <i>Maintenance schedule</i>: Interval for replacement of battery pack changed. |
| B | This revision includes the following additions and/or changes: <ul style="list-style-type: none">• Implementation of IRB360 1/1600. |

Continues on next page

| Revision | Description |
|----------|--|
| C | <p>This revision includes the following additions and/or changes:</p> <ul style="list-style-type: none"> Chapter Maintenance sections Regular maintenance on page 109, Telescopic shaft, axis 4, standard on page 112, Telescopic shaft, wash down, axis 4 on page 114, Telescopic shaft, stainless, axis 4 on page 116 and Bar system on page 122 updated concerning collisions. Chapter Maintenance section Bar system on page 122 updated on how to measure the distance between the bearing holders. Circuit diagrams are not included in this document but delivered as separate files. See Circuit diagrams on page 277. List of standards updated, see Applicable standards on page 264. Spare parts chapter - art. no. updated for telescopic shaft and upper arm. <p>Updates in the chapter Safety:</p> <ul style="list-style-type: none"> Updated safety signal graphics for the levels <i>Danger</i> and <i>Warning</i>, see Safety signals in the manual on page 38. New safety labels on the manipulators, see Safety symbols on product labels on page 40. Revised terminology: <i>robot</i> replaced with <i>manipulator</i>. |
| D | <p>This revision includes the following additions and/or changes:</p> <ul style="list-style-type: none"> Minor updates in the chapter <i>Calibration</i>. |
| E | <p>This revision includes the following additions and/or changes:</p> <ul style="list-style-type: none"> Added caution regarding swivel cup, see Fitting equipment on robot on page 82. Updated instructions for cleaning, see Cleaning activities on page 151. Updated tightening sequence, see Replacement of base cover gasket on page 172. Updated refitting instruction, see Replacement of brake release button on page 233. Added information about when to update resolver values, see When to calibrate on page 237. Updated information in Environmental information on page 260. Updated spare parts, see Spare parts in the base. |
| F | <p>This revision includes the following updates:</p> <ul style="list-style-type: none"> A new block, about general illustrations, added in section How to read the product manual on page 16. New Option 864-1 connection FB7 on robot base. |
| G | <p>This revision includes the following updates:</p> <ul style="list-style-type: none"> Spare part number for the telescopic shaft (1600) is corrected, see Spare parts - telescopic shaft. Some general tightening torques have been changed/added, see updated values in Screw joints on page 168. Maintenance interval regarding replacement of the telescopic shaft is changed from 8,000 hours to 4,000 hours, see Maintenance schedule IRB 360 on page 110. Added WARNING - Safety risks during handling of batteries on page 53. |

Continues on next page

Overview of this manual

Continued

| Revision | Description |
|----------|--|
| H | This revision includes the following updates: <ul style="list-style-type: none">Variant IRB 360 - 8/1130 is added to the manual.Information about type and volume of oil in gearboxes is removed from the manual, and is instead now available in the <i>Technical reference manual - Lubrication in gearboxes - 3HAC042927-001</i>. More information in section Type of lubrication in gearboxes on page 140.Added Replacing parts on the robot on page 170.Added information about an alternative bearing ring, see Spare parts and Bar system on page 122.A new SMB unit and battery is introduced, with longer battery lifetime.New article numbers for set screws, see Spare parts, telescopic shafts.Corrected directions in figure for calibration movement and jogging directions, see Calibration movement directions for all axes on page 240. |
| J | This revision includes the following updates: <ul style="list-style-type: none">Variant IRB 360 - 6/1600 is added to the manual.Corrected the protection class for protection typ Standard, see Protection classes on page 62.Changed the tightening torque, see Replacement of motor axis 4 on page 213.Added information about visual difference between bearing ring versions, see Different versions of bearing rings require different maintenance procedures on page 122.Universal joint 3HAC028132-001 is replaced with 3HAC046664-001, see Spare parts - telescopic shafts. |
| K | This revision includes the following updates: <ul style="list-style-type: none">Illustrations of placement of labels updated.Added information about risks when scrapping a decommissioned robot, see Scraping of robot on page 261.<i>Spare parts and exploded views</i> are not included in this document but delivered as a separate document. See Product manual, spare parts - IRB 360.Mechanical interface of IRB 360 - 8/1130 and IRB 360 - 6/1600 updated. |
| L | This revision includes the following updates: <ul style="list-style-type: none">Added information in calibration chapter, see Using the jogging window on the FlexPendant on page 254.Clarification made about when to choose standard calibration vs. ring calibration, see Types of calibration on page 238.Clarification made about measured distance between bearing holders, regarding wear on bearing rings, see Distance between bearing holders on page 124.Minor corrections |
| M | This revision includes the following updates: <ul style="list-style-type: none">Updated instructions for cleaning, see Cleaning activities on page 151.Minor corrections |
| N | This revision includes the following updates: <ul style="list-style-type: none">Minor corrections |

Continues on next page

| Revision | Description |
|----------|--|
| P | Published in release R16.2. The following updates are done in this revision: <ul style="list-style-type: none">• Corrections due to updates in terminology.• Warning about high center of gravity during transport added.• Updates about parameter <i>Calibration Position (cal_position)</i> in Calibration information on page 237.• Added information about tightening torque in section Replacement of movable plate on page 190. |
| Q | Published in release R17.1. The following updates are made in this revision: <ul style="list-style-type: none">• Major updates in cleaning section.• Updates regarding checking the calibration position.• Measurement method in Maintenance added. |

Product documentation, IRC5

Categories for user documentation from ABB Robotics

The user documentation from ABB Robotics is divided into a number of categories. This listing is based on the type of information in the documents, regardless of whether the products are standard or optional.

All documents listed can be ordered from ABB on a DVD. The documents listed are valid for IRC5 robot systems.

Product manuals

Manipulators, controllers, DressPack/SpotPack, and most other hardware is delivered with a **Product manual** that generally contains:

- Safety information.
- Installation and commissioning (descriptions of mechanical installation or electrical connections).
- Maintenance (descriptions of all required preventive maintenance procedures including intervals and expected life time of parts).
- Repair (descriptions of all recommended repair procedures including spare parts).
- Calibration.
- Decommissioning.
- Reference information (safety standards, unit conversions, screw joints, lists of tools).
- Spare parts list with exploded views (or references to separate spare parts lists).
- Circuit diagrams (or references to circuit diagrams).

Technical reference manuals

The technical reference manuals describe reference information for robotics products.

- *Technical reference manual - Lubrication in gearboxes*: Description of types and volumes of lubrication for the manipulator gearboxes.
- *Technical reference manual - RAPID overview*: An overview of the RAPID programming language.
- *Technical reference manual - RAPID Instructions, Functions and Data types*: Description and syntax for all RAPID instructions, functions, and data types.
- *Technical reference manual - RAPID kernel*: A formal description of the RAPID programming language.
- *Technical reference manual - System parameters*: Description of system parameters and configuration workflows.

Continues on next page

Application manuals

Specific applications (for example software or hardware options) are described in **Application manuals**. An application manual can describe one or several applications.

An application manual generally contains information about:

- The purpose of the application (what it does and when it is useful).
- What is included (for example cables, I/O boards, RAPID instructions, system parameters, DVD with PC software).
- How to install included or required hardware.
- How to use the application.
- Examples of how to use the application.

Operating manuals

The operating manuals describe hands-on handling of the products. The manuals are aimed at those having first-hand operational contact with the product, that is production cell operators, programmers, and trouble shooters.

The group of manuals includes (among others):

- *Operating manual - Emergency safety information*
- *Operating manual - General safety information*
- *Operating manual - Getting started, IRC5 and RobotStudio*
- *Operating manual - IRC5 Integrator's guide*
- *Operating manual - IRC5 with FlexPendant*
- *Operating manual - RobotStudio*
- *Operating manual - Trouble shooting IRC5*

How to read the product manual

Reading the procedures

The procedures contain references to figures, tools, material, and so on. The references are read as described below.

References to figures

The procedures often include references to components or attachment points located on the manipulator/controller. The components or attachment points are marked with *italic text* in the procedures and completed with a reference to the figure where the current component or attachment point is shown.

The denomination in the procedure for the component or attachment point corresponds to the denomination in the referenced figure.

The table below shows an example of a reference to a figure from a step in a procedure.

| | Action | Note/Illustration |
|----|---|--|
| 8. | Remove the <i>rear attachment screws</i> , <i>gearbox</i> . | Shown in the figure Location of gearbox on page xx . |

References to required equipment

The procedures often include references to equipment (spare parts, tools, etc.) required for the different actions in the procedure. The equipment is marked with *italic text* in the procedures and completed with a reference to the section where the equipment is listed with further information, that is article number and dimensions.

The designation in the procedure for the component or attachment point corresponds to the designation in the referenced list.

The table below shows an example of a reference to a list of required equipment from a step in a procedure.

| | Action | Note/Illustration |
|----|--|--|
| 3. | Fit a new <i>sealing</i> , <i>axis 2</i> to the <i>gearbox</i> . | Art. no. is specified in Required equipment on page xx . |

Safety information

The manual includes a separate safety chapter that must be read through before proceeding with any service or installation procedures. All procedures also include specific safety information when dangerous steps are to be performed.

Read more in the chapter [Safety on page 17](#).

Illustrations

The robot is illustrated with general figures that does not take painting or protection type in consideration.

Likewise, certain work methods or general information that is valid for several robot models, can be illustrated with illustrations that show a different robot model than the one that is described in the current manual.

1 Safety

1.1 Introduction to safety information

Overview

The safety information in this manual is divided into the following categories:

- General safety aspects, important to attend to before performing any service work on the robot. These are applicable for all service work and are found in [*General safety information on page 18*](#).
- Safety signals and symbols shown in the manual and on the robot, warning for different types of dangers, are found in [*Safety signals and symbols on page 38*](#).
- Specific safety information, pointed out in the procedures. How to avoid and eliminate the danger is either described directly in the procedure, or in specific instructions in the section [*Safety related instructions on page 46*](#).

1 Safety

1.2.1 Introduction to general safety information

1.2 General safety information

1.2.1 Introduction to general safety information

Definitions

This section details general safety information for personnel performing installation, repair and maintenance work.

Sections

The general safety information is divided into the following sections.

| Section | Examples of content |
|--|---|
| <i>Safety in the manipulator system on page 19</i> | This section describes the following: <ul style="list-style-type: none">• safety, service• limitation of liability• related information |
| <i>Protective stop and emergency stop on page 21</i> | This section describes protective stop and emergency stop. |
| <i>Safety risks on page 22</i> | This section lists dangers relevant when working with the product. The dangers are split into different categories. <ul style="list-style-type: none">• safety risks during installation or service• risks associated with live electrical parts |
| <i>Safety actions on page 31</i> | This section describes actions which may be taken to remedy or avoid dangers. <ul style="list-style-type: none">• fire extinguishing• safe use of the teach pendant or jogging device |

1.2.2 Safety in the manipulator system

Validity and responsibility

The information does not cover how to design, install and operate a complete system, nor does it cover all peripheral equipment that can influence the safety of the entire system. To protect personnel, the complete system must be designed and installed in accordance with the safety requirements set forth in the standards and regulations of the country where the robot is installed.

The users of ABB industrial robots are responsible for ensuring that the applicable safety laws and regulations in the country concerned are observed and that the safety devices necessary to protect people working with the robot system are designed and installed correctly. Personnel working with robot must be familiar with the operation and handling of the industrial robot as described in the applicable documents, for example:

- *Operating manual - IRC5 with FlexPendant*
- *Operating manual - General safety information*¹
- *Product manual*

¹ This manual contains all safety instructions from the product manuals for the robots and the controllers.

The robot system shall be designed and constructed in such a way as to allow safe access to all areas where intervention is necessary during operation, adjustment, and maintenance.

Where it is necessary to perform tasks within the safeguarded space there shall be safe and adequate access to the task locations.

Users shall not be exposed to hazards, including slipping, tripping, and falling hazards.

Connection of external safety devices

Apart from the built-in safety functions, the robot is also supplied with an interface for the connection of external safety devices. An external safety function can interact with other machines and peripheral equipment via this interface. This means that control signals can act on safety signals received from the peripheral equipment as well as from the robot.

Limitation of liability

Any information given in this manual regarding safety must not be construed as a warranty by ABB that the industrial robot will not cause injury or damage even if all safety instructions are complied with.

Related information

| Type of information | Detailed in document | Section |
|--------------------------------|---|--------------------------------|
| Installation of safety devices | <i>Product manual for the robot</i> | Installation and commissioning |
| Changing operating modes | <i>Operating manual - IRC5 with FlexPendant</i> <i>Operator's Manual - IRC5P</i> | Operating modes |

Continues on next page

1 Safety

1.2.2 Safety in the manipulator system

Continued

| Type of information | Detailed in document | Section |
|-------------------------------|-------------------------------------|--------------------------------|
| Restricting the working space | <i>Product manual for the robot</i> | Installation and commissioning |

1.2.3 Protective stop and emergency stop

Overview

The protective stops and emergency stops are described in the product manual for the controller.

1 Safety

1.2.4.1 Safety risks during installation and service work on robots

1.2.4 Safety risks

1.2.4.1 Safety risks during installation and service work on robots

Overview

This section includes information on general safety risks to be considered when performing installation and service work on the robot.

These safety instructions have to be read and followed by any person who deals with the installation and maintenance of the robot. Only persons who know the robot and are trained in the operation and handling of the robot are allowed to maintain the robot. Persons who are under the influence of alcohol, drugs or any other intoxicating substances are not allowed to maintain, repair, or use the robot.

General risks during installation and service

- The instructions in the product manual in the chapters *Installation and commissioning*, and *Repair* must always be followed.
- Emergency stop buttons must be positioned in easily accessible places so that the robot can be stopped quickly.
- Those in charge of operations must make sure that safety instructions are available for the installation in question.
- Those who install or service/maintain the robot must have the appropriate training for the equipment in question and in any safety matters associated with it.

Spare parts and special equipment

ABB does not supply spare parts and special equipment which have not been tested and approved by ABB. The installation and/or use of such products could negatively affect the structural properties of the robot and as a result of that affect the active or passive safety operation. ABB is not liable for damages caused by the use of non-original spare parts and special equipment. ABB is not liable for damages or injuries caused by unauthorized modifications to the robot system.

Personal protective equipment

Always use suitable personal protective equipment, based on the risk assessment for the robot installation.

Nation/region specific regulations

To prevent injuries and damages during the installation of the robot, the regulations applicable in the country concerned and the instructions of ABB Robotics must be complied with.

Non-voltage related risks

- Make sure that no one else can turn on the power to the controller and robot while you are working with the system. A good method is to always lock the main switch on the controller cabinet with a safety lock.

Continues on next page

1.2.4.1 Safety risks during installation and service work on robots

Continued

- Safety zones, which must be crossed before admittance, must be set up in front of the robot's working space. Light beams or sensitive mats are suitable devices.
- Turntables or the like should be used to keep the operator out of the robot's working space.
- If the robot is installed at a height, hanging, or other than standing directly on the floor, there may be additional risks than those for a robot standing directly on the floor.
- The axes are affected by the force of gravity when the brakes are released. In addition to the risk of being hit by moving robot parts, there is a risk of being crushed by the parallel arm (if there is one).
- Energy stored in the robot for the purpose of counterbalancing certain axes may be released if the robot, or parts thereof, are dismantled.
- When dismantling/assembling mechanical units, watch out for falling objects.
- Be aware of stored heat energy in the controller.
- Never use the robot as a ladder, which means, do not climb on the robot motors or other parts during service work. There is a serious risk of slipping because of the high temperature of the motors and oil spills that can occur on the robot.
- Never use the robot as a ladder, which means, do not climb on the manipulator motors or other parts during service work. There is a risk of the robot being damaged.

To be observed by the supplier of the complete system

When integrating the robot with external devices and machines:

- The supplier of the complete system must ensure that all circuits used in the safety function are interlocked in accordance with the applicable standards for that function.
- The supplier of the complete system must ensure that all circuits used in the emergency stop function are interlocked in a safe manner, in accordance with the applicable standards for the emergency stop function.

Complete robot

| Safety risk | Description |
|-----------------|---|
| Hot components! |  CAUTION Motors and gearboxes are HOT after running the robot! Touching motors and gearboxes may result in burns! With a higher environment temperature, more surfaces on the manipulator will get HOT and may also result in burns. |

Continues on next page

1 Safety

1.2.4.1 Safety risks during installation and service work on robots

Continued

| Safety risk | Description |
|---|--|
| Removed parts may result in collapse of the robot! |  WARNING Take any necessary measures to ensure that the robot does not collapse as parts are removed. For example, secure the lower arm according to the repair instruction if removing the axis-2 motor. |
| Removed cables to the measurement system |  WARNING If the internal cables for the measurement system have been disconnected during repair or maintenance, then the revolution counters must be updated. |

Cabling

| Safety risk | Description |
|---|--|
| Cable packages are sensitive to mechanical damage! |  CAUTION The cable packages are sensitive to mechanical damage. Handle the cable packages and the connectors with care in order to avoid damage. |

Gearboxes and motors

| Safety risk | Description |
|---|---|
| Gears may be damaged if excessive force is used! |  CAUTION Whenever parting/mating motor and gearbox, the gears may be damaged if excessive force is used! |

1.2.4.2 CAUTION - Hot parts may cause burns!

1.2.4.2 CAUTION - Hot parts may cause burns!**Description**

During normal operation, many robot parts become hot, especially the drive motors and gearboxes. Sometimes areas around these parts also become hot. Touching these may cause burns of various severity.

Because of a higher environment temperature, more surfaces on the robot get hot and may result in burns.

Elimination

The following instructions describe how to avoid the dangers specified above:

| | Action | Information |
|---|--|-------------|
| 1 | Always use your hand, at some distance, to feel if heat is radiating from the potentially hot component before actually touching it. | |
| 2 | Wait until the potentially hot component has cooled if it is to be removed or handled in any other way. | |

1 Safety

1.2.4.3 Safety risks related to tools/work pieces

1.2.4.3 Safety risks related to tools/work pieces

Safe handling

It must be possible to safely turn off tools, such as milling cutters, etc. Make sure that guards remain closed until the cutters stop rotating.

It should be possible to release parts by manual operation (valves).

Safe design

Grippers/end effectors must be designed so that they retain work pieces in the event of a power failure or a disturbance to the controller.

Unauthorized modifications of the originally delivered robot are prohibited. Without the consent of ABB it is forbidden to attach additional parts through welding, riveting, or drilling of new holes into the castings. The strength could be affected.



CAUTION

Ensure that a gripper is prevented from dropping a work piece, if such is used.

1.2.4.4 Safety risks related to pneumatic/hydraulic systems

General

Special safety regulations apply to pneumatic and hydraulic systems.



Note

All components that remain pressurized after separating the machine from the power supply must be provided with clearly visible drain facilities and a warning sign that indicates the need for pressure relief before adjustments or performing any maintenance on the robot system.

Residual energy

- Residual energy can be present in these systems. After shutdown, particular care must be taken.
- The pressure must be released in the complete pneumatic or hydraulic systems before starting to repair them.
- Work on hydraulic equipment may only be performed by persons with special knowledge and experience of hydraulics.
- All pipes, hoses, and connections have to be inspected regularly for leaks and damage. Damage must be repaired immediately.
- Splashed oil may cause injury or fire.

Safe design

- Gravity may cause any parts or objects held by these systems to drop.
- Dump valves should be used in case of emergency.
- Shot bolts should be used to prevent tools, etc., from falling due to gravity.

1 Safety

1.2.4.5 Safety risks during operational disturbances

General

- The industrial robot is a flexible tool that can be used in many different industrial applications.
- All work must be carried out professionally and in accordance with the applicable safety regulations.
- Care must be taken at all times.

Qualified personnel

Corrective maintenance must only be carried out by qualified personnel who are familiar with the entire installation as well as the special risks associated with its different parts.

Extraordinary risks

If the working process is interrupted, extra care must be taken due to risks other than those associated with regular operation. Such an interruption may have to be rectified manually.

1.2.4.6 Risks associated with live electric parts

Voltage related risks, general

Work on the electrical equipment of the robot must be performed by a qualified electrician in accordance with electrical regulations.

- Although troubleshooting may, on occasion, need to be carried out while the power supply is turned on, the robot must be turned off (by setting the main switch to OFF) when repairing faults, disconnecting electric leads and disconnecting or connecting units.
- The main supply to the robot must be connected in such a way that it can be turned off from outside the working space of the robot.
- Make sure that no one else can turn on the power to the controller and robot while you are working with the system. A good method is to always lock the main switch on the controller cabinet with a safety lock.

The necessary protection for the electrical equipment and robot system during construction, commissioning, and maintenance is guaranteed if the valid regulations are followed.

All work must be performed:

- by qualified personnel
- on machine/robot system in deadlock
- in an isolated state, disconnected from power supply, and protected against reconnection.

Voltage related risks, IRC5 controller

A danger of high voltage is associated with, for example, the following parts:

- Be aware of stored electrical energy (DC link, Ultracapacitor bank unit) in the controller.
- Units such as I/O modules, can be supplied with power from an external source.
- The main supply/main switch
- The transformers
- The power unit
- The control power supply (230 VAC)
- The rectifier unit (262/400-480 VAC and 400/700 VDC. Note: capacitors!)
- The drive unit (400/700 VDC)
- The drive system power supply (230 VAC)
- The service outlets (115/230 VAC)
- The customer power supply (230 VAC)
- The power supply unit for additional tools, or special power supply units for the machining process.
- The external voltage connected to the controller remains live even when the robot is disconnected from the mains.
- Additional connections.

Continues on next page

1 Safety

1.2.4.6 Risks associated with live electric parts

Continued

Voltage related risks, robot

A danger of high voltage is associated with the robot in:

- The power supply for the motors (up to 800 VDC).
 - The user connections for tools or other parts of the installation (max. 230 VAC).
-

Voltage related risks, tools, material handling devices, etc.

Tools, material handling devices, etc., may be live even if the robot system is in the OFF position. Power supply cables which are in motion during the working process may be damaged.

1.2.5 Safety actions

1.2.5.1 Safety fence dimensions

General

Install a safety cell around the robot to ensure safe robot installation and operation.

Dimensioning

The fence or enclosure must be dimensioned to withstand the force created if the load being handled by the robot is dropped or released at maximum speed.

Determine the maximum speed from the maximum velocities of the robot axes and from the position at which the robot is working in the work cell (see the section *Robot motion* in the *Product specification*).

Also consider the maximum possible impact caused by a breaking or malfunctioning rotating tool or other device fitted to the robot.

1 Safety

1.2.5.2 Fire extinguishing



Note

Use a CARBON DIOXIDE (CO₂) extinguisher in the event of a fire in the robot or controller!

1.2.5.3 Emergency release of the robot arm

Description

In an emergency situation, the brakes on a robot axis can be released manually by pushing a brake release button.

How to release the brakes is detailed in the section:

- [Manually releasing the brakes on page 79.](#)

The robot arm may be moved manually on smaller robot models, but larger models may require using an overhead crane or similar equipment.

Increased injury

Before releasing the brakes, make sure that the weight of the arms does not increase the pressure on the trapped person, further increasing any injury!



DANGER

When releasing the holding brakes, the robot axes may move very quickly and sometimes in unexpected ways.

Make sure no personnel is near or beneath the robot arm.

1 Safety

1.2.5.4 Brake testing

1.2.5.4 Brake testing

When to test

During operation, the holding brake of each axis normally wears down. A test can be performed to determine whether the brake can still perform its function.

How to test

The function of the holding brake of each axis motor may be verified as described below:

- 1 Run each robot axis to a position where the combined weight of the robot arm and any load is maximized (maximum static load).
- 2 Switch the motor to the MOTORS OFF.
- 3 Inspect and verify that the axis maintains its position.

If the robot does not change position as the motors are switched off, then the brake function is adequate.

1.2.5.5 Risk of disabling function "Reduced speed 250 mm/s"



Note

Do not change *Transm gear ratio* or other kinematic system parameters from the FlexPendant or a PC. This will affect the safety function "Reduced speed 250 mm/s".

1 Safety

1.2.5.6 Safe use of the jogging device

1.2.5.6 Safe use of the jogging device

Three-position enabling device

The three-position enabling device is a manually operated, constant pressure push-button which, when continuously activated in one position only, allows potentially hazardous functions but does not initiate them. In any other position, hazardous functions are stopped safely.

The three-position enabling device is of a specific type where you must press the push-button only half-way to activate it. In the fully in and fully out positions, operating the robot is impossible.



Note

The three-position enabling device is a push-button located on the jogging device which, when pressed halfway in, switches the system to MOTORS ON. When the enabling device is released or pushed all the way in, the manipulator switches to the MOTORS OFF state.

To ensure safe use of the jogging device, the following must be implemented:

- The enabling device must never be rendered inoperational in any way.
- During programming and testing, the enabling device must be released as soon as there is no need for the robot to move.
- Anyone entering the working space of the robot must always bring the jogging device with him/her. This is to prevent anyone else from taking control of the robot without his/her knowledge.

Hold-to-run function

The hold-to-run function allows movement when a button connected to the function is actuated manually and immediately stops any movement when released. The hold-to-run function can only be used in manual mode.

How to operate the hold-to-run function for IRC5 is described in *Operating manual - IRC5 with FlexPendant*.

1.2.5.7 Work inside the working range of the robot



WARNING

If work must be carried out within the work area of the robot, then the following points must be observed:

- The operating mode selector on the controller must be in the manual mode position to render the three-position enabling device operational and to block operation from a computer link or remote control panel.
- The maximum speed of the robot is limited to 250 mm/s when the operating mode selector is in the position *Manual mode with reduced speed*. This should be the normal position when entering the working space.
The position *Manual mode with full speed (100%)* may only be used by trained personnel who are aware of the risks that this entails. *Manual mode with full speed (100%)* is not available in USA or Canada.
- Pay attention to the rotating axes of the robot. Keep away from axes to not get entangled with hair or clothing. Also, be aware of any danger that may be caused by rotating tools or other devices mounted on the robot or inside the cell.
- Test the motor brake on each axis, according to the section [Brake testing on page 34](#).
- To prevent anyone else from taking control of the robot, always put a safety lock on the cell door and bring the three-position enabling device with you when entering the working space.



WARNING

NEVER, under any circumstances, stay beneath any of the robot's axes! There is always a risk that the robot will move unexpectedly when robot axes are moved using the three-position enabling device or during other work inside the working range of the robot.

1 Safety

1.3.1 Safety signals in the manual

1.3 Safety signals and symbols

1.3.1 Safety signals in the manual

Introduction to safety signals

This section specifies all dangers that can arise when doing the work described in the user manuals. Each danger consists of:

- A caption specifying the danger level (DANGER, WARNING, or CAUTION) and the type of danger.
- A brief description of what will happen if the operator/service personnel do not eliminate the danger.
- Instruction about how to eliminate danger to simplify doing the work.

Danger levels

The table below defines the captions specifying the danger levels used throughout this manual.

| Symbol | Designation | Significance |
|---|-------------------------------|---|
|  xx0200000022 | DANGER | Warns that an accident <i>will</i> occur if the instructions are not followed, resulting in a serious or fatal injury and/or severe damage to the product. It applies to warnings that apply to danger with, for example, contact with high voltage electrical units, explosion or fire risk, risk of poisonous gases, risk of crushing, impact, fall from height, and so on. |
|  xx0100000002 | WARNING | Warns that an accident <i>may</i> occur if the instructions are not followed that can lead to serious injury, possibly fatal, and/or great damage to the product. It applies to warnings that apply to danger with, for example, contact with high voltage electrical units, explosion or fire risk, risk of poisonous gases, risk of crushing, impact, fall from height, etc. |
|  xx0200000024 | ELECTRICAL SHOCK | Warns for electrical hazards which could result in severe personal injury or death. |
|  xx0100000003 | CAUTION | Warns that an accident may occur if the instructions are not followed that can result in injury and/or damage to the product. It also applies to warnings of risks that include burns, eye injury, skin injury, hearing damage, crushing or slipping, tripping, impact, fall from height, etc. Furthermore, it applies to warnings that include function requirements when fitting and removing equipment where there is a risk of damaging the product or causing a breakdown. |
|  xx0200000023 | ELECTROSTATIC DISCHARGE (ESD) | Warns for electrostatic hazards which could result in severe damage to the product. |

Continues on next page

1.3.1 Safety signals in the manual

Continued

| Symbol | Designation | Significance |
|---|-------------|--|
|  xx0100000004 | NOTE | Describes important facts and conditions. |
|  xx0100000098 | TIP | Describes where to find additional information or how to do an operation in an easier way. |

1 Safety

1.3.2 Safety symbols on product labels

1.3.2 Safety symbols on product labels

Introduction to labels

This section describes safety symbols used on labels (stickers) on the product.

Symbols are used in combinations on the labels, describing each specific warning. The descriptions in this section are generic, the labels can contain additional information such as values.



Note

The safety and health symbols on the labels on the product must be observed. Additional safety information given by the system builder or integrator must also be observed.

Types of labels

Both the robot and the controller are marked with several safety and information labels, containing important information about the product. The information is useful for all personnel handling the robot system, for example during installation, service, or operation.

The safety labels are language independent, they only use graphics. See [Symbols on safety labels on page 40](#).

The information labels can contain information in text (English, German, and French).

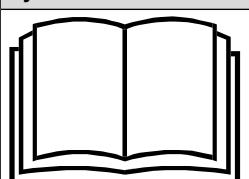
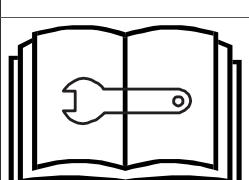
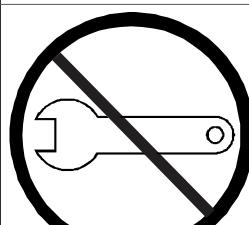
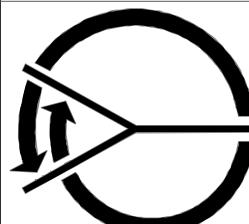
Symbols on safety labels

| Symbol | Description |
|--------------|--|
| xx0900000812 | Warning! Warns that an accident <i>may</i> occur if the instructions are not followed that can lead to serious injury, possibly fatal, and/or great damage to the product. It applies to warnings that apply to danger with, for example, contact with high voltage electrical units, explosion or fire risk, risk of poisonous gases, risk of crushing, impact, fall from height, etc. |
| xx0900000811 | Caution! Warns that an accident may occur if the instructions are not followed that can result in injury and/or damage to the product. It also applies to warnings of risks that include burns, eye injury, skin injury, hearing damage, crushing or slipping, tripping, impact, fall from height, etc. Furthermore, it applies to warnings that include function requirements when fitting and removing equipment where there is a risk of damaging the product or causing a breakdown. |
| xx0900000839 | Prohibition Used in combinations with other symbols. |

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1.3.2 Safety symbols on product labels

Continued

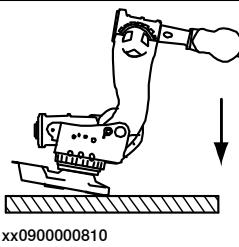
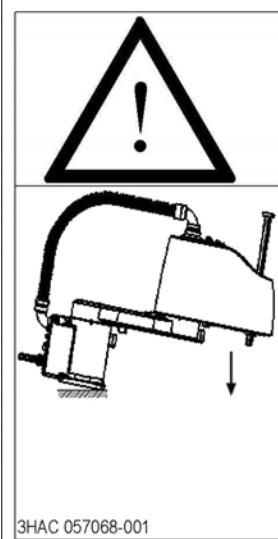
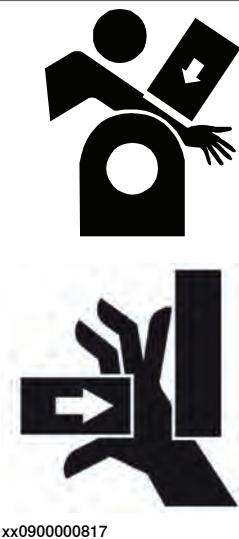
| Symbol | Description |
|---|--|
|  xx0900000813 | See user documentation Read user documentation for details. Which manual to read is defined by the symbol: <ul style="list-style-type: none"> • No text: <i>Product manual</i>. • EPS: <i>Application manual - Electronic Position Switches</i>. |
|  xx0900000816 | Before disassemble, see product manual |
|  xx0900000815 | Do not disassemble Disassembling this part can cause injury. |
|  xx0900000814 | Extended rotation This axis has extended rotation (working area) compared to standard. |
|  xx0900000808 | Brake release Pressing this button will release the brakes. This means that the robot arm can fall down. |

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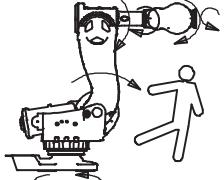
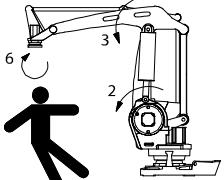
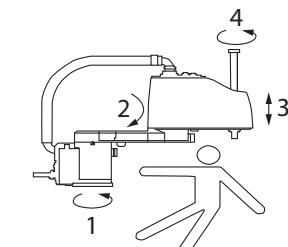
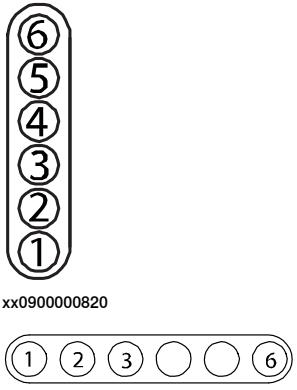
1 Safety

1.3.2 Safety symbols on product labels

Continued

| Symbol | Description |
|---|--|
|  xx0900000810 | Tip risk when loosening bolts The robot can tip over if the bolts are not securely fastened. |
|  3HAC 057068-001 | |
|  xx1500002402 | Crush Risk of crush injuries. |
|  xx0900000818 | Heat Risk of heat that can cause burns. |

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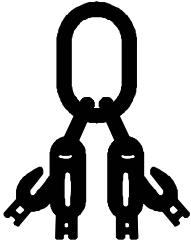
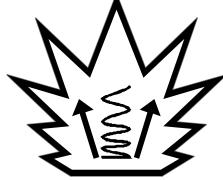
| Symbol | Description |
|---|---|
|  xx0900000819 | Moving robot The robot can move unexpectedly. |
|  xx1000001141 | |
|  xx1500002616 | |
|  xx0900000820 | Brake release buttons |
|  xx0900000821 | Lifting bolt |

Continues on next page

1 Safety

1.3.2 Safety symbols on product labels

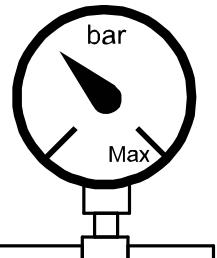
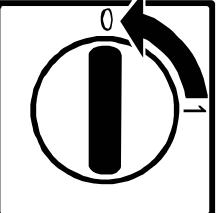
Continued

| Symbol | Description |
|---|--|
|  xx1000001242 | Chain sling with shortener |
|  xx0900000822 | Lifting of robot |
|  xx0900000823 | Oil Can be used in combination with prohibition if oil is not allowed. |
|  xx0900000824 | Mechanical stop |
|  xx1000001144 | No mechanical stop |
|  xx0900000825 | Stored energy Warns that this part contains stored energy. Used in combination with <i>Do not disassemble</i> symbol. |

Continues on next page

1.3.2 Safety symbols on product labels

Continued

| Symbol | Description |
|--|---|
|  xx0900000826 | Pressure Warns that this part is pressurized. Usually contains additional text with the pressure level. |
|  xx0900000827 | Shut off with handle Use the power switch on the controller. |
|  xx1400002648 | Do not step Warns that stepping on these parts can cause damage to the parts. |

1 Safety

1.4.1 DANGER - Moving robots are potentially lethal!

1.4 Safety related instructions

1.4.1 DANGER - Moving robots are potentially lethal!

Description

Any moving robot is a potentially lethal machine.

When running, the robot may perform unexpected and sometimes irrational movements. Moreover, all movements are performed with great force and may seriously injure any personnel and/or damage any piece of equipment located within the working range of the robot.

Elimination

| | Action | Note |
|---|--|---|
| 1 | Before attempting to run the robot, make sure all emergency stop equipment is correctly installed and connected. | Emergency stop equipment such as gates, tread mats, light curtains, etc. |
| 2 | Usually the hold-to-run function is active only in manual full speed mode. To increase safety it is also possible to activate hold-to-run for manual reduced speed with a system parameter. The hold-to-run function is used in manual mode, not in automatic mode. | How to use the hold-to-run function is described in section <i>How to use the hold-to-run function</i> in the <i>Operating manual - IRC5 with FlexPendant</i> . |
| 3 | Make sure no personnel are present within the working range of the robot before pressing the start button. | |

1.4.2 DANGER - First test run may cause injury or damage!

1.4.2 DANGER - First test run may cause injury or damage!**Description**

Since performing a service activity often requires disassembly of the robot, there are several safety risks to take into consideration before the first test run.

Elimination

Follow the procedure below when performing the first test run after a service activity, such as repair, installation, or maintenance.

**DANGER**

Running the robot without fulfilling the following aspects, may cause severe damage to the robot.

| | Action |
|---|--|
| 1 | Remove all service tools and foreign objects from the robot and its working area. |
| 2 | Verify that the robot is secured to its position, see installation section in the product manual for the robot. |
| 3 | Verify that any safety equipment installed to secure the robot arm position or restrict the robot arm motion during service activity is removed. |
| 4 | Verify that the fixture and work piece are well secured, if applicable. |
| 5 | Install all safety equipment properly. |
| 6 | Make sure all personnel are standing at a safe distance from the robot, that is out of its reach behind safety fences, and so on. |
| 7 | Pay special attention to the function of the part that previously was serviced. |

Collision risks**CAUTION**

When programming the movements of the robot, always identify potential collision risks before the first test run.

1 Safety

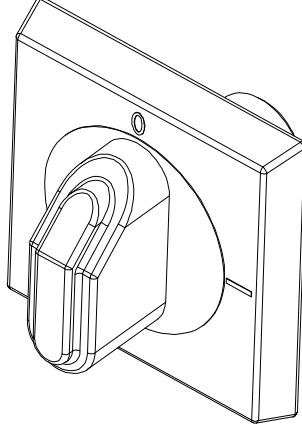
1.4.3 DANGER - Make sure that the main power has been switched off!

1.4.3 DANGER - Make sure that the main power has been switched off!

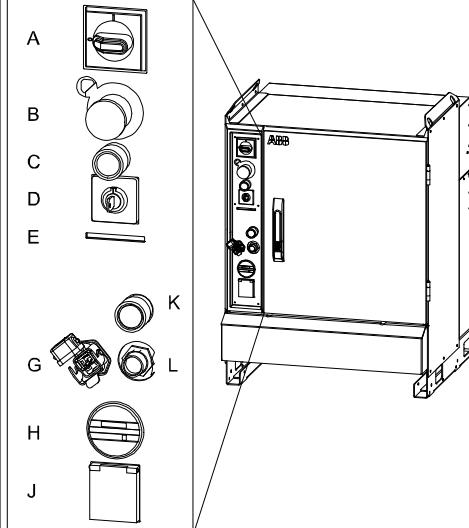
Description

Working with high voltage is potentially lethal. Persons subjected to high voltage may suffer cardiac arrest, burn injuries, or other severe injuries. To avoid these dangers, do not proceed working before eliminating the danger as detailed below.

Elimination, IRC5 Panel Mounted Controller

| | Action | Note/illustration |
|---|--|---|
| 1 | Switch off the main switch for the controller. |  xx0600003255 |

Elimination, IRC5 Single Cabinet Controller

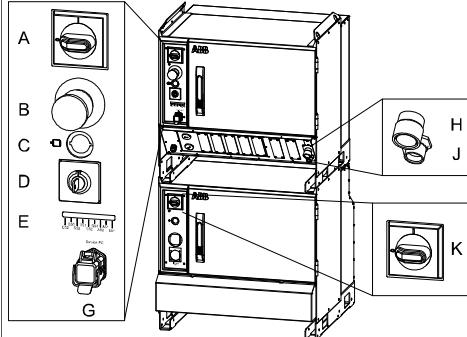
| | Action | Note/illustration |
|---|---|--|
| 1 | Switch off the main switch on the controller cabinet. |  xx0600002782 A: Main switch |

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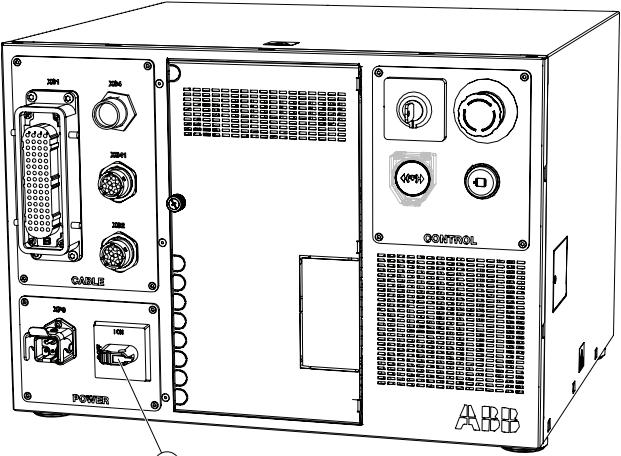
1.4.3 DANGER - Make sure that the main power has been switched off!

Continued

Elimination, IRC5 Dual Cabinet Controller

| | Action | Note/illustration |
|---|---|--|
| 1 | Switch off the main switch on the Drive Module. |  <p>xx0600002783</p> <p>K: Main switch, Drive Module</p> |
| 2 | Switch off the main switch on the Control Module. | A: Main switch, Control Module |

Elimination, IRC5 Compact Controller

| | Action | Note/illustration |
|---|---|---|
| 1 | Switch off the main power switch on the controller cabinet. | <p>Note that the position of the main switch can vary depending on the year model.</p>  <p>xx0900000313</p> <p>A: Main power switch</p> |
| 2 | Disconnect the input power cable from the wall socket. | |

1 Safety

1.4.4 WARNING - The unit is sensitive to ESD!

Description

ESD (electrostatic discharge) is the transfer of electrical static charge between two bodies at different potentials, either through direct contact or through an induced electrical field. When handling parts or their containers, personnel not grounded may potentially transfer high static charges. This discharge may destroy sensitive electronics.

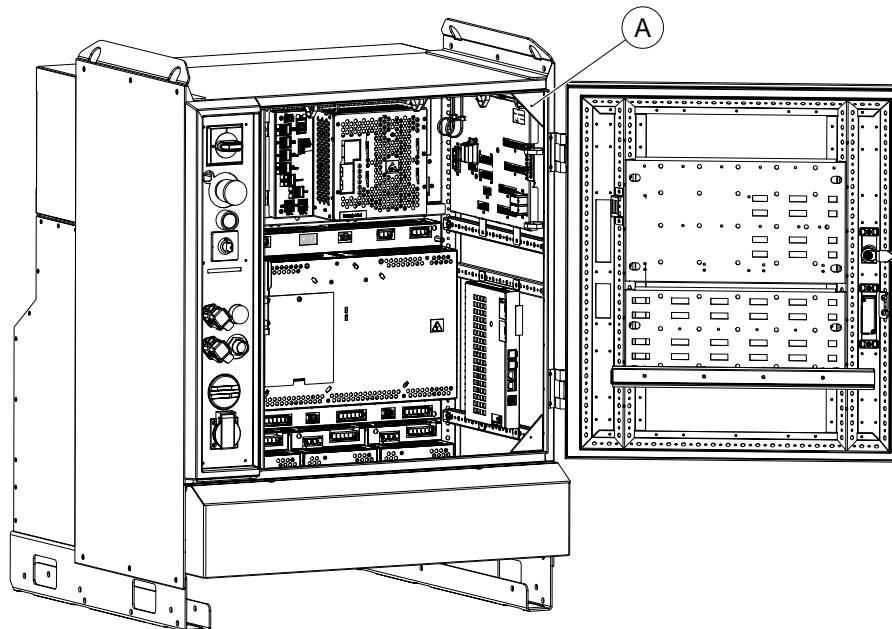
Elimination

| Action | Note |
|------------------------------------|---|
| 1 Use a wrist strap. | Wrist straps must be tested frequently to ensure that they are not damaged and are operating correctly. |
| 2 Use an ESD protective floor mat. | The mat must be grounded through a current-limiting resistor. |
| 3 Use a dissipative table mat. | The mat should provide a controlled discharge of static voltages and must be grounded. |

Location of wrist strap button

The location of the wrist strap button is shown in the following illustration.

IRC5



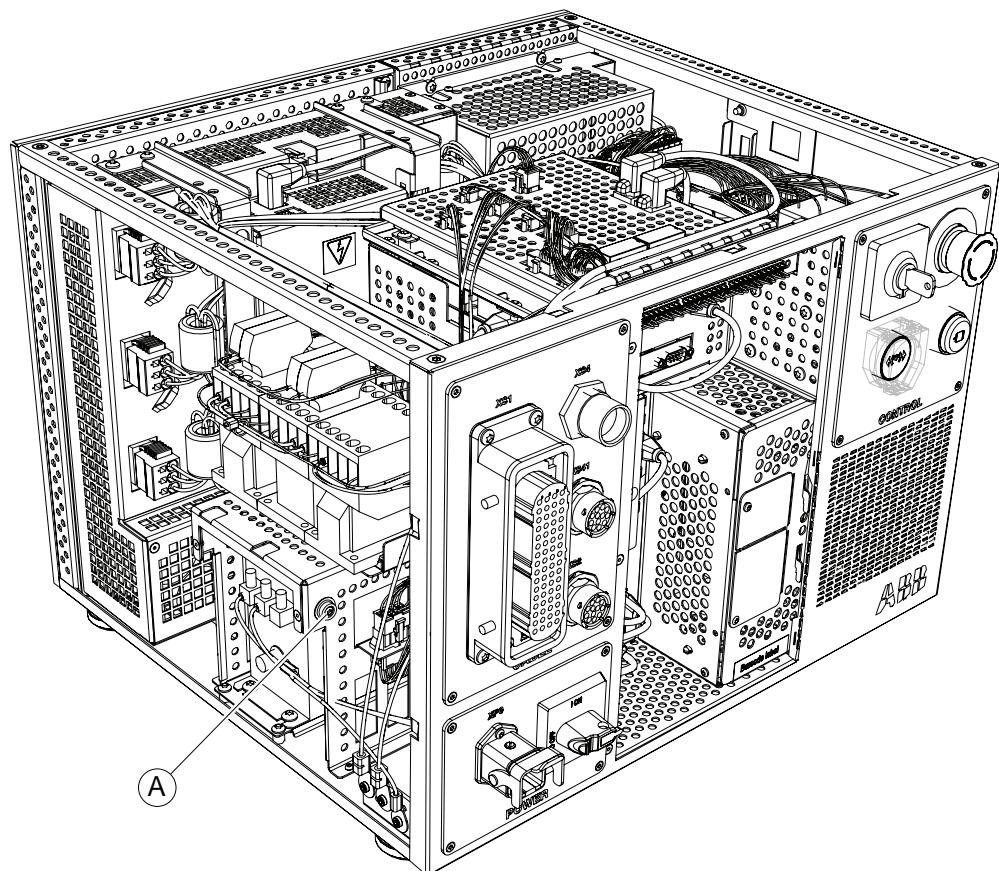
A Wrist strap button

Continues on next page

1.4.4 WARNING - The unit is sensitive to ESD!

Continued

IRC5 Compact Controller



xx1400001622

| | |
|---|--------------------|
| A | Wrist strap button |
|---|--------------------|

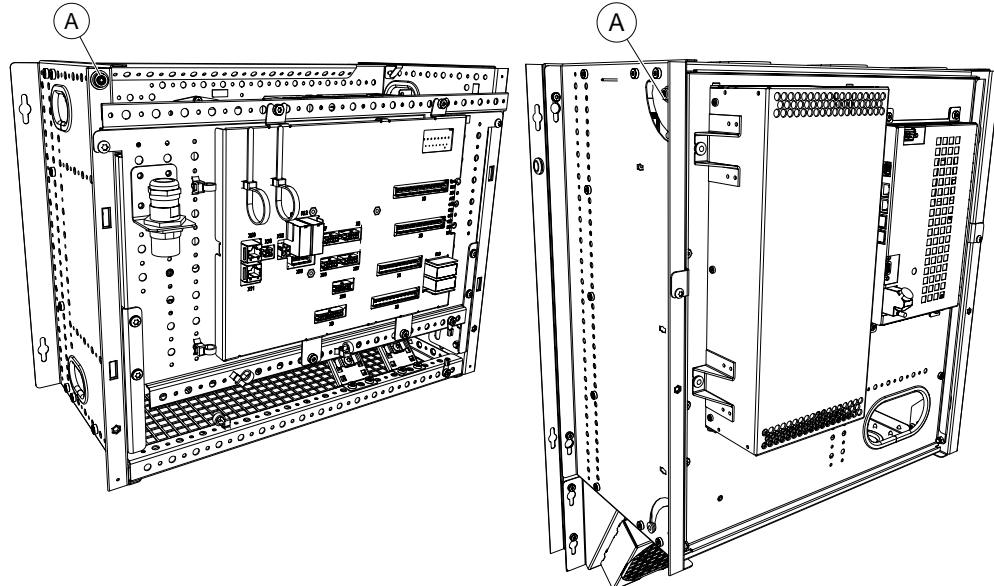
Continues on next page

1 Safety

1.4.4 WARNING - The unit is sensitive to ESD!

Continued

Panel Mounted Controller



xx1300001960

| | |
|---|--------------------|
| A | Wrist strap button |
|---|--------------------|

1.4.5 WARNING - Safety risks during handling of batteries

Description

Under normal conditions of use, the electrode materials and liquid electrolyte in the batteries are not exposed to the outside, provided the battery integrity is maintained and seals remain intact.

There is a risk of exposure only in case of abuse (mechanical, thermal, electrical) which leads to the activation of safety valves and/or the rupture of the battery container. Electrolyte leakage, electrode materials reaction with moisture/water or battery vent/explosion/fire may follow, depending upon the circumstances.



Note

Appropriate disposal regulations must be observed.

Elimination

| | Action | Note |
|---|--|--|
| 1 | Do not short circuit, recharge, puncture, incinerate, crush, immerse, force discharge or expose to temperatures above the declared operating temperature range of the product. Risk of fire or explosion. | Operating temperatures are listed in Pre-installation procedure on page 59 . |
| 2 | Use safety glasses when handling the batteries. | |
| 3 | In the event of leakage, wear gloves and chemical apron. | |
| 4 | In the event of fire, use self-contained breathing apparatus. | |

1 Safety

1.4.6 WARNING - Safety risks during work with gearbox lubricants (oil or grease)

Description

When handling gearbox lubricants, there is a risk of both personal injury and product damage occurring. The following safety information must be regarded before performing any work with lubricants in the gearboxes.



Note

When handling oil, grease, or other chemical substances the safety information of the manufacturer must be observed.



Note

When aggressive media is handled, an appropriate skin protection must be provided. Gloves and goggles are recommended.



Note

Appropriate disposal regulations must be observed.



Note

Take special care when handling hot lubricants.

Warnings and elimination

| Warning | Description | Elimination/Action |
|--|---|---|
| xx0100000002 Hot oil or grease | Changing and draining gearbox oil or grease may require handling hot lubricant heated up to 90 °C. | Make sure that protective gear like goggles and gloves are always worn during this activity. |
| xx0100000002 Allergic reaction | When working with gearbox lubricant there is a risk of an allergic reaction. | Make sure that protective gear like goggles and gloves are always worn. |
| xx0100000002 Possible pressure build-up in gearbox | When opening the oil or grease plug, there may be pressure present in the gearbox, causing lubricant to spray from the opening. | Open the plug carefully and keep away from the opening. Do not overfill the gearbox when filling. |

Continues on next page

1.4.6 WARNING - Safety risks during work with gearbox lubricants (oil or grease)

Continued

| Warning | Description | Elimination/Action |
|--|--|--|
|  xx0100000002 Do not overfill | <p>Overfilling of gearbox lubricant can lead to internal over-pressure inside the gearbox which in turn may:</p> <ul style="list-style-type: none"> • damage seals and gaskets • completely press out seals and gaskets • prevent the robot from moving freely. | <p>Make sure not to overfill the gearbox when filling it with oil or grease!</p> <p>After filling, verify that the level is correct.</p> |
|  xx0100000002 Do not mix types of oil | <p>Mixing types of oil may cause severe damage to the gearbox.</p> | <p>When filling gearbox oil, do not mix different types of oil unless specified in the instructions. Always use the type of oil specified by the manufacturer!</p> |
|  xx0100000098 Heat up the oil | <p>Warm oil drains quicker than cold oil.</p> | <p>When changing gearbox oil, first run the robot for a time to heat up the oil.</p> |
|  xx0100000004 Specified amount depends on drained volume | <p>The specified amount of oil or grease is based on the total volume of the gearbox. When changing the lubricant, the amount refilled may differ from the specified amount, depending on how much has previously been drained from the gearbox.</p> | <p>After filling, verify that the level is correct.</p> |
|  xx0100000003 Contaminated oil in gear boxes | <p>When draining the oil make sure that as much oil as possible is drained from the gearbox. The reason for this is to drain as much oil sludge and metal chips as possible from the gearbox. The magnetic oil plugs will take care of any remaining metal chips.</p> | |

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2 Installation and commissioning

2.1 Introduction

General

This chapter contains assembly instructions and information for installing the IRB 360 at the working site.

More detailed technical data can be found in the *Product specification* for the IRB 360, such as:

- Load diagram
- Permitted extra loads (equipment), if any
- Location of extra loads (equipment), if any.

Safety information

Before any installation work is commenced, it is extremely important that all safety information is observed!

There are general safety aspects that must be read through, as well as more specific safety information that describes the danger and safety risks when performing the procedures. Read the chapter [Safety on page 17](#) before performing any installation work.



Note

If the IRB 360 is connected to power, always make sure that the robot is connected to *protective earth* before starting any installation work!

For more information see:

- *Product manual - IRC5*

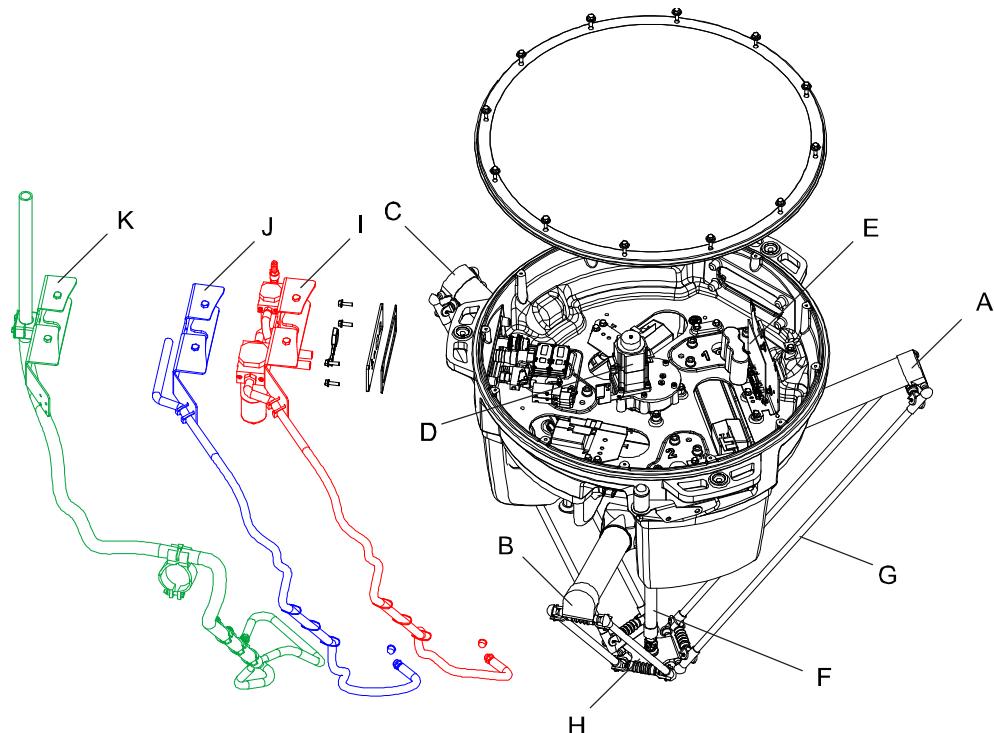
2 Installation and commissioning

2.2 Structure manipulator

2.2 Structure manipulator

Manipulator structure

The figure shows the manipulator structure and components.



xx0700000451

| | |
|---|-----------------------------|
| A | Upper arm axis 1 |
| B | Upper arm axis 2 |
| C | Upper arm axis 3 |
| D | Axis-4 motor |
| E | SMB unit |
| F | Telescopic shaft axis 4 |
| G | Parallel arm |
| H | Movable plate |
| I | Vacuum kit (optional) |
| J | Medium house set (optional) |
| K | Large house set (optional) |

2.3 Unpacking

2.3.1 Pre-installation procedure

General

This instruction is primarily intended for use when unpacking and installing the robot for the first time. It also contains information useful during later re-installation of the robot.

Checking the pre-requisites for installation

The check-list below details what must be observed before proceeding with the actual installation of the robot:

|  | Note | |
|---|---|--|
| Read and follow these instructions before installation of the robot. | | |
| Action | Detailed in section: | |
| 1 Make sure only qualified installation personnel conforming to all national and local codes are allowed to perform the installation. | | |
| 2 Make sure the robot has not been damaged, by visually inspecting its exterior. | Check especially following items: <ul style="list-style-type: none">• Composite arms (upper arms and bar system); no hacks• Joint balls; no scratches• Ventilation hose; no holes | |
| 3 Make sure the lifting accessory to be used is dimensioned to handle the weight of the robot. | . | |
| 4 If the robot is not to be installed directly, it must be stored. | | |
| 5 Make sure the appointed operating environment of the robot conforms to the specifications. | | |
| 6 Before taking the robot to its installation site, make sure the site conforms to applicable requirements. | | |
| 7 Before moving the robot, make sure it does not tip over! | | |
| 8 When these prerequisites have been met, the robot may be taken to its installation site. | For assemble of the robot, see section Assembling the robot IRB 360 on page 65 | |

Weight

The following table shows the weight of the robot model.

| Robot model | Weight |
|----------------|-----------------------|
| Standard | 120 kg (264.5 pounds) |
| Wash-Down (WD) | 120 kg (264.5 pounds) |

Continues on next page

2 Installation and commissioning

2.3.1 Pre-installation procedure

Continued

| Robot model | Weight |
|---------------------------|-----------------------|
| Wash-Down stainless (WDS) | 145 kg (319.6 pounds) |

Loads on foundation

The following tables show the various forces and torques working on the robot during different kinds of operation.

See figure below the tables.

Robot version IRB 360 - 1/800, IRB 360 - 1/1130, IRB 360 - 3/1130, IRB 360 - 1/1600

| Force N | Max. load in operation |
|---------|------------------------|
| Fx | ±330 N |
| Fy | ±260 N |
| Fz | -1500 ±170 N |

| Torque Nm | Max. load in operation |
|-----------|------------------------|
| Mx | ±200 Nm |
| My | ±230 Nm |
| Mz | ±100 Nm |

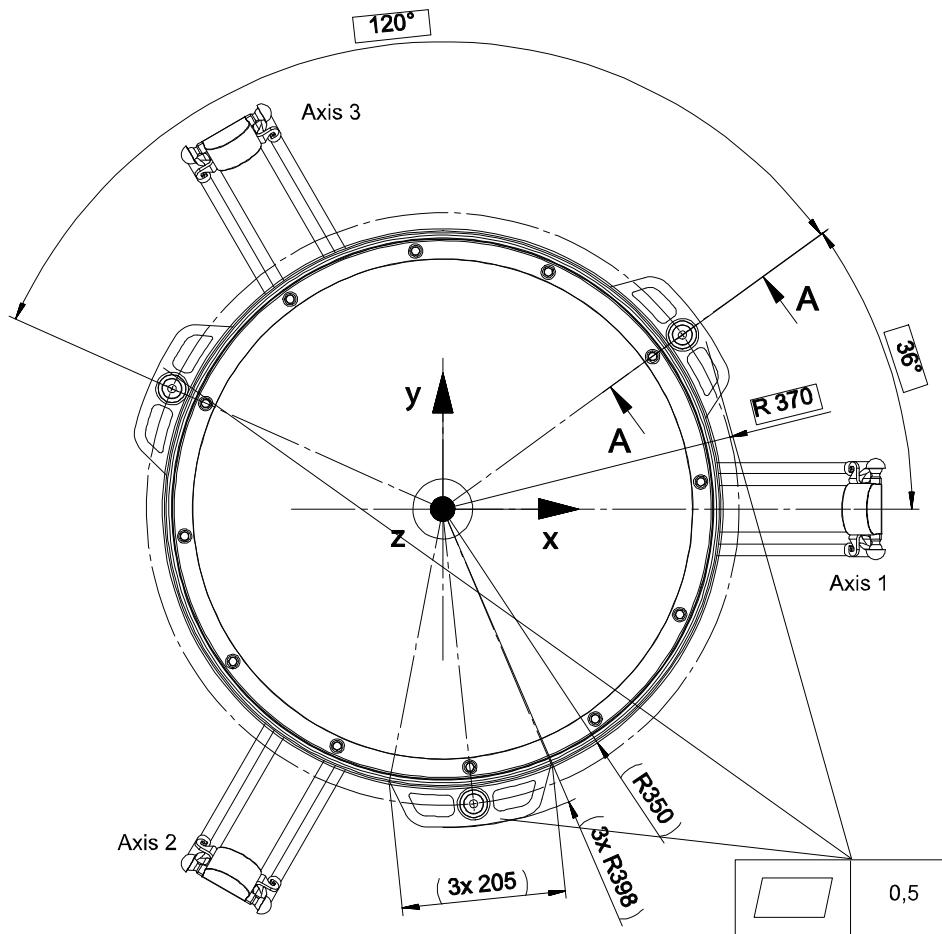
Robot version IRB 360 - 8/1130, IRB 360 - 6/1600

| Force N | Max. load in operation |
|---------|------------------------|
| Fx | ±550 N |
| Fy | ±500 N |
| Fz | -1500 ±460 N |

| Torque Nm | Max. load in operation |
|-----------|------------------------|
| Mx | ±380 Nm |
| My | ±440 Nm |
| Mz | ±180 Nm |

Continues on next page

Illustration



en0900000413

The three support points of the manipulator base box shall be mounted against three flat surfaces within the specification above. Shims is used if necessary.

Requirements, foundation

The following subsections show the requirements for the foundation regarding stiffness and forces.

Stiffness of robot frame

The stiffness of the robot frame must be designed to minimize the influence on the dynamic behavior of the robot. It is recommended that a frame with a lowest natural frequency (with the robot mounted in the frame) higher than 17 Hz is used for robot versions IRB 360 - 1/1130, IRB 360 - 3/1130, IRB 360 - 1/800, IRB 360 - 1/1600 and a frame with a lowest natural frequency higher than 40 Hz is used for robot version IRB 360 - 8/1130, IRB 360 - 6/1600. TuneServo can be used for adapting the robot tuning to a non-optimal foundation.

Forces

Maximum force in each fixing point are 500 N referring to the z-direction in the base coordinate system, regarding coordinate system see *Product specification - IRB 360*. A robot frame is not included in the delivery.

Continues on next page

2 Installation and commissioning

2.3.1 Pre-installation procedure

Continued

Storage conditions

The following table shows the allowed storage conditions for the robot.

| Parameter | Value |
|---|------------------|
| If the equipment is not going to be installed straight away, it must be stored in a dry area at an ambient temperature between. | -25 °C to +55 °C |

Operating conditions

The following table shows the allowed operating conditions for the robot.

| Parameter | Value |
|---------------------|----------------------------------|
| Ambient temperature | 0 °C to +45 °C. |
| Relative humidity | Max. 95% at constant temperature |

Protection classes

The following table shows the protection class of the robot.

| Equipment | Protection class |
|----------------------------------|------------------|
| Standard (Std.) | IP54 |
| Wash-Down (WD) | IP67 |
| Wash-Down Stainless (WDS) | IP69K |
| Clean Room, Stainless Clean Room | IP54 |

2.3.2 Transport

General

This section describes how to transport the manipulator.



Note

The transport shall be made by qualified personnel and should conform to all national and local codes.

Transport position

Whenever the manipulator is transported, it must be in mounting position. It is not allowed to turn the manipulator up side down.

When air transport is used, the robot must be located in a pressure-equalized area.



WARNING

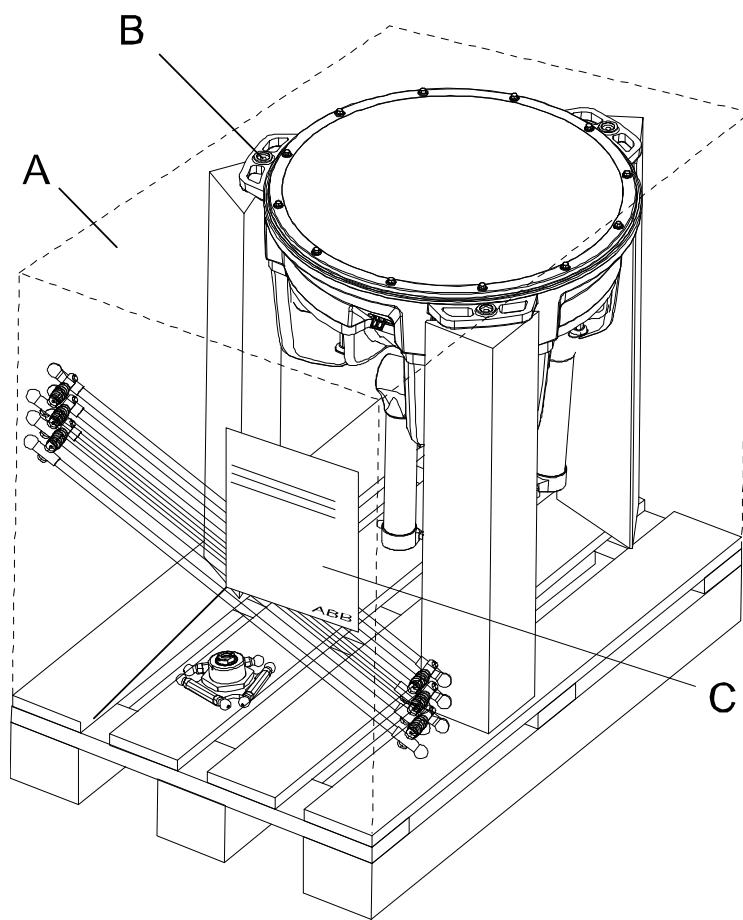
The center of gravity for IRB 360 during transport is very high, 804-810 mm from the bottom. It might tilt and fall when carried on a forklift.

Continues on next page

2 Installation and commissioning

2.3.2 Transport

Continued



xx0700000434

| | |
|---|---------------------|
| A | Robot delivery box |
| B | Securing point x3 |
| C | Robot delivery note |

2.3.3 Assembling the robot IRB 360

Overview

Follow these steps to assemble the robot after unpacking.

Assembling the robot

| Action | Note |
|---|---|
| 1 Prepare the working site according to sections: | Amount of required space on page 72 Orienting and securing the robot frame on page 73. |
| 2 Lift the robot according to instructions in sections: | Lifting the robot with fork lift on page 68. Lifting the robot with roundslings on page 70. Pre-installation procedure on page 59 |
| 3 Secure the robot according to section: | Orienting and securing the robot on page 75. |
| 4 Assemble the parallel arms according to section: | Replacement of parallel arms on page 178. |
| 5 Assemble the telescopic shaft according to section: | Replacement of telescopic shaft on page 194. |
| 6 Assemble the movable plate according to section: | Replacement of movable plate on page 190. |
| 7 Connect the controller and the manipulator. | Connecting the controller to the manipulator on page 101 |

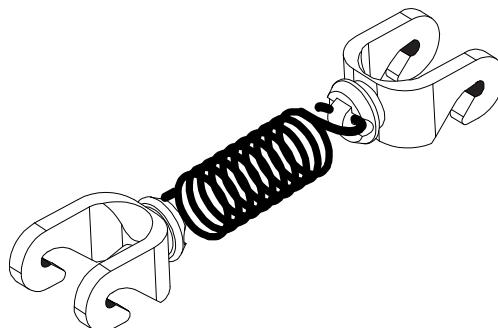


CAUTION

Before mounting external equipment on the robot, first read the section [Fitting equipment on robot on page 82](#).

Assembly options

To facilitate cleaning, it is possible to use the spring units without the rubber bellows, if that is preferred due to hygienic or other reasons.



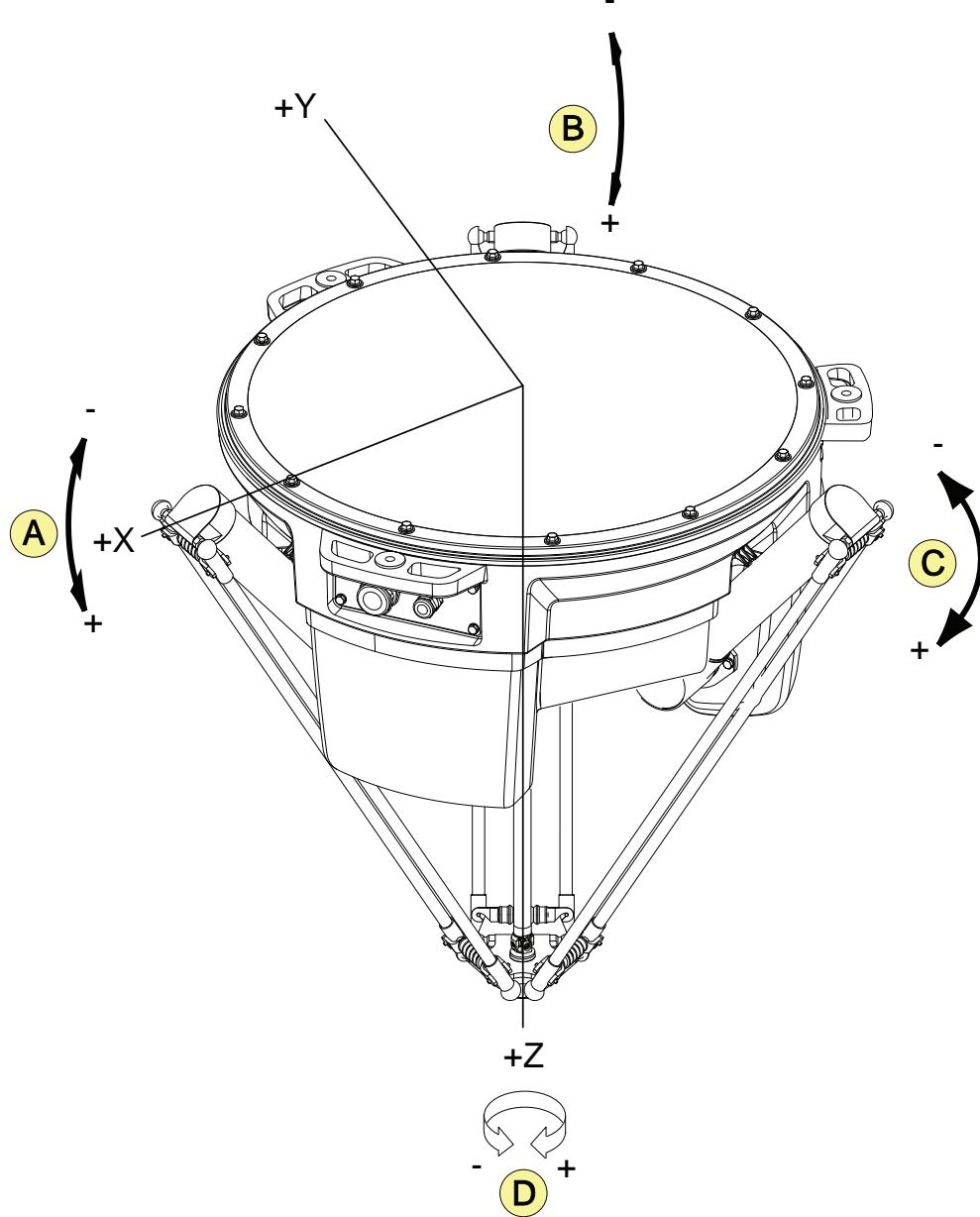
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2 Installation and commissioning

2.3.4 Working range and type of motion

2.3.4 Working range and type of motion

Motion pattern

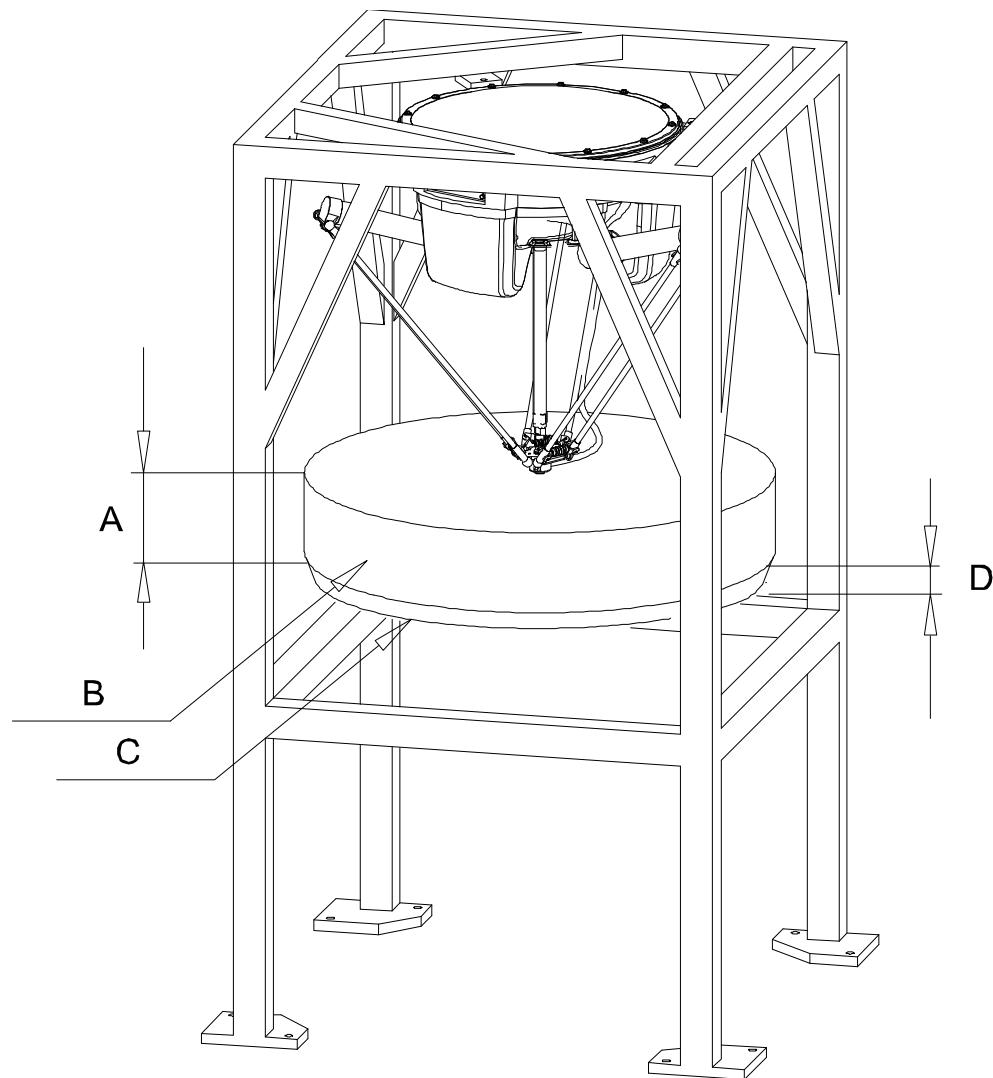


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| | |
|---|--------|
| A | Axis 1 |
| B | Axis 2 |
| C | Axis 3 |
| D | Axis 4 |

Continues on next page

Working range



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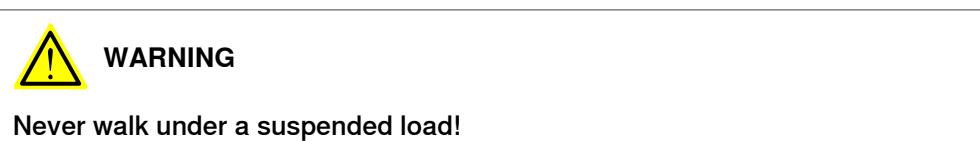
| Robot variant | Measurement A | Diameter B | Diameter C | Measurement D |
|------------------|---------------|------------|------------|---------------|
| IRB 360 - 1/1130 | 250 mm | 1130 mm | 967 mm | 50 mm |
| IRB 360 - 3/1130 | 250 mm | 1130 mm | 967 mm | 50 mm |
| IRB 360 - 1/800 | 200 mm | 800 mm | - | - |
| IRB 360 - 1/1600 | 300 mm | 1600 mm | 1440 mm | 50 mm |
| IRB 360 - 6/1600 | 305 mm | 1600 mm | 1200 mm | 155 mm |
| IRB 360 - 8/1130 | 250 mm | 1130 mm | 750 mm | 100 mm |

2 Installation and commissioning

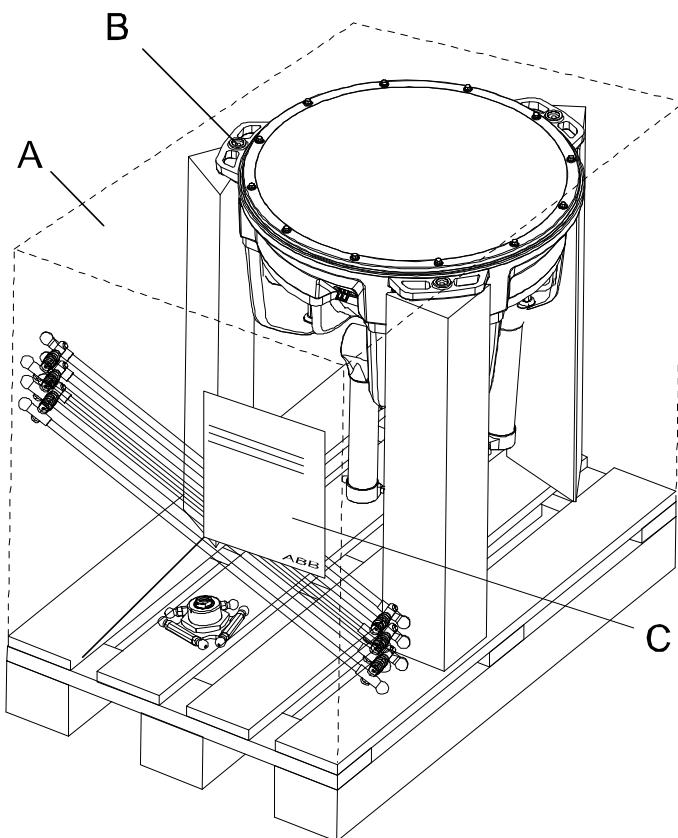
2.4.1 Lifting the robot with fork lift

2.4 On-site installation

2.4.1 Lifting the robot with fork lift



Lifting position



xx0700000434

| | |
|---|---------------------------------|
| A | Robot package top |
| B | Robot package securing point x3 |
| C | Delivery note |

Recommended equipment

| Equipment | Art.no. | Note |
|-----------|---------|------|
| Fork lift | | |

Continues on next page

Lifting the robot

| | Action | Note |
|---|---|------|
| 1 |  CAUTION The delivery package weighs 200 kg! All lifting accessories used must be sized accordingly. | |
| 2 | Lift the robot package to the installation site. | |

2 Installation and commissioning

2.4.2 Lifting the robot with roundslings

2.4.2 Lifting the robot with roundslings

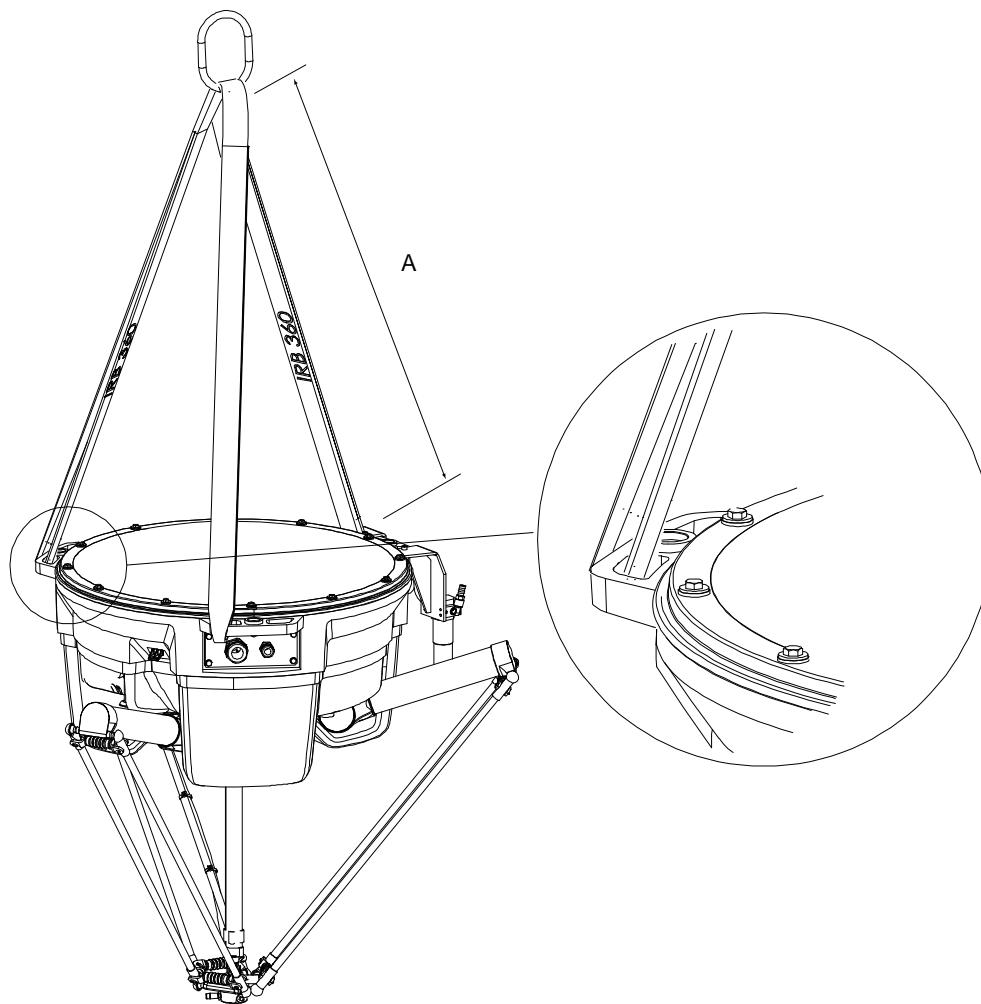


WARNING

Never walk under a suspended load!

The best way to lift the manipulator is to use lifting straps and a traverse crane.
The lifting strap dimensions must comply with the applicable standards for lifting.

Lifting position



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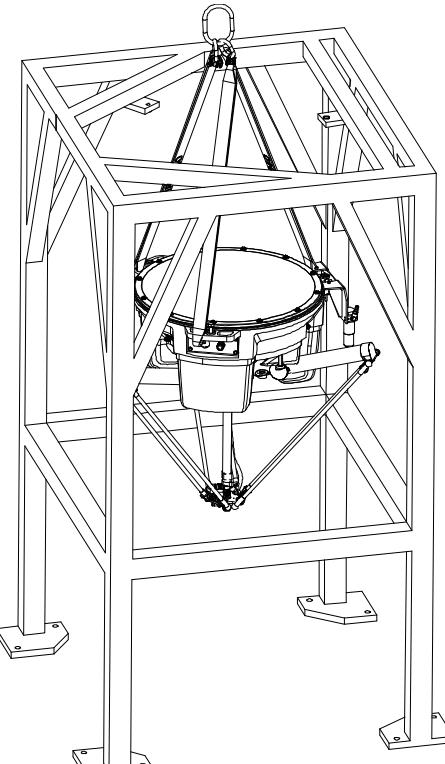
| | |
|---|---------------------|
| A | L= 500 mm (20 inch) |
|---|---------------------|

Recommended equipment

| Equipment | Art.no. | Note |
|-------------|---------|------|
| Roundslings | | |

Continues on next page

Lifting the robot with roundslings

| | Action | Note |
|---|--|---|
| 1 | <p>Attach the roundslings to the robot base box, see figure Lifting position on page 70.</p> <p>! CAUTION</p> <p>The IRB 360 weighs 120 kg (Std) and 145 kg (WDS). All lifting accessories used must be sized accordingly.</p> |  <p>xx0700000466</p> |

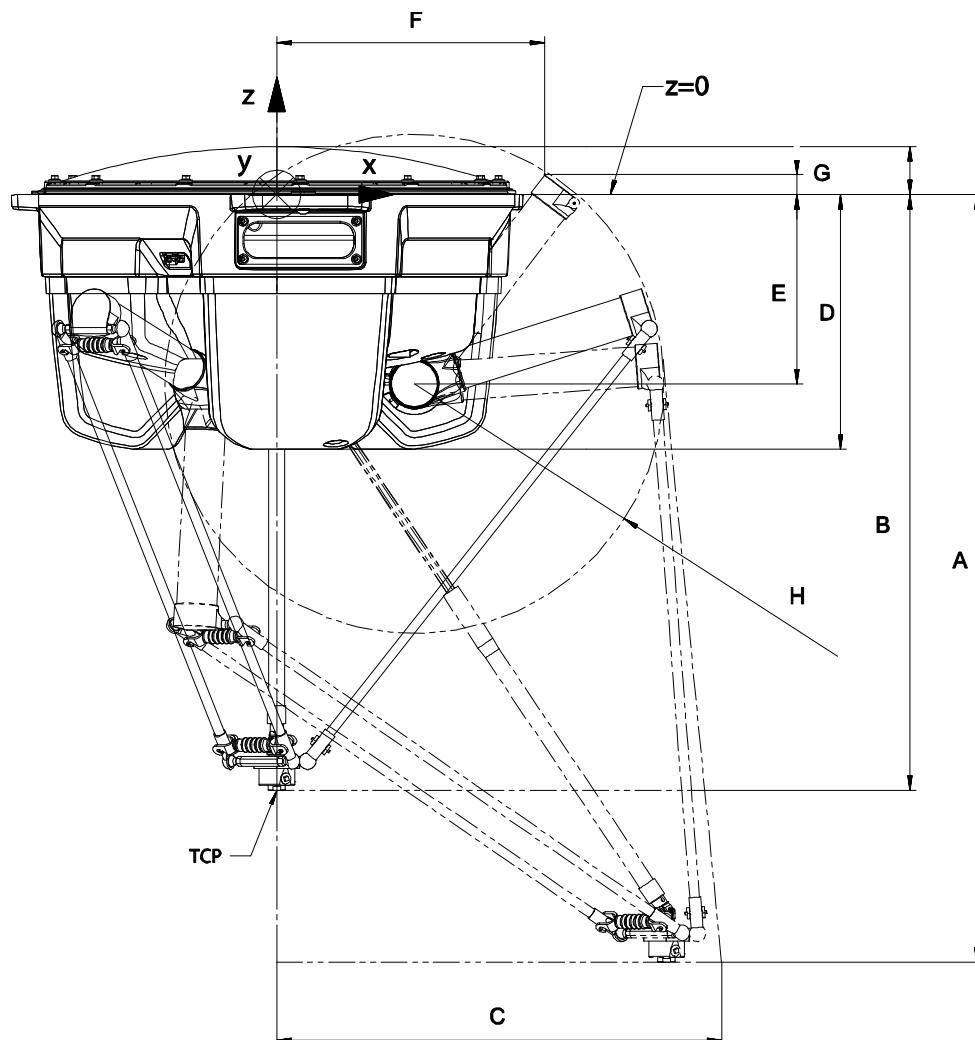
2 Installation and commissioning

2.4.3 Amount of required space

2.4.3 Amount of required space

Required space

The following figure shows the required amount of space to operate the manipulator.



xx0700000489

Dimensions

| Variant | A (mm) | B (mm) | C (mm) | D (mm) | E (mm) | F (mm) | G (mm) | H (mm) |
|------------------|--------|--------|--------|--------|--------|--------|--------|--------|
| IRB 360 - 1/1130 | 1115 | 865 | 647 | 370 | 275 | 389.5 | 28.50 | R366 |
| IRB 360 - 3/1130 | | | | | | | | |
| IRB 360 - 8/1130 | 1142 | 892 | 650 | 370 | 275 | 389.5 | 28.50 | R366 |
| IRB 360 - 1/800 | 1160 | 960 | 481 | 370 | 275 | | | R251 |
| IRB 360 - 1/1600 | 1412 | 1112 | 880 | 370 | 275 | 438 | 95 | R447 |
| IRB 360 - 6/1600 | 1412.5 | 1107.5 | 883 | 370 | 275 | 478.9 | 148.3 | R515 |

2.4.4 Orienting and securing the robot frame

General

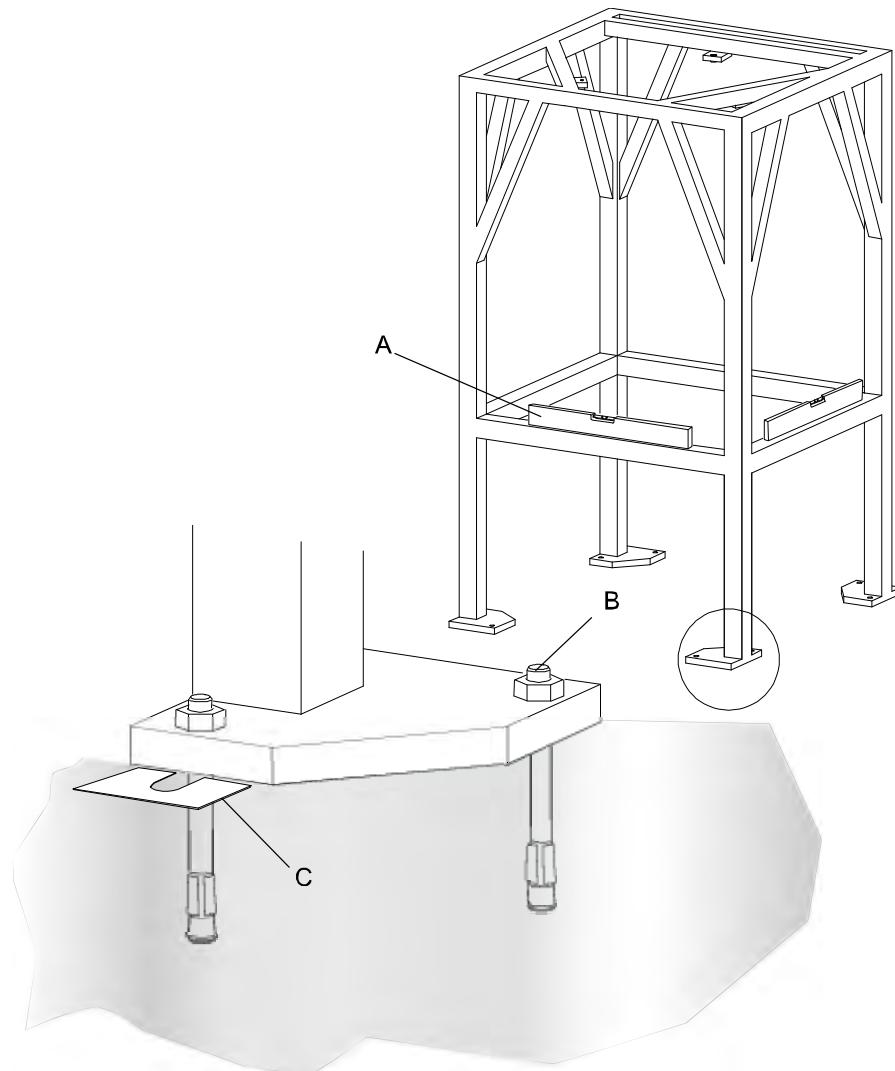
This section details how to orient and secure the robot frame at a horizontal level at the installation site in order to run the robot safely.



WARNING

Make sure that the robot frame is secured before mounting the robot.

Illustration



xx0700000469

| | |
|---|---------------------------------------|
| A | Spirit level |
| B | Chemical or mechanical expander bolts |
| C | Shim |

Continues on next page

2 Installation and commissioning

2.4.4 Orienting and securing the robot frame

Continued

Required equipment and references

| Equipment | Spare part no. | Note |
|---|----------------|--|
| Spirit level | | |
| Shim | | Shim drawing on page 74 |
| Chemical bolts or mechanical expanding bolts. | | |
| Standard tools | | Standard toolkit on page 268 |

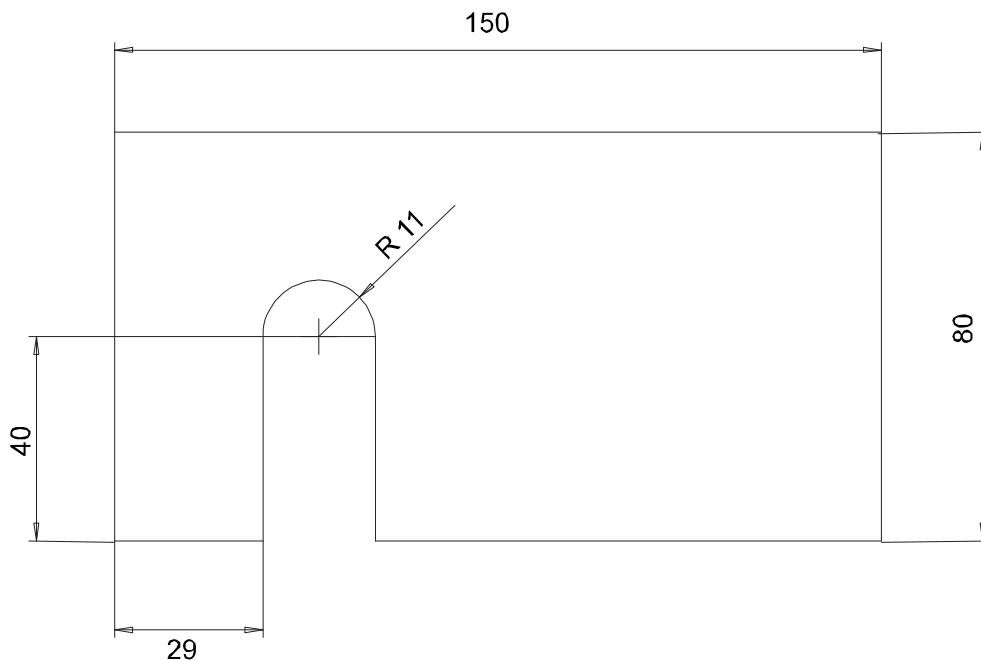
| References |
|---|
| Pre-installation procedure on page 59 |

Orienting and securing

| | Action | Note |
|---|---|---|
| 1 | Make sure the installation site for the robot conforms to the specifications in section Pre-installation procedure on page 59 . | |
| 2 | Prepare the installation site. | |
| 3 | Use a water level to level the robot frame. | Use shim for leveling. Example of shim shown in Shim drawing on page 74 |
| 4 | Secure the robot frame to the floor. | Use chemical or mechanical expander bolts. |

Shim drawing

Example of shim.



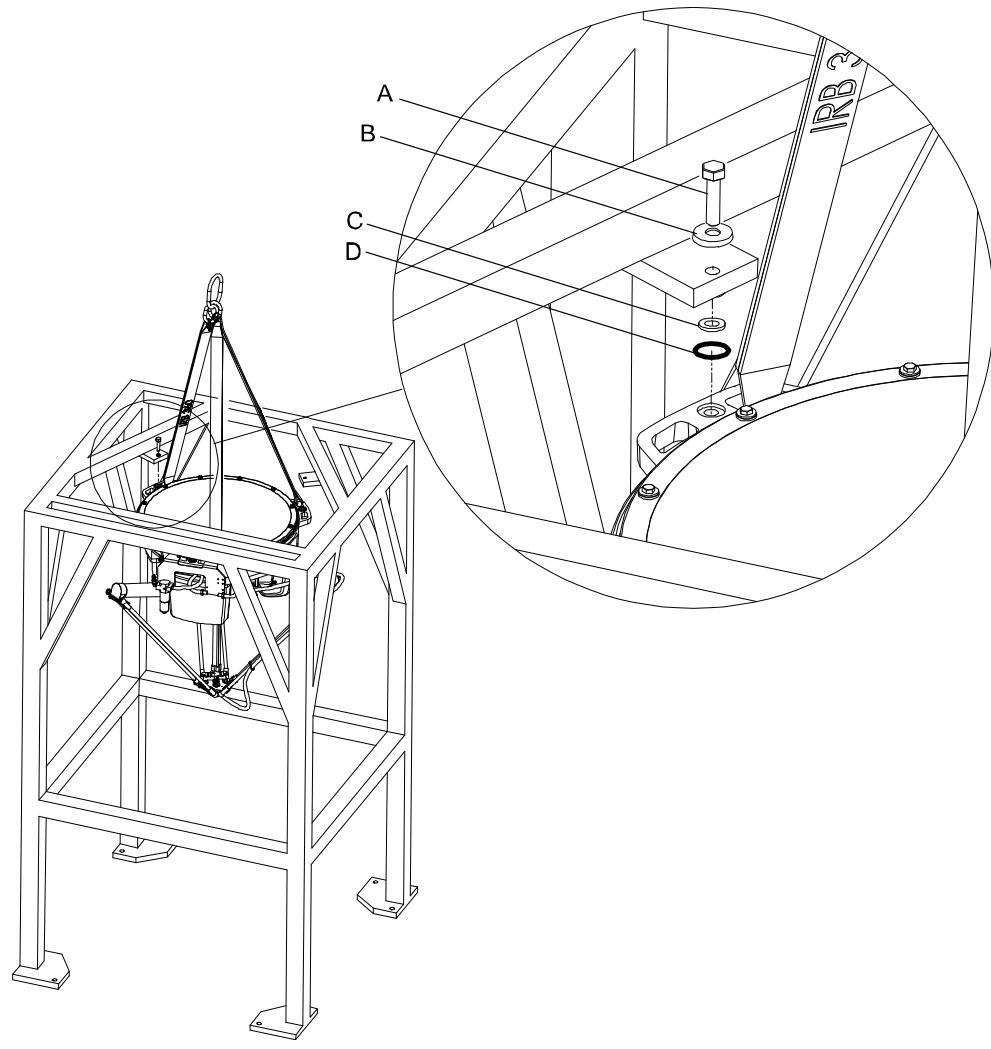
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2.4.5 Orienting and securing the robot

General

This section describes how to orient and secure the robot at a horizontal level at the installation site.

Illustration



xx0700000444

| | |
|---|-------------------------------------|
| A | Screw M12 |
| B | Bonded seal washer, rubber/metal |
| C | Spacer, metal |
| D | Washer, EPDM-rubber compressed 50%. |

Required equipment

| Equipment, etc. | Spare part no. | Note |
|-----------------|--|------|
| Standard tools | Standard toolkit on page 268 | |

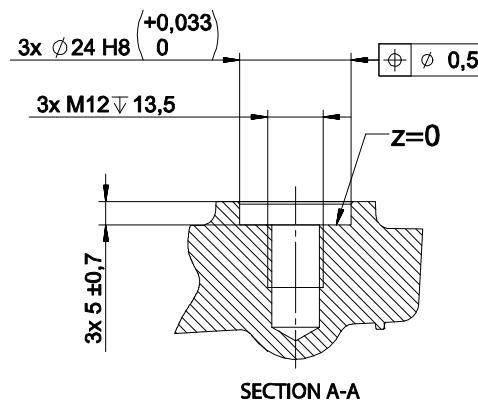
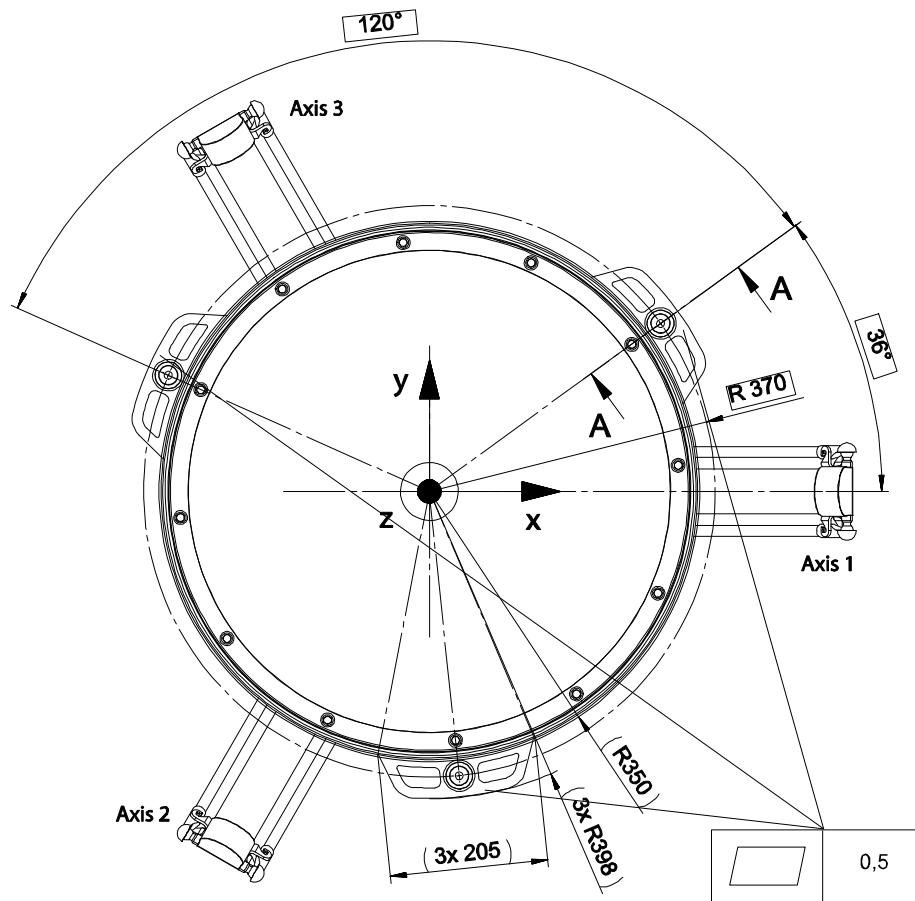
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2 Installation and commissioning

2.4.5 Orienting and securing the robot

Continued

Hole configuration, base

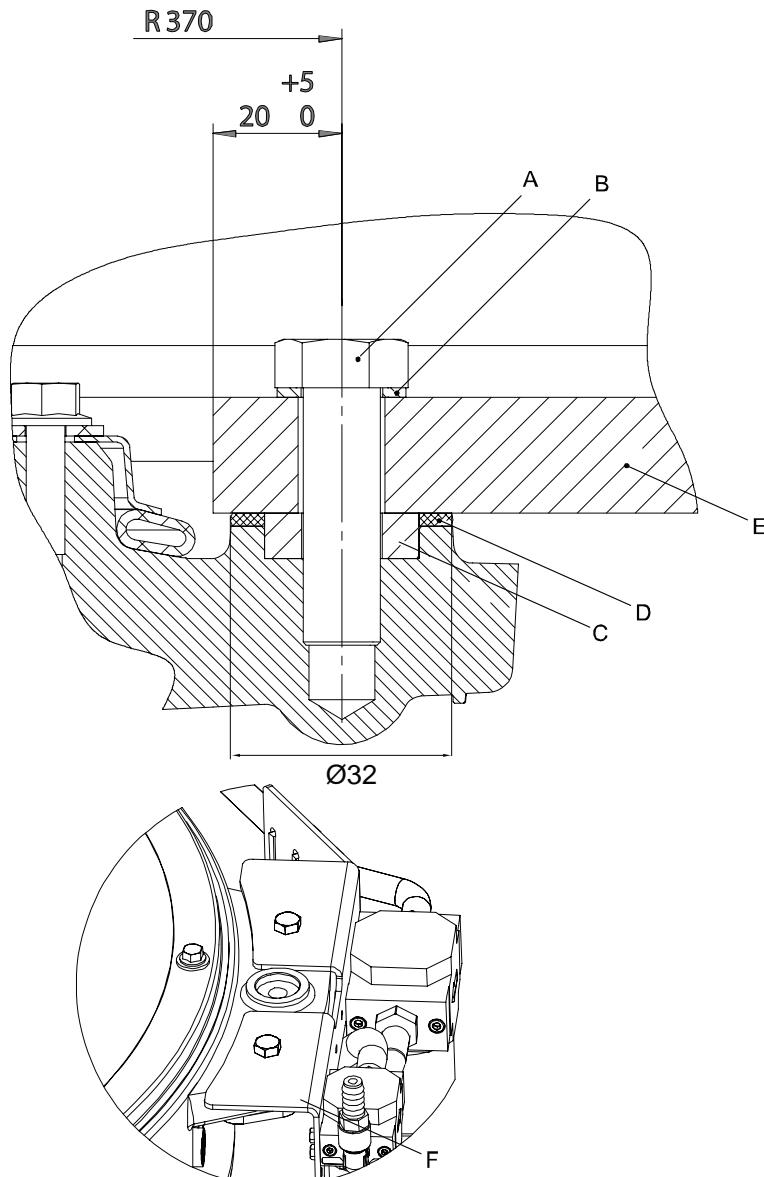


xx0700000467

The three support points of the manipulator base box shall be mounted against three flat surfaces with a flatness within the specification. Use shims if necessary.

Continues on next page

Attachment bolts, specification



xx0700000522

| | |
|---|-------------------------------------|
| A | Screw M12 |
| B | Bonded seal washer, rubber/metal. |
| C | Spacer, metal |
| D | Washer, EPDM-rubber compressed 50%. |
| E | Robot frame |
| F | Bracket |

| Attachments | Dimensions |
|--|---|
| Attachment bolts, 3 pcs. | M12x (50) The length of the screws depend on the design of the robot frame |
| Bonded seal washer, rubber/metal, 3 pcs. | |

Continues on next page

2 Installation and commissioning

2.4.5 Orienting and securing the robot

Continued

| Attachments | Dimensions |
|--|---|
| Washer, EPDM-rubber compressed 50%, 3 pcs. | Illustration on page 75 |
| Spacer, metal, 3 pcs. | Illustration on page 75 |

Orienting and securing

| | Action | Note |
|---|--|--|
| 1 | Make sure the installation site for the robot conforms to the specifications in section Pre-installation procedure on page 59 . | |
| 2 | Prepare the installation site. | Detailed in section Orienting and securing the robot frame on page 73 |
| 3 | Lift the robot to the installation site. | Detailed in section Lifting the robot with fork lift on page 68 and in section Lifting the robot with roundslings on page 70 |
| 4 |  Note If use of ABB's vacuum system is intended, make sure there is a space left for the bracket (F). | |
| 5 | Fit and tighten the bolts and washers in the base attachment holes. | The screw joint must be able to withstand the stress loads defined in section Pre-installation procedure on page 59 . |

2.4.6 Manually releasing the brakes



DANGER

Releasing the brakes is a hazardous action that may cause injury and damage property. It must be done with great care and only when absolutely necessary.

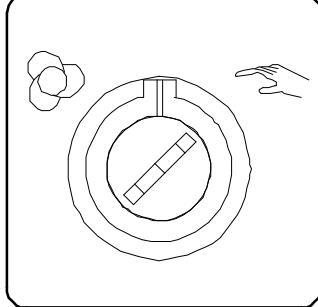
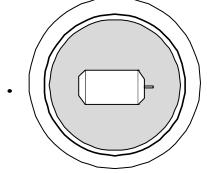
General

This section describes how to release the holding brakes.

The brake release button is located on the base of the robot, close to the center.

Using the brake release unit when the robot is connected to the controller

This section describes how to release the holding brakes using the internal brake release unit.

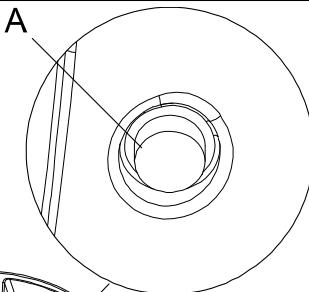
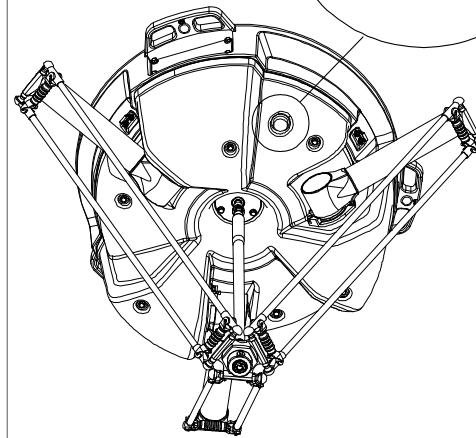
| Action | Note |
|---|--|
| 1 On the FlexPendant press the stop button. | |
| 2 On the controller, set the key switch into manual position. |  xx0700000625 |
| 3 Check the motors off button, make sure that the button flashes. |  en0400000795 |

Continues on next page

2 Installation and commissioning

2.4.6 Manually releasing the brakes

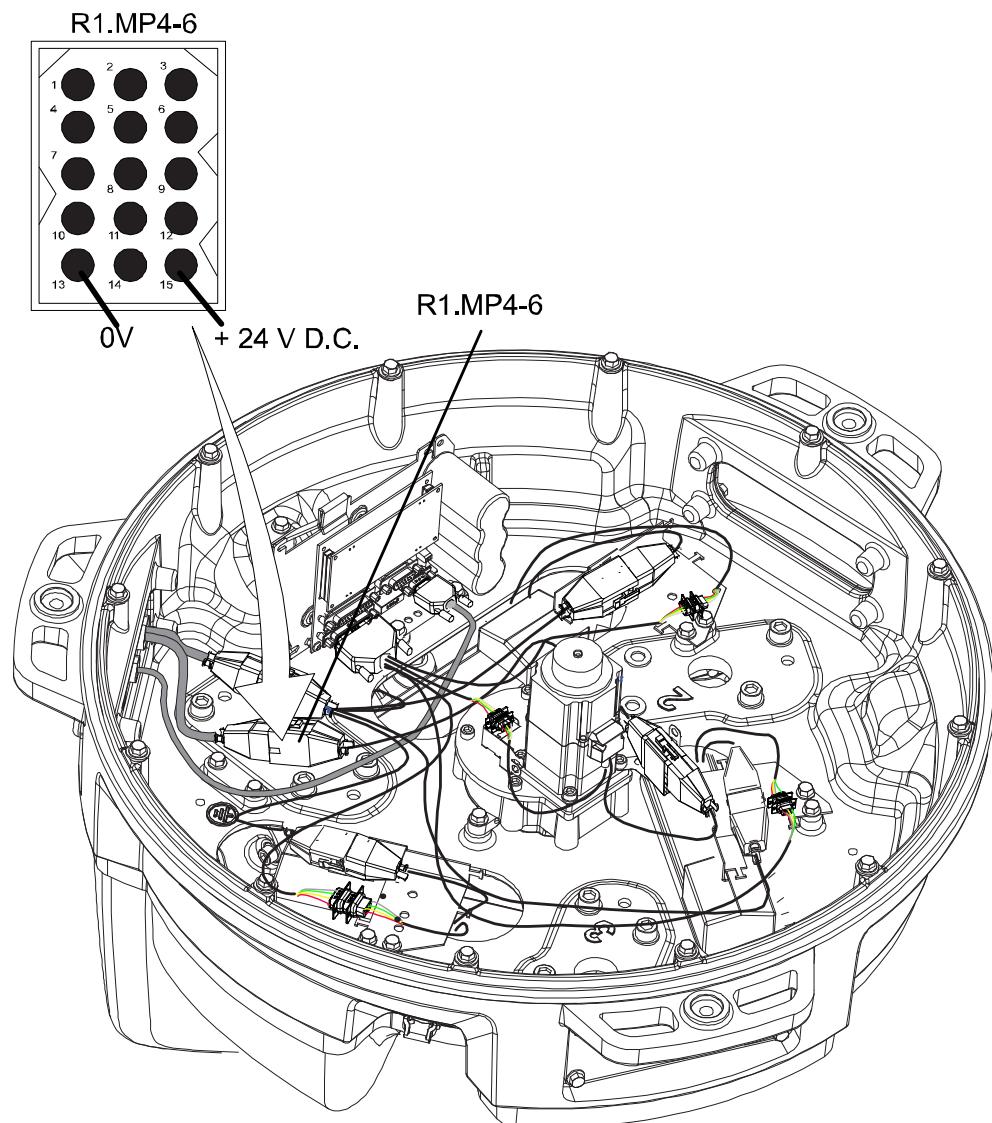
Continued

| Action | Note |
|---|--|
| 4 The internal brake release unit is located at the base of the robot. |   xx0700000435 A Brake release button |
| 5 Press and hold the brake release button (keep it pressed in). The brake will function again as soon as the button is released. | |

Continues on next page

Using the brake release unit with an external power supply

This section describes how to release the holding brakes with the internal brake release unit, using an external voltage supply. This is done if the robot is not connected to the controller.



xx0700000441



Note

Be careful not to interchange the 24 V and 0 V pins. If they are mixed-up, electrical components can be damaged.

| Action | Note |
|--|---|
| 1 Connect an external power +24V supply to the FCI connector (pin 13 to 0V and pin 15 to +24V). | See cable harness in <i>Spare parts - cable harness</i> . |
| 2 Press and hold the brake release button (keep it pressed in). The brake will function again as soon as the button is released. | |

2 Installation and commissioning

2.4.7 Fitting equipment on robot

Overview

This section describes how to fit equipment on the IRB 360.



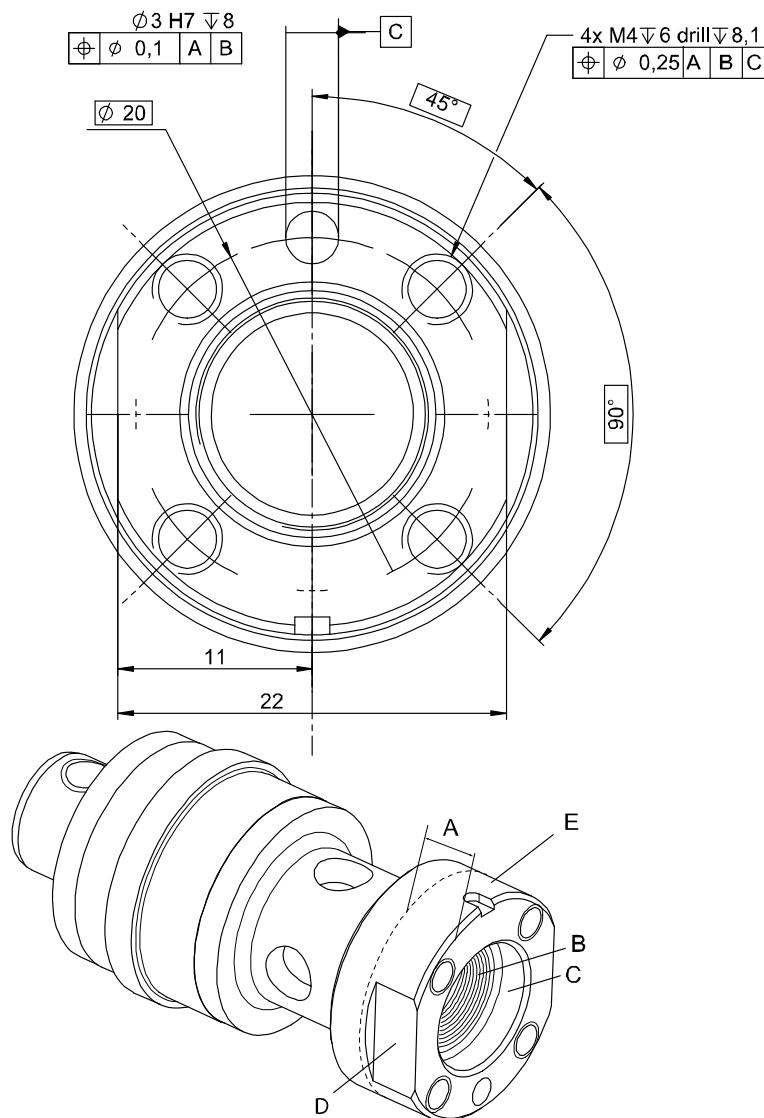
Note

All equipment and cables used on the robot, must be designed and fitted not to damage the robot and/or its parts.

Continues on next page

Mechanical interface

STD - IRB 360 - 1/1130, IRB 360 - 3/1130, IRB 360 - 1/800, IRB 360 - 1/1600



xx0700000471

| | |
|---|--------------------------------------|
| A | Free space, depth 6 mm |
| B | R1/4" |
| C | Ø14 H8 depth 4 mm |
| D | Key grip = width 22 mm height 5.5 mm |
| E | Ø25 h8 depth 6 mm |

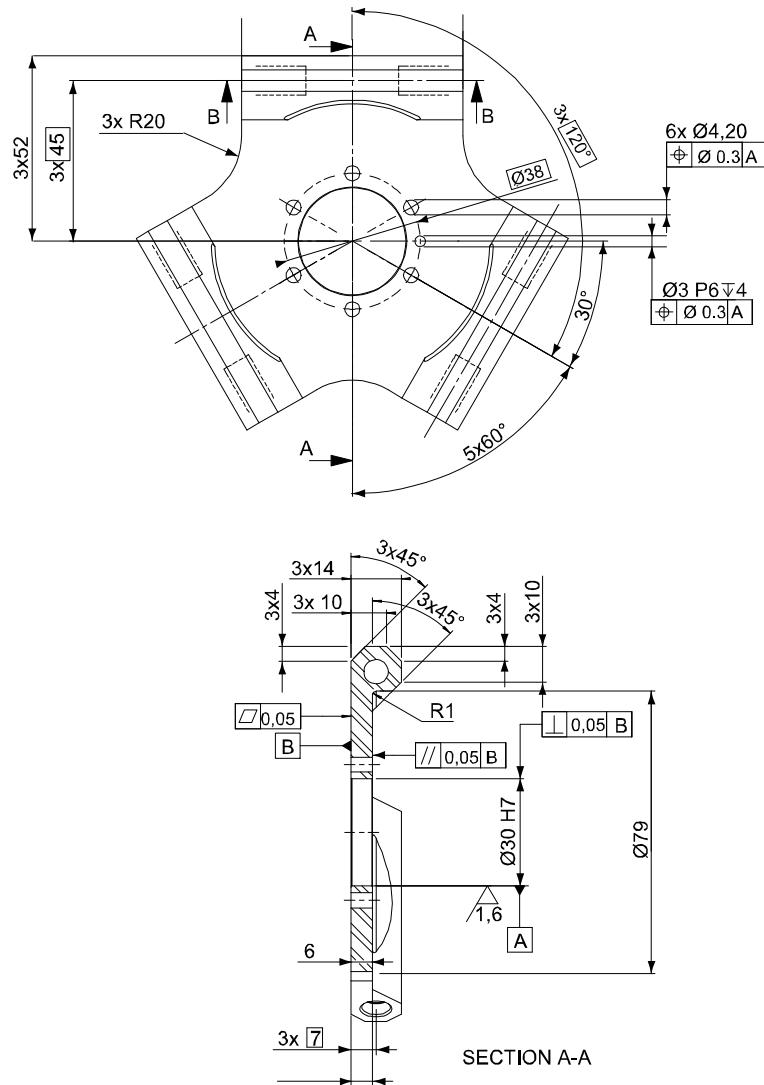
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2 Installation and commissioning

2.4.7 Fitting equipment on robot

Continued

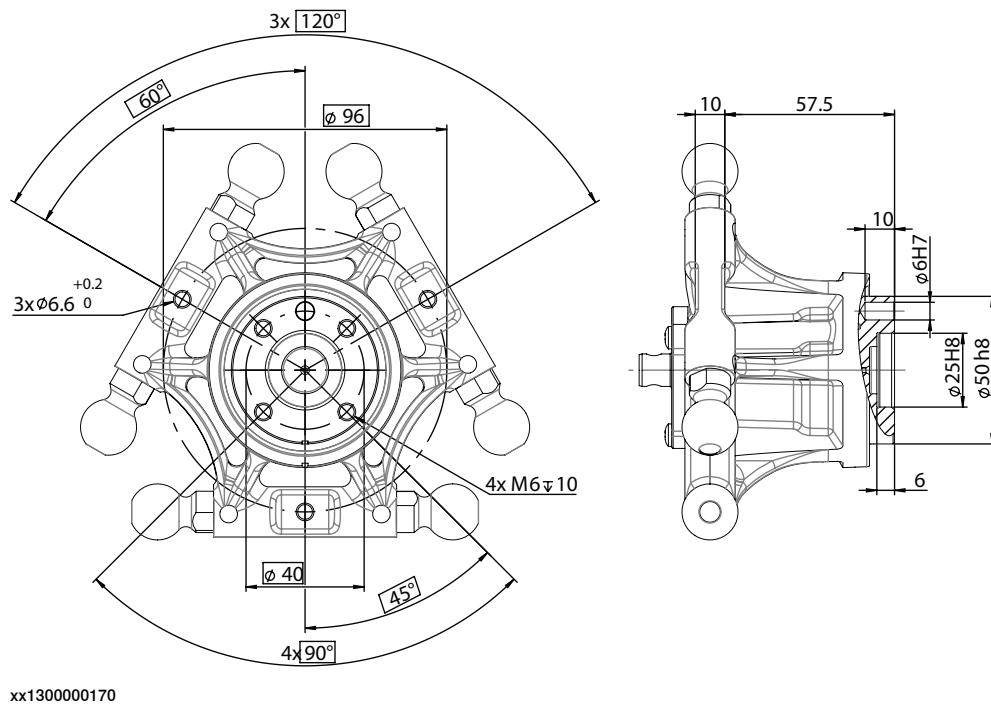
3D - IRB 360 - 1/1130, IRB 360 - 3/1130, IRB 360 - 1/800, IRB 360 - 1/1600



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Continues on next page

IRB 360 - 8/1130, IRB 360 - 6/1600



Required equipment

| Equipment | Article number | Note |
|------------------|----------------|--|
| Standard tools | - | Standard toolkit on page 268 |
| Open end spanner | - | 22 mm |

Mounting equipment R1/4" on movable plate with swivel



CAUTION

Never drill a hole in the manipulator without first consulting maintenance staff or the design department at ABB.



CAUTION

Never remove the swivel cup. The cup protects the bearings.

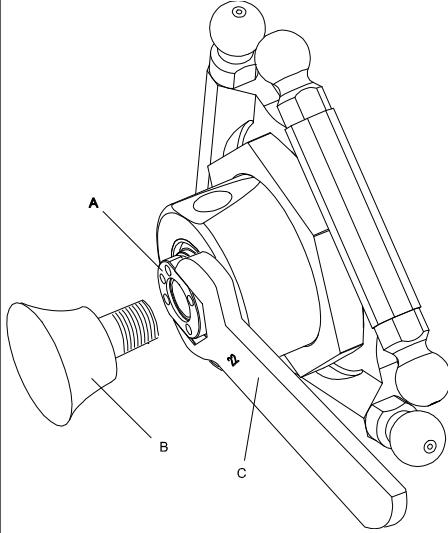
| | Action | Note |
|---|---|---------------|
| 1 | Attach the tool to the mounting flange. | Fitting R1/4" |

Continues on next page

2 Installation and commissioning

2.4.7 Fitting equipment on robot

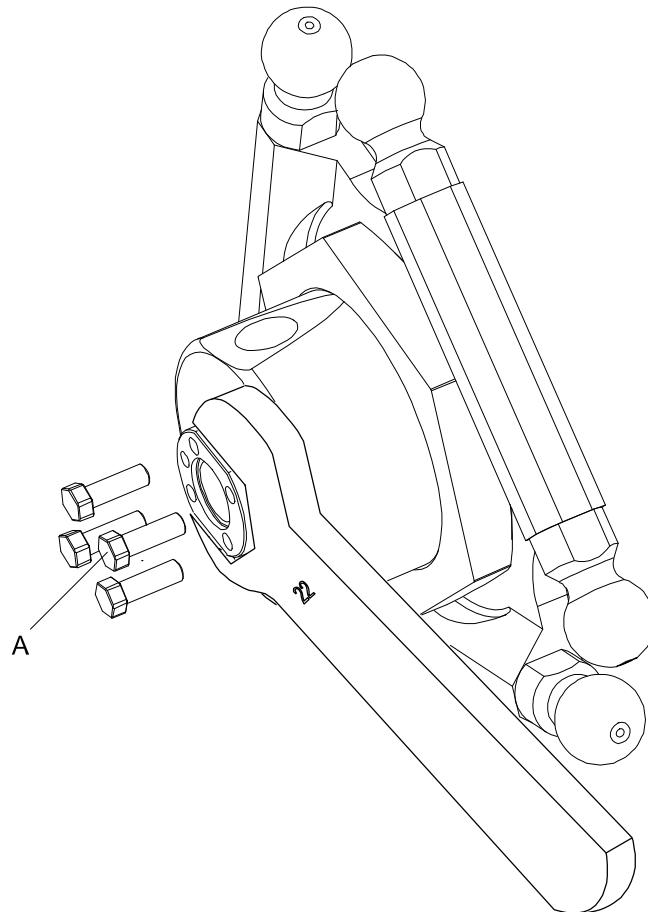
Continued

| Action | Note | | | | | | |
|--|---|---|-----------------|---|----------------------|---|------------------------|
| 2  CAUTION If the movable plate is equipped with a swivel: Always use an open-end spanner 22 mm or similar on the mounting flange, when tightening. |  xx0700000490 <table border="1"><tr><td>A</td><td>Mounting flange</td></tr><tr><td>B</td><td>Tool (fitting R1/4")</td></tr><tr><td>C</td><td>Open-end spanner 22 mm</td></tr></table> | A | Mounting flange | B | Tool (fitting R1/4") | C | Open-end spanner 22 mm |
| A | Mounting flange | | | | | | |
| B | Tool (fitting R1/4") | | | | | | |
| C | Open-end spanner 22 mm | | | | | | |
| 3  Note If axial tool movement using axis 4 is intended, use a locking liquid or a lock screw to prevent rotation of tool. If a high frequent use of linear tool movement is intended, use a tool with mounting flange. | | | | | | | |

Continues on next page

Mounting equipment to flange on movable plate with swivel

IRB 360 - 1/1130, IRB 360 - 3/1130, IRB 360 - 1/800, IRB 360 - 1/1600



xx0700000523

| | | |
|---|--|------|
| A | 4 pcs Screws M4 | |
| 1 | Action Attach the tool to the mounting flange. | Note |
| 2 | <p>! CAUTION Always use an open-end spanner 22 mm or similar on the mounting flange, when tightening.</p> | |

Attachment screws

| Attachments | Note |
|--------------------------------------|--|
| Suitable screws, lightly lubricated: | M4 (Length depending on tool) |
| Suitable washer. | |
| Tightening torque. | See section Screw joints on page 168 . |

2 Installation and commissioning

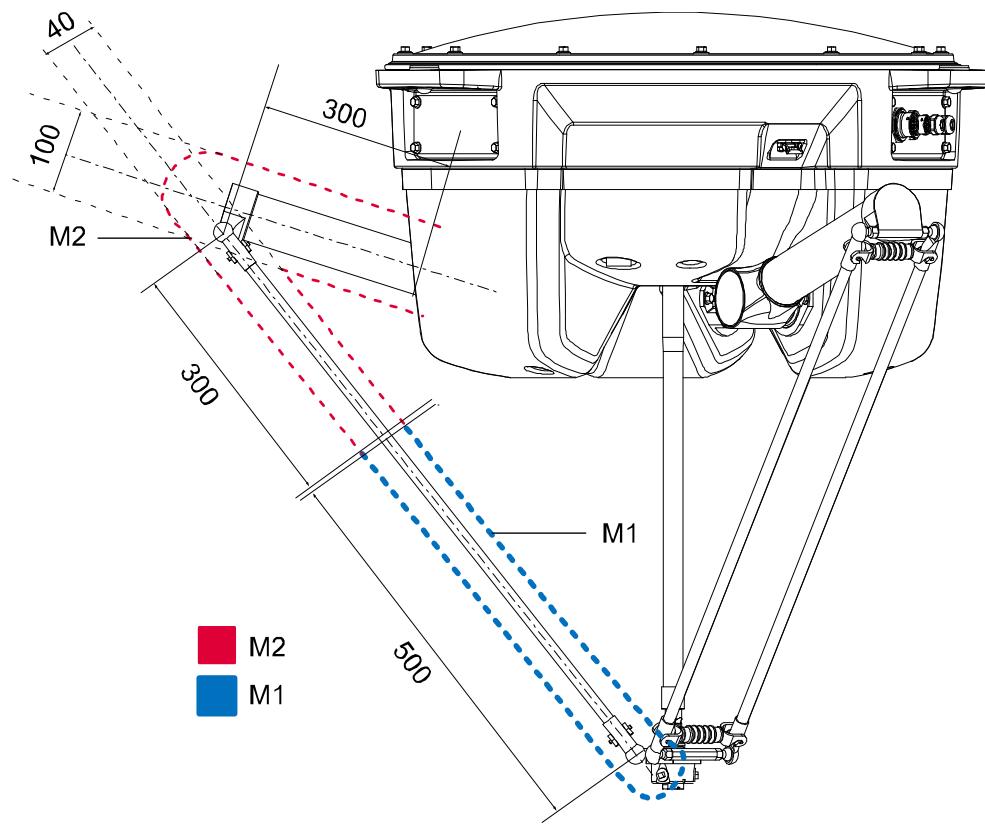
2.4.8 Loads

2.4.8 Loads

General

This section describes loads from external equipment. For information about general loads and diagrams see *Product specification - IRB 360*.

Extra equipment mounted on the manipulator arms



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| | |
|----|---|
| M1 | Limitation lines for center of gravity for M1 |
| M2 | Limitation lines for center of gravity for M2 |

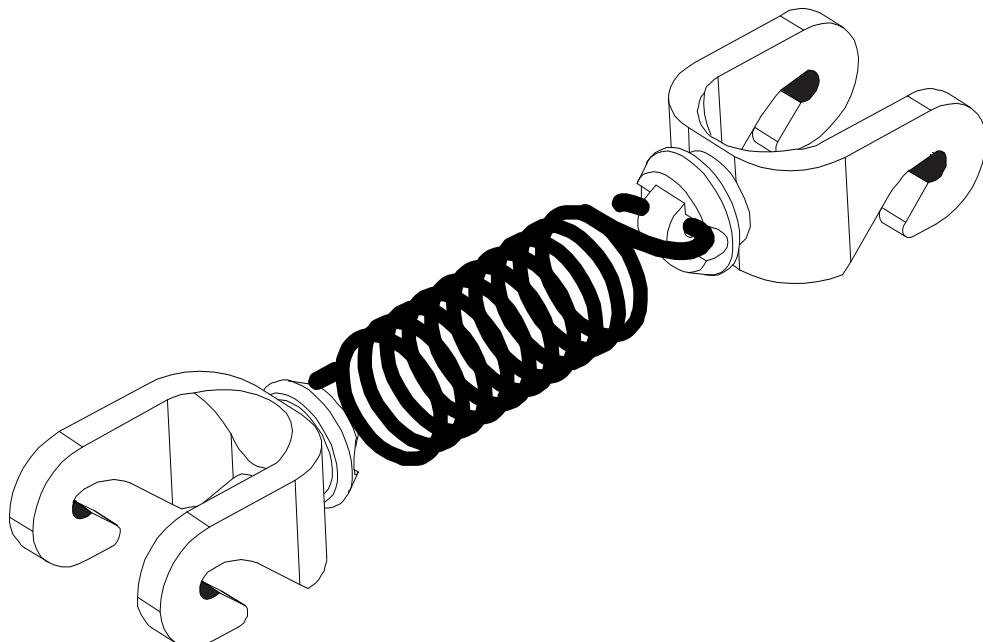
The robot is tuned for the vacuum system or medium sized hose (options). If one of these options is used no extra load should be defined. If neither the vacuum system nor the medium sized hose is chosen:

- and both M1 and M2 are less than 175 g each, the robot can run with full performance and no extra load should be defined.
- and M1 is more than 175 g, an extra load should be defined in the load definition. The extra load should be M1-175 g. Maximum extra load allowed is 175 g (M1 max =350g).
- and M2 is more than 175 g, an extra load should be defined in the load definition. The extra load should be M2-175 g. Maximum extra load allowed is 175 g (M2 max = 350 g).
- The extra load should be defined in TCP 0.

Continues on next page

Optional use of rubber bellows - IRB 360 - 1/1130, IRB 360 - 3/1130, IRB 360 - 1/800, IRB 360 - 1/1600

To simplify cleaning, it is possible to use the spring units without the rubber bellows.



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To remove the rubber bellows, see section [*Replacement of parallel arms on page 178*](#).

2 Installation and commissioning

2.5.1 Installation of safety lamp (option 213-1)

2.5 Installation of options

2.5.1 Installation of safety lamp (option 213-1)

General

This section describes installation of safety lamp.



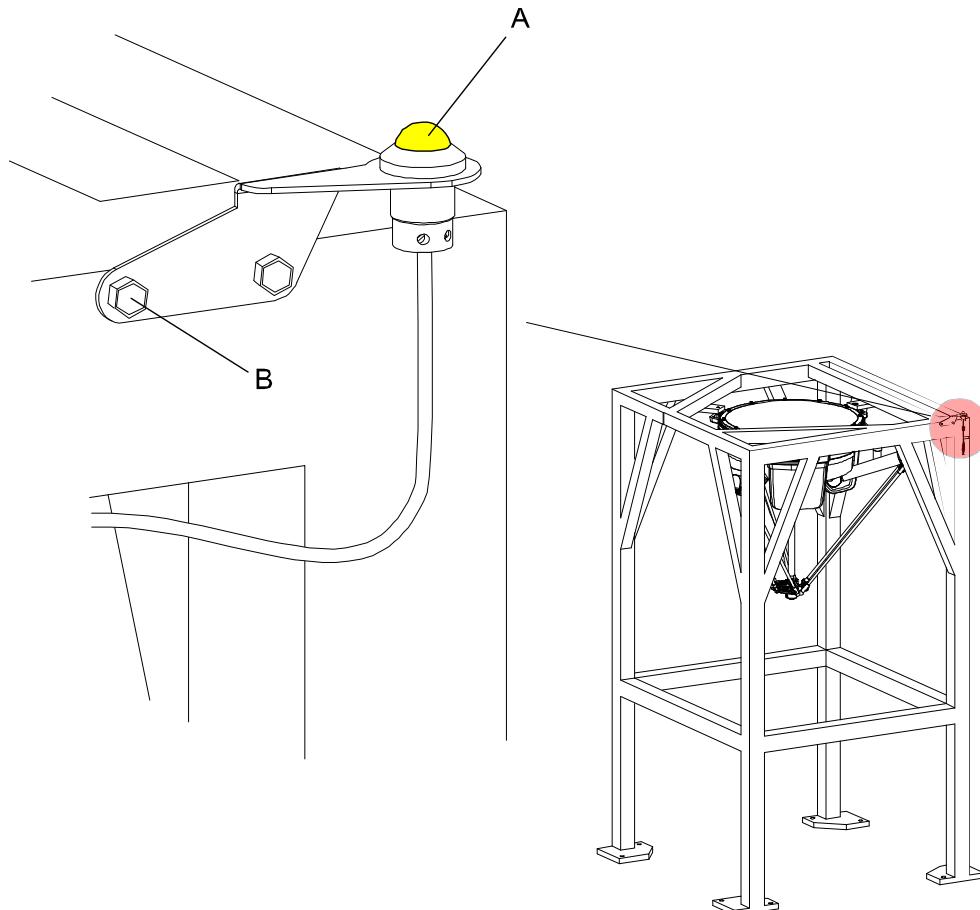
DANGER

Turn off all electrical power, hydraulic and pneumatic pressure supplies before entering the workspace of the manipulator.

Also read the safety sections:

- [Safety risks related to pneumatic/hydraulic systems on page 27](#)
- [Risks associated with live electric parts on page 29](#)
- [Safety risks during installation and service work on robots on page 22](#)

Location



xx0700000546

| | |
|---|------------------------------|
| A | Warning lamp. |
| B | Screw M8 of suitable length. |

Continues on next page

2 Installation and commissioning

2.5.1 Installation of safety lamp (option 213-1)

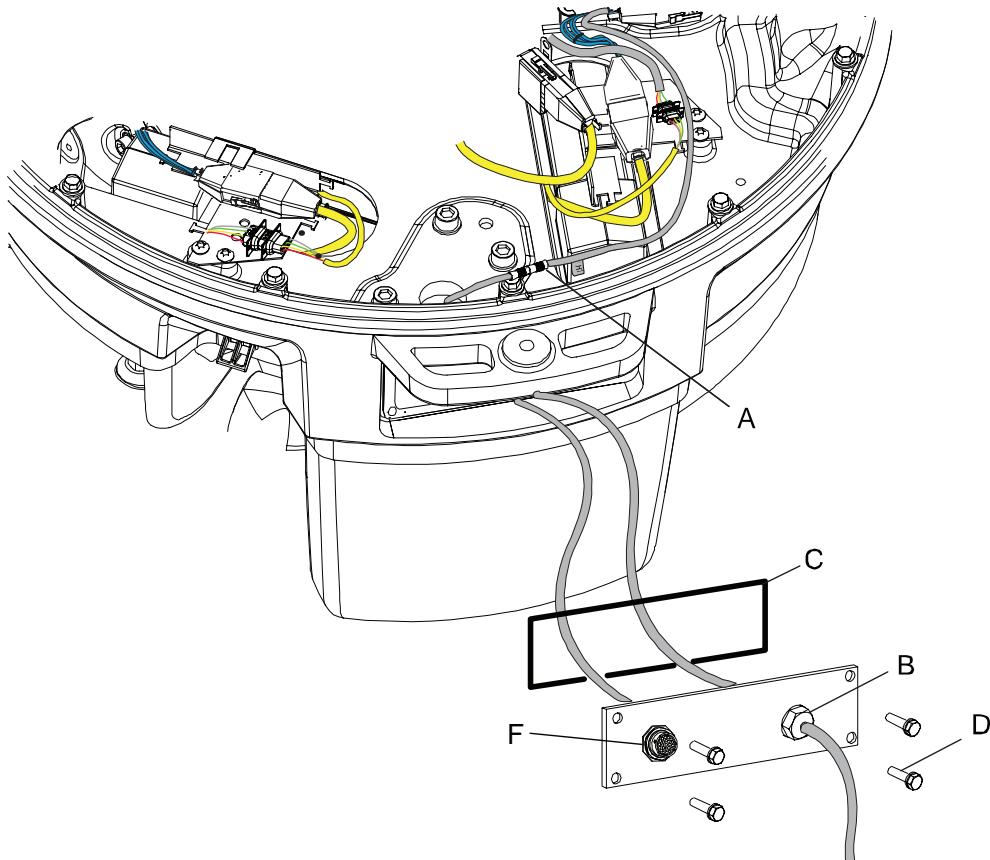
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Required equipment and references

| Equipment | Spare Part No. | Note |
|-----------------------|--|--|
| Standard tools. | | Standard toolkit on page 268 |
| Safety lamp (option). | <i>Spare parts - customer options signal lamp IRB 360.</i> | |
| Cover | 3HAC028966-006 | |
| Cover gasket | 3HAC028972-001 | |

| References |
|--|
| Replacement of base cover gasket on page 172 |
| Standard toolkit on page 268 |

Installation



xx0700000577

| | |
|---|--|
| A | Safety lamp connectors R3.H1and R3.H2 |
| B | Lead-through in cover plate for the optional safety lamp. |
| C | Cover gasket 3HAC028972-001 |
| D | 4pcs Screw M6x20 |
| F | FB7 connector for resolver signals for axis 7 (Option 864-1) |

Continues on next page

2 Installation and commissioning

2.5.1 Installation of safety lamp (option 213-1)

Continued

| | Action | Note |
|---|--|---|
| 1 | Remove the base cover | Described in section Replacement of base cover gasket on page 172 |
| 2 | Replace the cover plate with the optional safety lamp cover plate with gasket. | Tightening torque 4 Nm |
| 3 | Locate the connectors R3.H1 - R3.H2 and connect the safety lamp harness to it. | |
| 4 | Mount the safety lamp. | Placement is optional. |

2.5.2 Installation of (optional) customer connections IRB 360

General

This section describes installation of customer connections.



DANGER

Turn off all electrical power, hydraulic and pneumatic pressure supplies before entering the workspace of the manipulator.

Also read the safety sections:

- *Safety risks related to pneumatic/hydraulic systems on page 27*
- *Risks associated with live electric parts on page 29*
- *Safety risks during installation and service work on robots on page 22*

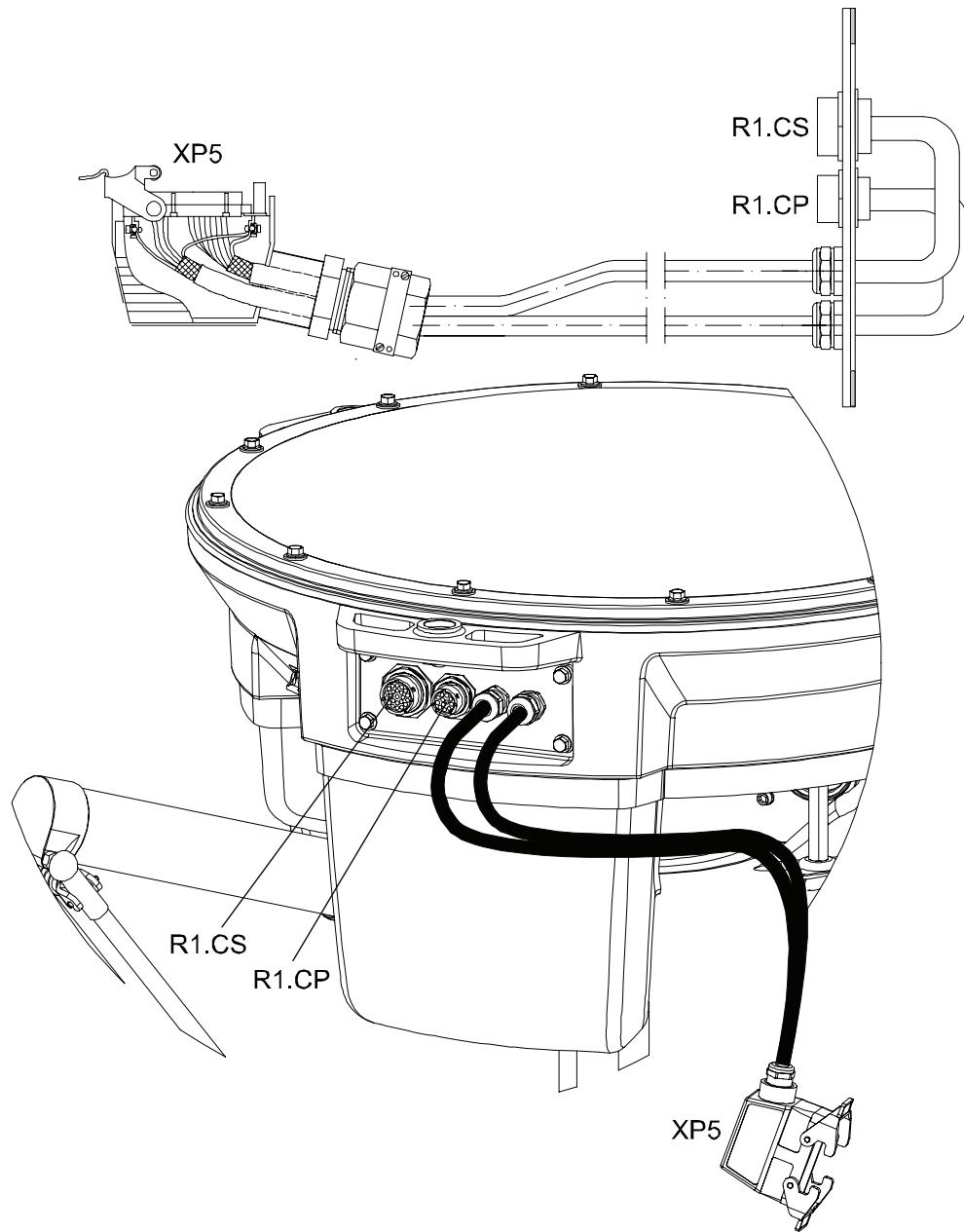
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2 Installation and commissioning

2.5.2 Installation of (optional) customer connections IRB 360

Continued

Location



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Connections in customer cable

| Wire | Spec. | Connection point A | | | Connection point B | | | Note |
|--------------|-------|--------------------|------|------|--------------------|------|------|------|
| | | Designation | Term | Type | Designation | Term | Type | |
| Power | | | | | | | | |
| 1 | RD | XP5 | A1 | 2 | R1.CP | 1 | 13 | |
| 2 | BU | XP5 | B1 | 2 | R1.CP | 2 | 13 | |
| 3 | GN | XP5 | C1 | 2 | R1.CP | 3 | 13 | |

Continues on next page

2 Installation and commissioning

2.5.2 Installation of (optional) customer connections IRB 360

Continued

| Wire | Spec. | Connection point A | | | Connection point B | | | Note |
|----------------|-------|--------------------|---------------------------|------|--------------------|-------------------|------|-----------------------|
| | | Designation | Term | Type | Designation | Term | Type | |
| 4 | YE | XP5 | D1 | 2 | R1.CP | 4 | 13 | |
| 5 | WH | XP5 | A2 | 2 | R1.CP | 5 | 13 | |
| 6 | BK | XP5 | B2 | 2 | R1.CP | 6 | 13 | |
| 7 | BN | XP5 | C2 | 2 | R1.CP | 8 | 13 | |
| 8 | VT | XP5 | D2 | 2 | R1.CP | 9 | 13 | |
| 9 | OG | XP5 | A3 | 2 | R1.CP | 10 | 13 | |
| 10 | PK | XP5 | B3 | 2 | R1.CP | 11 | 13 | |
| 11 | TQ | | | | | | | Conductor to cut off. |
| 12 | GY | XP5 | Earth | 19 | R1.CP | 12 | 13 | i |
| SHIELD | | XP5 | Earth Ref. (DP shield) | 20 | | Earth (shield) | | 0V (ground) ii |
| Signals | | | | | | | | |
| | Pair | | | | | | | |
| 1.1 | 1 WH | XP5 | B5 | 4 | R1.CS | 1 | 15 | |
| 1.2 | 1 BU | XP5 | C5 | 4 | R1.CS | 2 | 15 | |
| 2.1 | 2 WH | XP5 | D5 | 4 | R1.CS | 3 | 15 | |
| 2.2 | 2 OG | XP5 | A6 | 4 | R1.CS | 4 | 15 | |
| 3.1 | 3 WH | XP5 | B6 | 4 | R1.CS | 5 | 15 | |
| 3.2 | 3 GN | XP5 | C6 | 4 | R1.CS | 6 | 15 | |
| 4.1 | 4 WH | XP5 | D6 | 4 | R1.CS | 7 | 15 | |
| 4.2 | 4 BN | XP5 | A7 | 4 | R1.CS | 8 | 15 | |
| 5.1 | 5 WH | XP5 | B7 | 4 | R1.CS | 9 | 15 | |
| 5.2 | 5 GY | XP5 | C7 | 4 | R1.CS | 10 | 15 | |
| 6.1 | 6 RD | XP5 | D7 | 4 | R1.CS | 11 | 15 | |
| 6.2 | 6 BU | XP5 | A8 | 4 | R1.CS | 12 | 15 | |
| 7.1 | 7 RD | XP5 | B8 | 4 | R1.CS | 13 | 15 | |
| 7.2 | 7 OG | XP5 | C8 | 4 | R1.CS | 14 | 15 | |
| 8.1 | 8 RD | XP5 | D8 | 4 | R1.CS | 15 | 15 | |
| 8.2 | 8 GN | XP5 | A9 | 4 | R1.CS | 16 | 15 | |
| 9.1 | 9 RD | XP5 | B9 | 4 | R1.CS | 17 | 15 | |
| 9.2 | 9 BN | XP5 | C9 | 4 | R1.CS | 18 | 15 | |
| 10.1 | 10 RD | XP5 | D9 | 4 | R1.CS | 19 | 15 | |
| 10.2 | 10 GY | XP5 | A10 | 4 | R1.CS | 20 | 15 | |
| 11.1 | 11 BK | XP5 | B10 | 4 | R1.CS | 21 | 15 | |
| 11.2 | 11 BU | XP5 | C10 | 4 | R1.CS | 22 | 15 | |

Continues on next page

2 Installation and commissioning

2.5.2 Installation of (optional) customer connections IRB 360

Continued

| Wire | Spec. | Connection point A | | | Connection point B | | | Note |
|--------|-------|--------------------|---------------------------|------|--------------------|------|------|-----------------------|
| | | Designation | Term | Type | Designation | Term | Type | |
| 12.1 | 12 BK | XP5 | D10 | 4 | R1.CS | 23 | 15 | |
| 12.2 | 12 OG | | | | | | | Conductor to cut off. |
| 13.1 | 13 BK | | | | | | | Conductor to cut off. |
| 13.2 | 13 GN | | | | | | | Conductor to cut off. |
| 14.1 | | | | | | | | Conductor to cut off. |
| 14.2 | | | | | | | | Conductor to cut off. |
| 15.1 | | | | | | | | Conductor to cut off. |
| 15.2 | | | | | | | | Conductor to cut off. |
| 16.1 | | | | | | | | Conductor to cut off. |
| 16.2 | | | | | | | | Conductor to cut off. |
| Shield | | XP5 | Earth Ref. (DP shield) | 20 | | | | 0V (Ground) ii |

i Use green/yellow shrinking hose on free conductors, in both ends.

ii Dual press both shields, and connect them to earth.

Installation

| | Action | Note |
|---|---|------------------------|
| 1 | Remove the standard cover plate. | |
| 2 | Fit the self-adhesive gasket on the customer cover plate. | |
| 3 | Install the customer cable harness. | Use standard tools. |
| 4 | Assemble the customer cover plate using the four attachment screws. | Tightening torque 4 Nm |

2.5.3 Installation of vacuum system (option 218-9)

General

This section describes installation of (optional) vacuum system on an IRB 360.



DANGER

Turn off all electrical power, hydraulic and pneumatic pressure supplies before entering the workspace of the manipulator.

Also read the safety sections:

- *Safety risks related to pneumatic/hydraulic systems on page 27*
- *Risks associated with live electric parts on page 29*
- *Safety risks during installation and service work on robots on page 22*

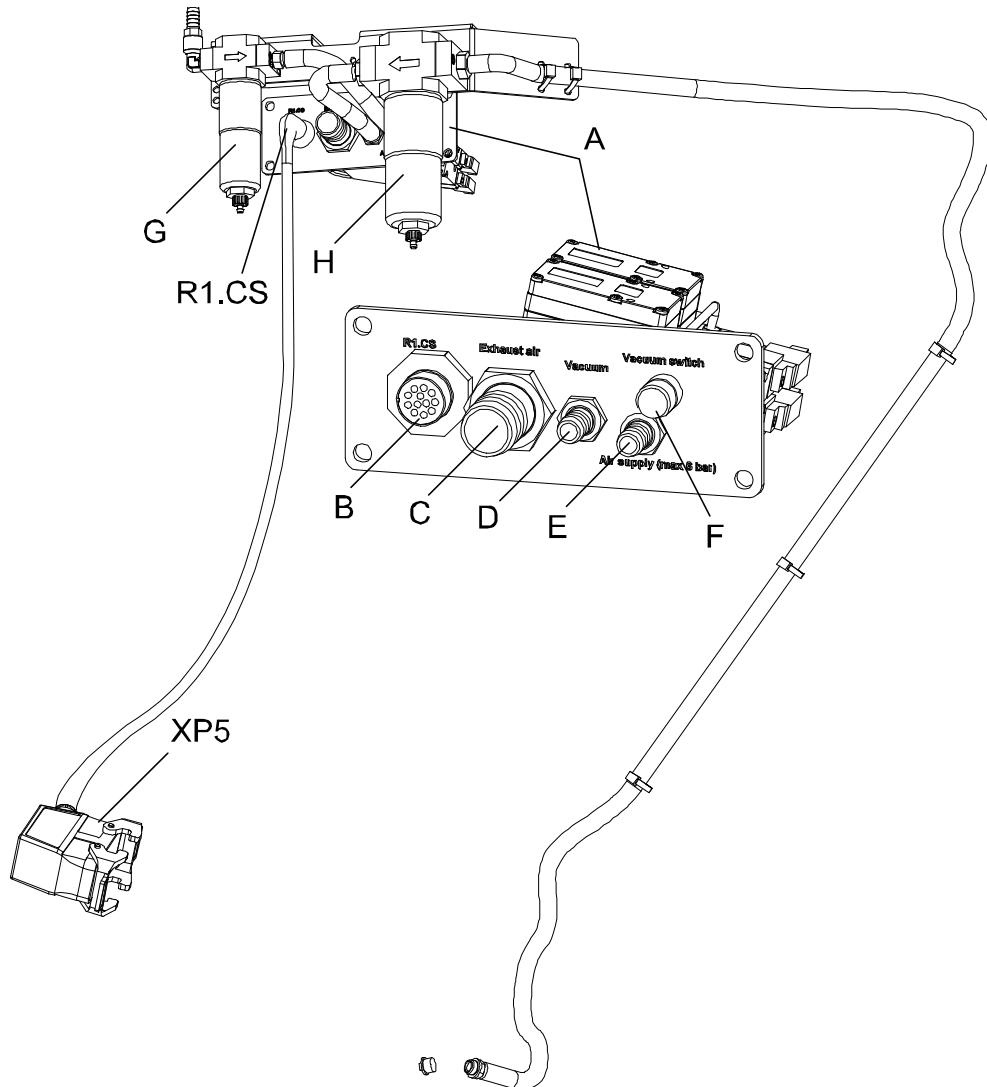
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2 Installation and commissioning

2.5.3 Installation of vacuum system (option 218-9)

Continued

Locations

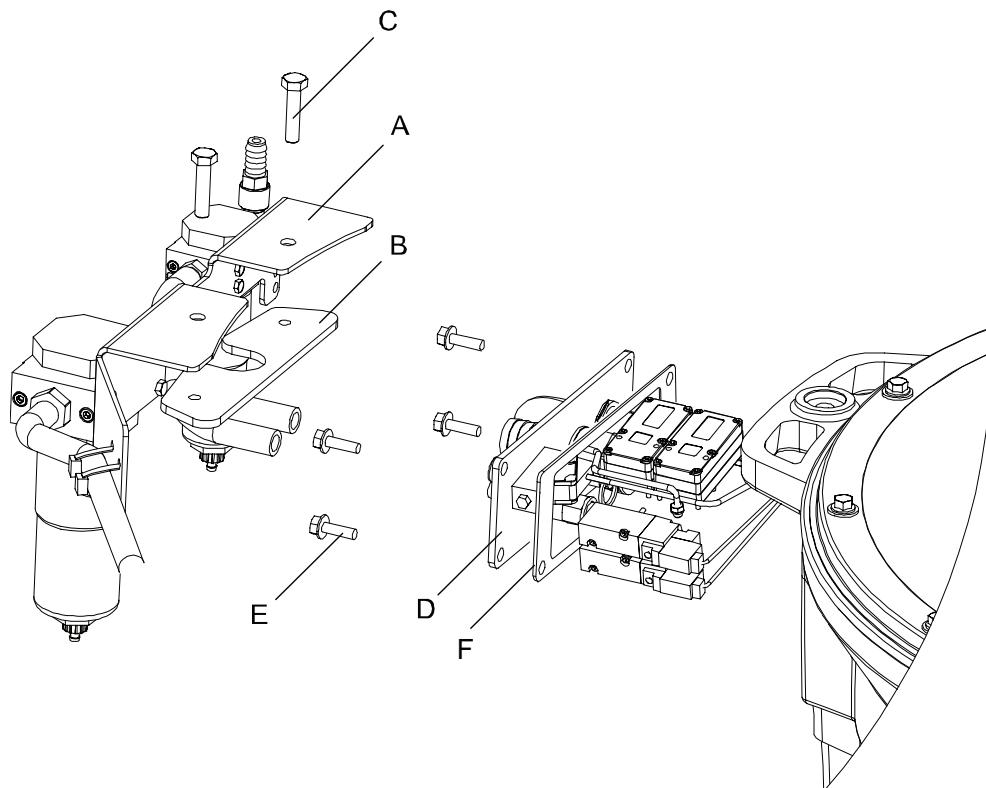


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| | |
|---|----------------------------------|
| A | Ejector unit |
| B | R1.CS |
| C | Exhaust air |
| D | Vacuum In |
| E | Compressed air in (max. 6 bar) |
| F | Vacuum switch |
| G | Air filter (compressed air side) |
| H | Air filter (vacuum side) |

Continues on next page

Mechanical installation ejector



xx0700000714

| | |
|---|--|
| A | Attachment |
| B | Bracket |
| C | Hexagon head screw, M8x35 (Steel 8.8-A2F) |
| D | Ejector unit |
| E | Hexagon bolt with flange, M6 x 20 (A2 DIN6921) |
| F | Gasket |

| | Action | Note |
|---|---|------|
| 1 | Follow the refitting instructions in section <i>Replacement of ejector unit on page 227</i> | |

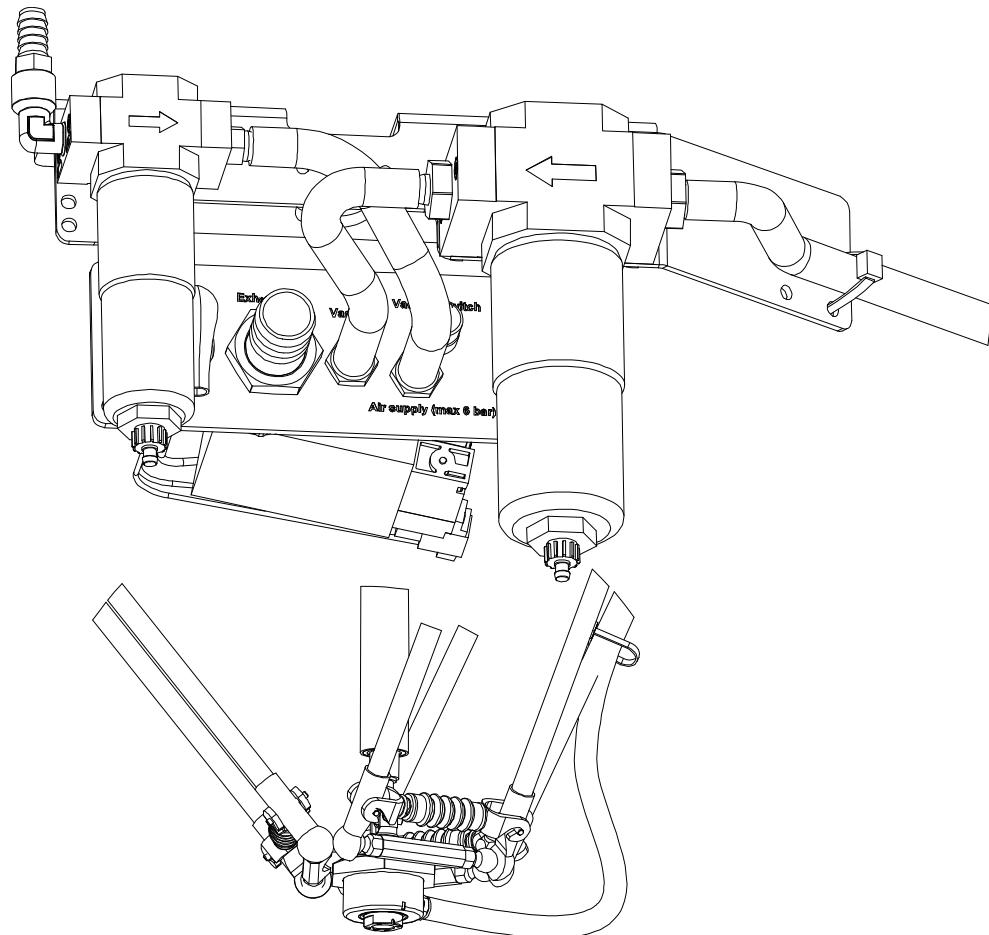
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2 Installation and commissioning

2.5.3 Installation of vacuum system (option 218-9)

Continued

Installation of hoses



xx0700000710

| | Action | Note |
|---|--|------|
| 1 | Follow the refitting instructions in section Replacement of vacuum hoses on page 223 . | |

Electrical installation

| | Action | Note |
|---|---|---|
| 1 | Assemble the customer cable 3HAC14860-X | X = Depending on length, see section Manipulator cables IRB 360 on page 104 |
| 2 | Use connection R1.CS on the front of the ejector unit, and the other end to the XP5 socket on the controller. | |

2.6.1 Connecting the controller to the manipulator

Overview

Two cables are used to connect the controller to the manipulator, one for measuring signals, and the other for motor and brakes. The connection on the manipulator is located on the robot base on the right side of axis 1 upper arm. **Connecting the controller to the manipulator is further described in the product manual for the controller.**



WARNING

Before starting to connect any cable to the controller, make sure that the line voltage cable is disconnected.

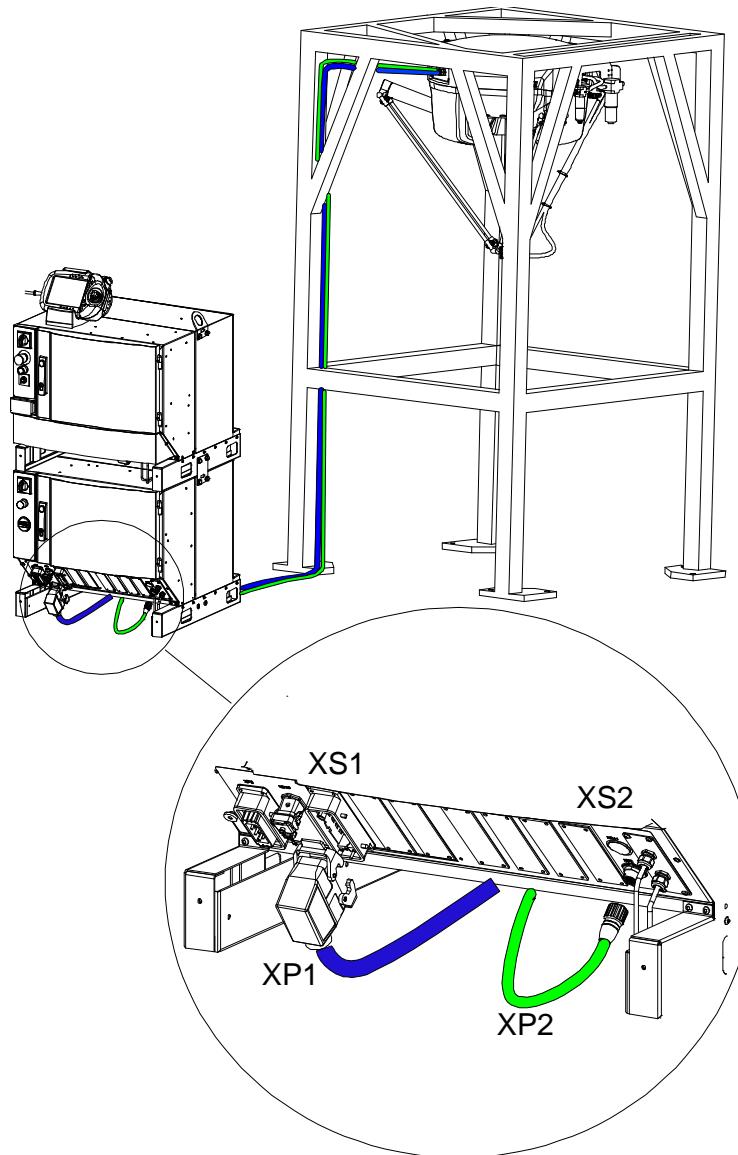
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2 Installation and commissioning

2.6.1 Connecting the controller to the manipulator

Continued

Controller connections

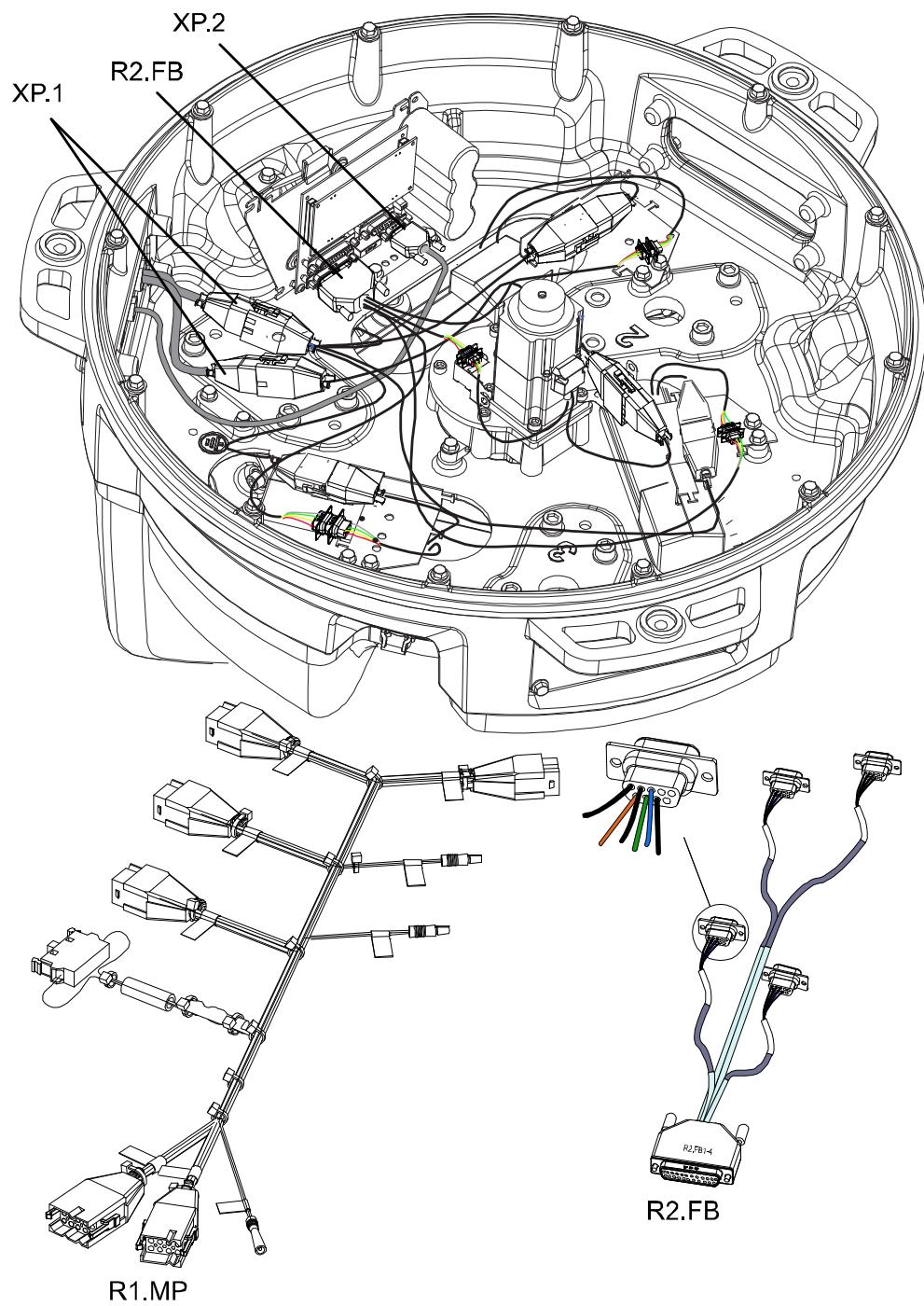


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The cables are connected to the front side of the cabinet using an industrial connector and a Burndy connector (see figure). A connector is designated XP when it has pins (male) and XS when it has sockets (female). Cable part numbers and length in section [Manipulator cables IRB 360 on page 104](#).

Continues on next page

Robot connections



xx0700000565

2 Installation and commissioning

2.6.2 Manipulator cables IRB 360

General

Connect the robot and controller to each other after securing them to the foundation. The following lists specify which cables to use for each respective application.

Cable categories

| Cable category | Description |
|--------------------------|--|
| Robot power cables | Handles power supply to the robot's motors. |
| Robot signal cables | Handles signals from the controller to the robot's motors, as well as feedback from the serial measurement board. |
| Customer cables (option) | Handles communication with equipment fitted on the robot by the customer, low voltage signals and high voltage power supply + protective ground. |

Robot control cable

These cables are included in the standard delivery. They are completely pre-manufactured and ready to plug in.

| Cable sub-category | Description | Connection point, cabinet | Connection point, robot |
|------------------------|--|---------------------------|-------------------------|
| Robot cable (power) | Transfers drive power from the drive units in the control cabinet to the robot motors. | XS1 | R1.MP1-3 R1.MP4-6 |
| Robot cable, (signals) | Transfers resolver data from and power supply to the serial measurement board. | S | X1(SMB) |

Robot control cable (power and signal)

These cables are sold in pair, including both one robot cable power, and one robot cable signal.

| Cable | Art. no. |
|--------------------------|----------------|
| Robot control cable 3 m | 3HAC029903-001 |
| Robot control cable 7 m | 3HAC029903-002 |
| Robot control cable 15 m | 3HAC029903-003 |
| Robot control cable 22 m | 3HAC029903-004 |
| Robot control cable 30 m | 3HAC029903-005 |

Robot control cable (power and signal) for Panel Mounted Controller

These cables are included in the standard delivery for the Panel Mounted Controller. The cable needs to be cut off and prepared to fit the controller's connection points, as described in the product manual for the controller.

| Cable | Art. no. |
|-------------------------|----------------|
| Robot control cable 7 m | 3HAC029903-002 |

Continues on next page

Customer connections

Customer connection (optional)

These cables including both power and signals are optional and **can not be combined with customer vacuum connections.**

| Cable | Art. no. |
|-----------------------------|----------------|
| Customer control cable 3 m | 3HAC030198-001 |
| Customer control cable 7 m | 3HAC030198-002 |
| Customer control cable 15 m | 3HAC030198-003 |
| Customer control cable 22 m | 3HAC030198-004 |
| Customer control cable 30 m | 3HAC030198-005 |

Customer vacuum connection (optional)

Signal cables for vacuum are optional and **can not be combined with customer connections.**

| Cable | Art. no. |
|-----------------------------|-------------|
| Customer control cable 3 m | 3HAC14860-7 |
| Customer control cable 7 m | 3HAC14860-1 |
| Customer control cable 15 m | 3HAC14860-2 |
| Customer control cable 22 m | 3HAC14860-3 |
| Customer control cable 30 m | 3HAC14860-4 |

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3 Maintenance

3.1 Introduction

Structure of this chapter

This chapter describes all the maintenance activities recommended for the IRB 360.

It is based on the maintenance schedule found at the beginning of the chapter. The schedule contains information about required maintenance activities including intervals, and refers to procedures for the activities.

Each procedure contains all the information required to perform the activity, including required tools and materials.

The procedures are gathered in different sections and divided according to the maintenance activity.

Safety information

Observe all safety information before conducting any service work!

There are general safety aspects that must be read through, as well as more specific safety information that describes the danger and safety risks when performing the procedures. Read the chapter [Safety on page 17](#) before performing any service work!



Note

If the IRB 360 is connected to power, always make sure that the IRB 360 is connected to protective earth before starting any maintenance work!

For more information see:

- *Product manual - IRC5*

3 Maintenance

3.2.1 Specification of maintenance intervals

3.2 Maintenance schedule

3.2.1 Specification of maintenance intervals

Introduction

The intervals are specified in different ways depending on the type of maintenance activity to be carried out and the working conditions of the IRB 360:

- Calendar time: specified in months regardless of whether the system is running or not.
- Operating time: specified in operating hours. More frequent running means more frequent maintenance activities.
- SIS: specified by the robot's SIS (Service Information System). A typical value is given for a typical work cycle, but the value will differ depending on how hard each part is run. The SIS used in M2004 is further described in the *Operating manual - Service Information System*.

3.2.2 Regular maintenance

Recommendation

The robot is designed to be able to work under very demanding conditions with a minimum of maintenance. Time between services can vary depending on the influence of the environment the robot is exposed for. We strongly recommend that at every stop in production, especially after collisions and after every wash down, the robot is inspected concerning the following parts.

Inspect regularly

- Telescopic shaft
- Spring units
- Bars
- Universal joints

Preventive maintenance

Nevertheless, certain routine checks and preventive maintenance must be carried out at specified periodic intervals, as shown in the following table.

| Preventive maintenance | Note |
|---|--|
| Clean the robot. | As described in section Cleaning activities on page 151 . |
| Lubricate sealings: <ul style="list-style-type: none"> • At regular intervals • When needed. | Recommended lubrication, see section: <ul style="list-style-type: none"> • Mounting instructions for bearings on page 164 |
| Controller: <ul style="list-style-type: none"> • Check that the sealing joints and cable glands are really airtight so that dust and dirt are not sucked into the cabinet. | |

3 Maintenance

3.2.3 Maintenance schedule IRB 360

3.2.3 Maintenance schedule IRB 360

Maintenance schedule

| Maintenance activity | Equipment | Daily | 400h | 500h | 4,000h 2 year | 30,000h 5 year |
|----------------------|--|-------|------|-------|-------------------------------------|------------------------------------|
| Inspection | Clean Room robot | x i | | | | |
| Inspection | Telescopic shaft | | | x | | |
| Inspection | Vacuum system | | | x ii | x | |
| Inspection | Bar system | | | x | x | |
| Inspection | Upper arms | | | | x | |
| Inspection | Spring unit | | | x iii | | |
| Inspection | Movable plate | | | | x | |
| Grease | Telescopic shaft (WDS) | | | x iv | | |
| Grease | Bearing rings 3HAC2091-1 v | | x | | | |
| Changing | Telescopic shaft including universal joints | | | | x | |
| Changing | Gearboxes oil, axes 1, 2, and 3 | | | | | x vi |
| Changing | Gearbox oil, axis 4 | | | | | x vi |
| Replacement | Battery pack, measurement system of type RMU101 or RMU102 (3-pole battery contact) | | | | | 36 months or battery low alert vii |
| Replacement | Battery pack, measurement system with 2-pole battery contact, e.g. DSQC633A | | | | 24 months or battery low alert viii | |

i Check for abnormal wear or contamination

ii Only if option is chosen. Change interval is dependant on the material in picked objects. Porous objects may cause shorter cleaning intervals.

iii Grease if the spring units make a grinding sound.

iv Do not grease the bearing rings 3HAC028087-001 in the arm system joints.

v There are two different types of bearing rings, 3HAC028087-001 is maintenance-free, 3HAC2091-1 must be lubricated according to maintenance schedule. See [Different versions of bearing rings require different maintenance procedures on page 122](#).

vi Oil should only be changed once after the first 30,000 h.

vii The battery low alert (38213 Battery charge low) is displayed when the battery needs to be replaced. The recommendation to avoid an unsynchronized robot is to keep the power to the controller turned on until the battery is to be replaced.

See the replacement instruction for more details.

viii The battery low alert (38213 Battery charge low) is displayed when remaining backup capacity (robot powered off) is less than 2 months. The typical lifetime of a new battery is 36 months if the robot is powered off 2 days/week or 18 months if the robot is powered off 16 h/day. The lifetime can be extended with a battery shutdown service routine. See [Operating manual - IRC5 with FlexPendant](#) for instructions.

Check regularly

Check regularly:

- Wear of bearing ring in joints of the arm system.

Continues on next page

- For any oil leaks. If a major oil leak is discovered, call for service personnel.
- For excessive play in gears. If play develops, call for service personnel.
- That the cabling between the control cabinet and robot is not damaged.
- Wear of plain bearings in telescopic shaft (wash-down protection).

Cleaning

Cleaning:

- Clean the robot exterior with a cloth when necessary. Do not use aggressive solvents which may damage paint or cabling. See section [Cleaning activities on page 151](#).
- Cleaning instructions for wash down version, see section [Cleaning activities on page 151](#).

3 Maintenance

3.3.1 Telescopic shaft, axis 4, standard

3.3 Inspection activities

3.3.1 Telescopic shaft, axis 4, standard

General

This section describes maintenance on the telescopic shaft, axis 4, with the interval 500 hours.



DANGER

Turn off all electrical power, hydraulic and pneumatic pressure supplies before entering the workspace of the manipulator.

Also read the safety sections:

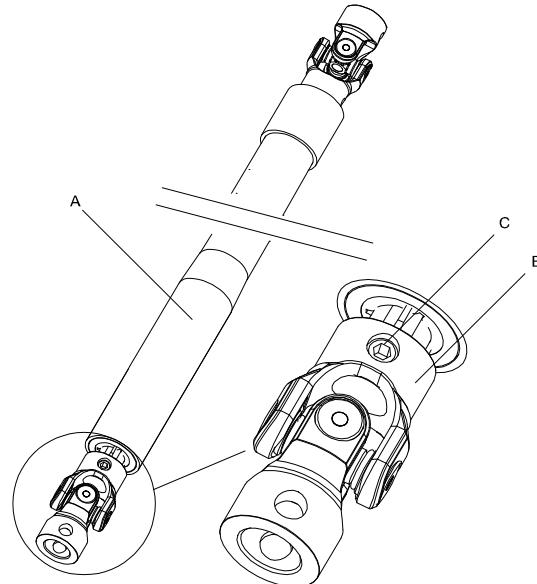
- [Safety risks related to pneumatic/hydraulic systems on page 27](#)
- [Risks associated with live electric parts on page 29](#)
- [Safety risks during installation and service work on robots on page 22](#)



Note

The wear on the bearings depends on the payload, cycle, environment, and lubrication.

Telescopic shaft



xx0700000556

| | |
|---|------------------------|
| A | Telescopic shaft (STD) |
| B | Universal joint |
| C | Set screw, dog point |

Continues on next page

Required equipment and references

| | Required equipment | Note |
|--|--------------------|--------------------------------------|
| | Standard tools | <i>Standard toolkit on page 268.</i> |
| References | | |
| <i>Replacement of telescopic shaft on page 194</i> | | |
| <i>Spare parts, telescopic shaft.</i> | | |

Interval 500 h

| | Action | Note |
|---|---|--|
| 1 | Check and retighten the set screws in the universal joints. | Described in section <i>Replacement of telescopic shaft on page 194.</i> |

Interval 4000 h

| | Action | Note |
|---|--|--------------------------------------|
| 1 | Change the telescopic shaft and the universal joint. | <i>Spare parts, telescopic shaft</i> |

After a collision and/or if arms have fallen off

| | Action | Note |
|---|--|--|
| 1 | Remove any remaining parts of the bar system from the <i>movable plate</i> . |  CAUTION Be careful when pulling out the <i>telescope</i> to full length. |
| 2 | Check for damages on the <i>universal joint</i> . | How to replace the universal joint, see section: • <i>Replacement of universal joint on page 197</i> |
| 3 | Move the <i>movable plate</i> in different directions in order to check if there are any indications of reduced moving ability of the <i>universal joint</i> . | How to replace the universal joint, see section: • <i>Replacement of universal joint on page 197</i> |

3 Maintenance

3.3.2 Telescopic shaft, wash down, axis 4

3.3.2 Telescopic shaft, wash down, axis 4

General

This section describes maintenance on the telescopic shaft (wash down), axis 4 interval 500 and 4000 h



DANGER

Turn off all electrical power, hydraulic and pneumatic pressure supplies before entering the workspace of the manipulator.

Also read the safety sections:

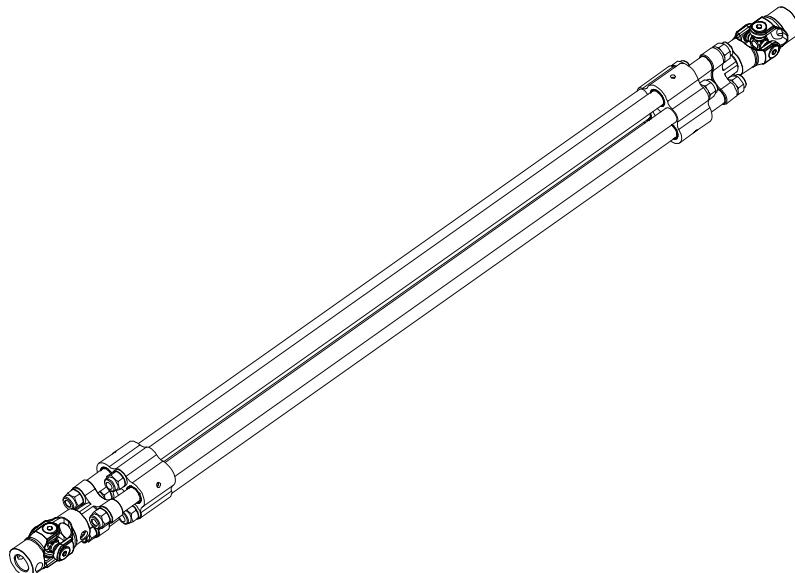
- *Safety risks related to pneumatic/hydraulic systems on page 27*
- *Risks associated with live electric parts on page 29*
- *Safety risks during installation and service work on robots on page 22*



Note

The wear on the bearings depends on the payload, cycle, environment, and lubrication.

Telescopic shaft



xx0700000717

Required equipment and references

References

Replacement of telescopic shaft on page 194

Spare parts, telescopic shaft.

Continues on next page

Interval 500 h

| | Action | Note |
|---|---|--|
| 1 | Check and retighten set screws. | |
| 2 | If the linear bushings are worn out or if the backlash is excessive, change the telescopic shaft and the universal joint. | Described in section Replacement of telescopic shaft on page 194 . |

Interval 4000 h

| | Action | Note |
|---|--|--------------------------------------|
| 1 | Change the telescopic shaft and the universal joint. | <i>Spare parts, telescopic shaft</i> |

After a collision and/or if arms have fallen off

| | Action | Note |
|---|--|--|
| 1 | Remove any remaining parts of the <i>bar system</i> from the <i>movable plate</i> . |  CAUTION Be careful when pulling out the <i>telescope</i> to full length. |
| 2 | Check for damages on the <i>universal joint</i> . | How to replace the universal joint, see section: • Replacement of universal joint on page 197 |
| 3 | Move the <i>movable plate</i> in different directions in order to check if there are any indications of reduced moving ability of the <i>universal joint</i> . | How to replace the universal joint, see section: • Replacement of universal joint on page 197 |

3 Maintenance

3.3.3 Telescopic shaft, stainless, axis 4

General

This section describes maintenance on the telescopic shaft (stainless), axis 4 interval 500 and 4000 h



DANGER

Turn off all electrical power, hydraulic and pneumatic pressure supplies before entering the workspace of the manipulator.

Also read the safety sections:

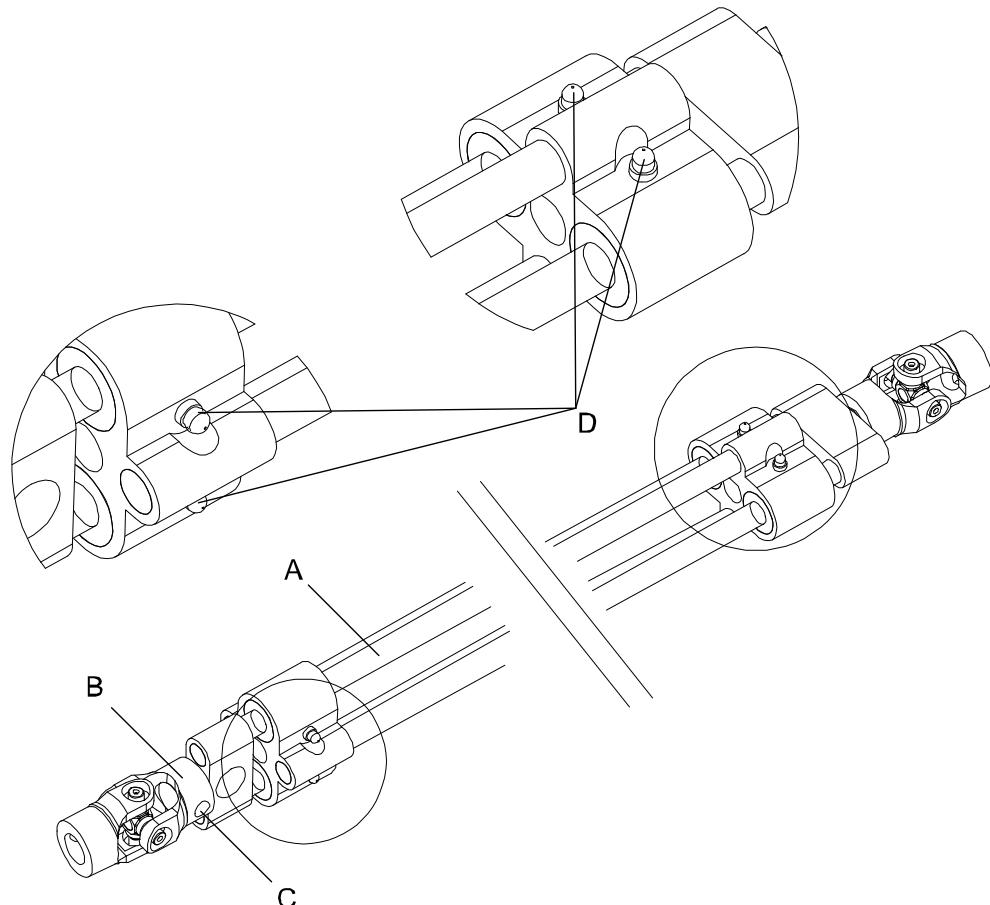
- *Safety risks related to pneumatic/hydraulic systems on page 27*
- *Risks associated with live electric parts on page 29*
- *Safety risks during installation and service work on robots on page 22*



Note

The wear on the bearings depends on the payload, cycle, environment, and lubrication.

Continues on next page

Telescopic shaft

xx0700000498

| | |
|---|----------------------------------|
| A | Telescopic shaft (WDS) |
| B | Universal joint |
| C | Set screw, dog point |
| D | Grease nipples (Ballnipple Ø3mm) |

Required equipment and references

| Required equipment | Spare part No. | Note |
|--------------------|---|---|
| Grease gun | | Made for grease nipples (Ballnipple Ø3mm) |
| Grease | Grease specification on page 271. | |
| Telescopic shaft | Spare parts, telescopic shaft | |
| Standard tools | Standard toolkit on page 268. | |

| References |
|---|
| Spare parts, telescopic shaft |
| Replacement of telescopic shaft on page 194 |

Continues on next page

3 Maintenance

3.3.3 Telescopic shaft, stainless, axis 4

Continued

Interval 500 h

| Action | Note |
|---|--|
| 1 Check and retighten the set screws in the universal joints. | |
| 2 Lubricate the linear bushing, using a shot lubricator. | |
| 3 If the linear bushing are worn out or if the backlash is excessive, replace the telescopic shaft. | Described in section Replacement of telescopic shaft on page 194 |

Interval 4000 h

| Action | Note |
|---|--------------------------------------|
| 1 Change the telescopic shaft and the universal joints. | <i>Spare parts, telescopic shaft</i> |

After a collision and/or if arms have fallen off

| Action | Note |
|--|---|
| 1 Remove any remaining parts of the <i>bar system</i> from the <i>movable plate</i> . |  CAUTION Be careful when pulling out the telescope to full length. |
| 2 Check for damages on the <i>universal joint</i> . | How to replace the universal joint, see section: • Replacement of universal joint on page 197 |
| 3 Move the <i>movable plate</i> in different directions in order to check if there are any indications of reduced moving ability of the <i>universal joint</i> . | How to replace the universal joint, see section • Replacement of universal joint on page 197 |

3.3.4 Vacuum system (optional)

General

This section describes maintenance on the vacuum system, with the intervals 500 and 4000 hours.



Note

Only use in lubricated air.



DANGER

Turn off all electrical power, hydraulic and pneumatic pressure supplies before entering the workspace of the manipulator.

Also read the safety sections:

- [Safety risks related to pneumatic/hydraulic systems on page 27](#)
- [Risks associated with live electric parts on page 29](#)
- [Safety risks during installation and service work on robots on page 22](#)

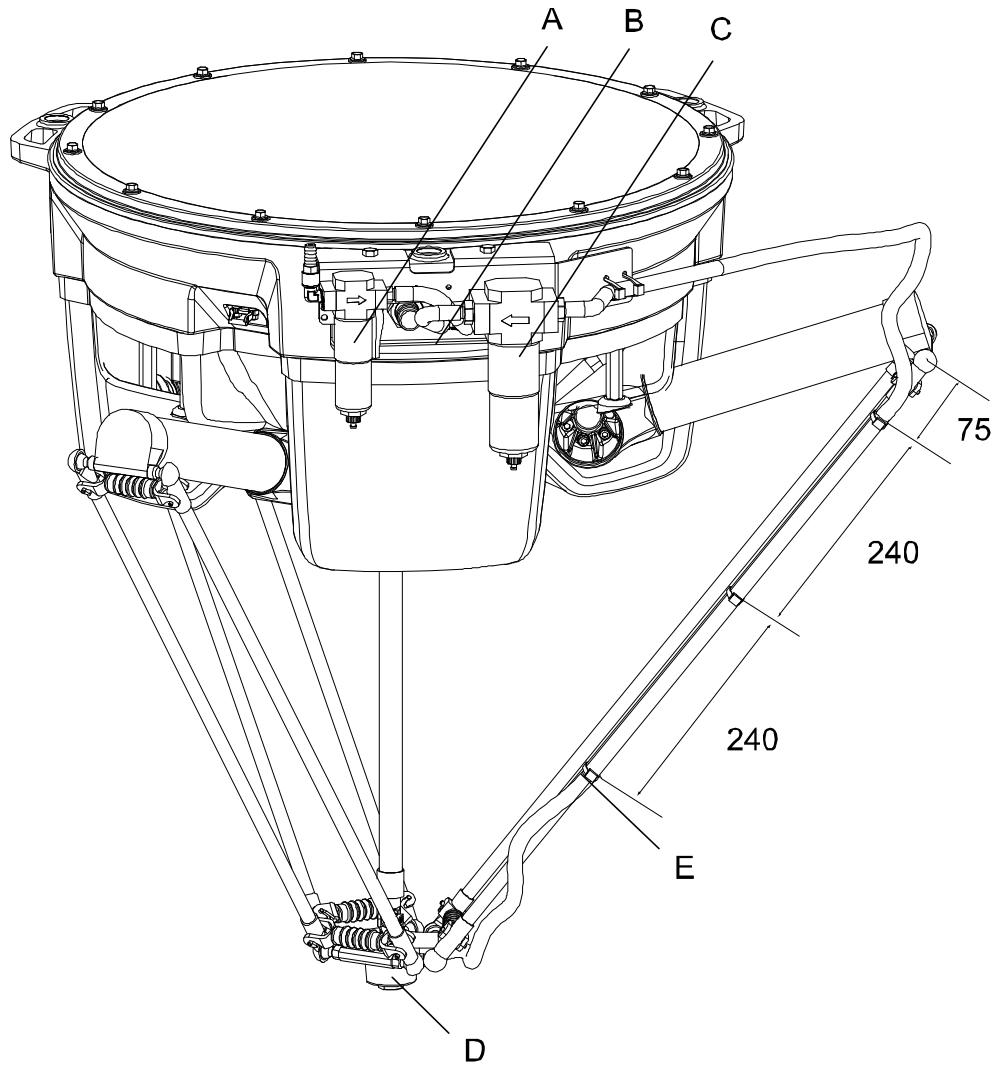
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3 Maintenance

3.3.4 Vacuum system (optional)

Continued

Vacuum system



xx0700000499

| | |
|---|--------------------------|
| A | Air filter inlet. |
| B | Ejector unit |
| C | Air filter inlet vacuum. |
| D | Swivel cup |
| E | Hose clamp |

Required equipment and references

| Required equipment | Spare part no. | Note |
|---|-----------------------------------|------|
| Pneumatic valve unit | <i>Spare parts, ejector unit.</i> | |
| References | | |
| Replacement of ejector unit on page 227 | | |
| Draining of water separation filter on page 225 | | |

Continues on next page

Interval 500 h

| | Action | Note |
|---|---|--|
| 1 | Empty air filter and check the position of the clamps for the hose. | Described in section Draining of water separation filter on page 225 . |
| 2 | Correct the positions on the outer clamps. | Positions shown in figure. |
| 3 | Check that the air supply is dry and clean. | Particle size must not exceed 5 µm |

Interval 4,000 h or 2 Years

| | Action | Note |
|---|---------------------------|---|
| 1 | Replace pneumatic valves. | The service life of the valves is 4×10^7 cycles. Described in section Replacement of ejector unit on page 227 |

3 Maintenance

3.3.5 Bar system

3.3.5 Bar system

General

This section describes maintenance on the bar system, with the intervals 500 and 4000 hours.



DANGER

Turn off all electrical power, hydraulic and pneumatic pressure supplies before entering the workspace of the manipulator.

Also read the safety sections:

- *Safety risks related to pneumatic/hydraulic systems on page 27*
- *Risks associated with live electric parts on page 29*
- *Safety risks during installation and service work on robots on page 22*



Note

The wear on the bearing rings depends on the payload, number of cycles, and environment. Collisions can damage the bearing rings!



CAUTION

The spring units must be removed according to the description in section *Replacement of parallel arms on page 178* or they will be damaged.



Note

Never use grease on the bar system.

Different versions of bearing rings require different maintenance procedures

Valid for robot versions: IRB 360 - 1/1130, IRB 360 - 3/1130, IRB 360 - 1/800, IRB 360 - 1/1600.

At delivery the robot is equipped with bearing rings 3HAC028087-001. These are maintenance free.

In specific environments the bearing rings 3HAC028087-001 might have been changed to bearing rings 3HAC2091-1 after delivery. These must be lubricated regularly.

If the bearing rings have been changed, this has been noted according to instructions enclosed with the delivery of the bearing rings 3HAC2091-1. The bearing rings 3HAC028087-001 are white. The bearing rings 3HAC2091-1 are grey.

Continues on next page

Required equipment and references

| Required equipment | Spare part no. | Note |
|---|--|--|
| Bearing rings | For article number see: • Spare parts - parallel arm system, IRB 360. | |
| Grease | - | Required for non-maintenance free bearing rings. • Mobilgrease FM 102 • Optimol Obeen UF 2 <i>See Different versions of bearing rings require different maintenance procedures on page 122.</i> |
| References | | |
| <i>Replacement of bearing rings on page 187</i> | | |

After a collision and/or if arms have fallen off

| | Action | Note |
|---|---|--|
| 1 | Check for damages on <i>bearing rings</i> . If needed, replace. | How to change bearing rings, see section: • <i>Replacement of bearing rings on page 187</i> |
| 2 | Check for contamination and/or residues of grease. | If needed clean the bearing rings with ethanol. |
| 3 | Lubricate bearing rings that are not maintenance-free (see <i>Different versions of bearing rings require different maintenance procedures on page 122</i>). | Type of grease, see <i>Required equipment and references on page 123</i> . |

Maintenance activity with interval 500 hours or 1 year

| | Action | Note |
|---|---|---|
| 1 | Check for wear on <i>bearing rings</i> , listen for screeching. Replace if needed. | How to replace bearing rings, see section: • <i>Replacement of bearing rings on page 187</i> |
| 2 | Lubricate bearing rings that are not maintenance free (see <i>Different versions of bearing rings require different maintenance procedures on page 122</i>). | Type of grease, see <i>Required equipment and references on page 123</i> . |

Maintenance activity with interval 4,000 hours or 2 years

| | Action | Note |
|---|--|---|
| 1 | Check surface of tube for cracks or damages. | Replace if damaged. |
| 2 | Check the distance between the bearing holders. | See <i>Distance between bearing holders on page 124</i> . |
| 3 | If needed, replace damaged parts as described in the repair chapter. | |

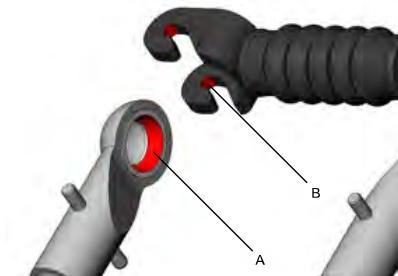
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3 Maintenance

3.3.5 Bar system

Continued

Bar system wear



xx0700000484

| | |
|---|---------------------------|
| A | Wear on bearing rings |
| B | Wear on spring unit forks |

Distance between bearing holders



Note

The bearing will normally wear a lot during the first hours of operation (0.1-0.5 mm). It may also show wear in the form of dust and small particles. After this initial run-in, wear will reduce significantly.

| | Action | Note |
|---|---|------------------|
| 1 | Measure the distance A between the bearing holders, according to the figure. Refer to the table below to see what distance requires replacement of the bearing ring. Replace the bearing ring, if required, according to section Replacement of bearing rings on page 187 . | xx1000000018 |

| Robot variant | Distance A | | |
|------------------|---------------|---|-----------------------------|
| | Initial value | Value that requires replacement of the bearing ring | Worn out value ⁱ |
| IRB 360 - 1/1130 | 126 mm (Std) | <125 mm (Std) | 124 mm (Std) |
| IRB 360 - 3/1130 | 130 mm (WDS) | <129 mm (WDS) | 128 mm (WDS) |
| IRB 360 - 1/800 | | | |
| IRB 360 - 1/1600 | | | |
| IRB 360 - 8/1130 | 130 mm | <129 mm | 128 mm |
| IRB 360 - 6/1600 | | | |

ⁱ The bearing ring is worn out and requires immediate replacement. Operating the robot beyond this value will cause permanent damage to the arm system components.

3.3.6 Joint balls

General

This section describes maintenance on the joint balls, with the interval 4000 hours.



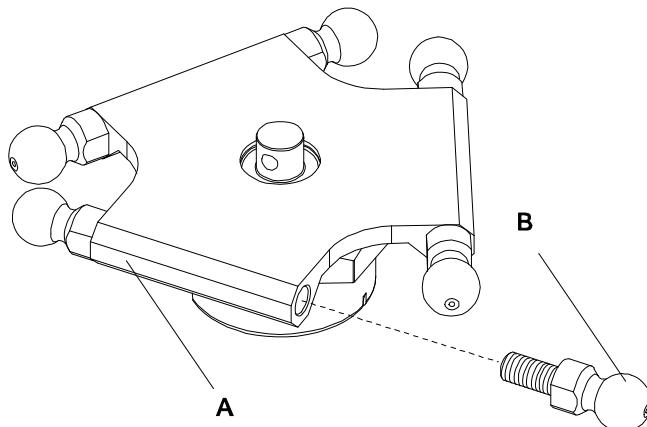
DANGER

Turn off all electrical power, hydraulic and pneumatic pressure supplies before entering the workspace of the manipulator.

Also read the safety sections:

- *Safety risks related to pneumatic/hydraulic systems on page 27*
- *Risks associated with live electric parts on page 29*
- *Safety risks during installation and service work on robots on page 22*

Check joint balls



xx0700000500

| | |
|---|---------------|
| A | Movable plate |
| B | Joint balls |

Required equipment and references

| Required equipment | Spare part No. | Note |
|---|----------------|-------------------------------------|
| Standard tools | | <i>Standard toolkit on page 268</i> |
| Pliers for parallel arms | 3HAC6194-1 | |
| References | | |
| <i>Replacement of joint balls on page 199</i> | | |

Interval 4,000 hours or 2 years

| | Action | Note |
|---|---|---|
| 1 | Check surface of joint balls for cracks or burrs. | If necessary replace the part as described in <i>Replacement of joint balls on page 199</i> |

3 Maintenance

3.3.7 Upper arms

3.3.7 Upper arms

General

This section describes maintenance on the upper arms, with the interval 4000 hours.



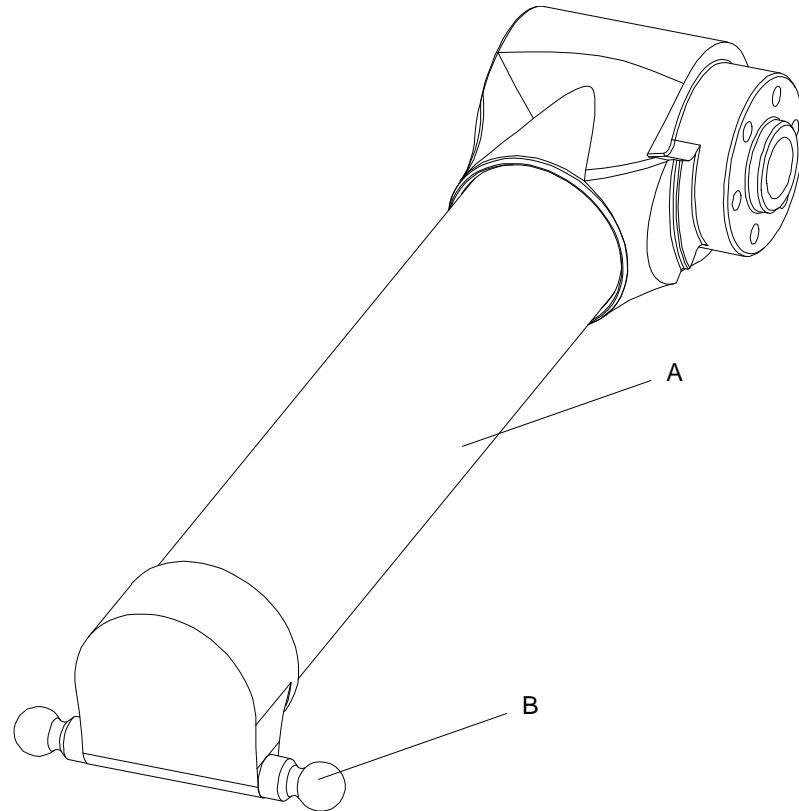
DANGER

Turn off all electrical power, hydraulic and pneumatic pressure supplies before entering the workspace of the manipulator.

Also read the safety sections:

- *Safety risks related to pneumatic/hydraulic systems on page 27*
- *Risks associated with live electric parts on page 29*
- *Safety risks during installation and service work on robots on page 22*

Check upper arm



xx0700000501

| | |
|---|----------------|
| A | Upper arm tube |
| B | Joint balls |

Continues on next page

Required equipment and references

| Required equipment | Spare part no. | Note |
|--|----------------|--|
| Standard tools | | Standard toolkit on page 268 |
| References | | |
| Replacement of joint balls on page 199 | | |
| Replacement of upper arm on page 183 | | |

Interval 4,000 hours or 2 years

| | Action | Note |
|---|---|--|
| 1 | Check the surface of the tube for cracks. | If necessary replace the part as described in section Replacement of upper arm on page 183 |
| 2 | Check surface of joint balls for cracks or burrs. | If necessary replace the part as described in Replacement of joint balls on page 199 |

3 Maintenance

3.3.8 Hoses

3.3.8 Hoses

General

This section describes maintenance on the hoses with the interval 500 hours.



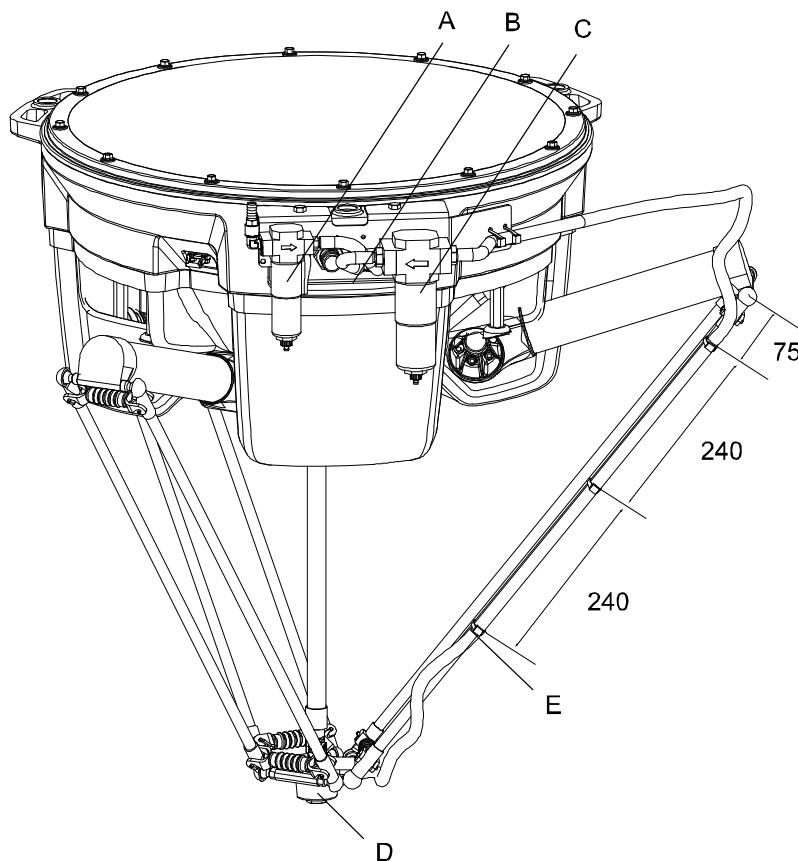
DANGER

Turn off all electrical power, hydraulic and pneumatic pressure supplies before entering the workspace of the manipulator.

Also read the safety sections:

- *Safety risks related to pneumatic/hydraulic systems on page 27*
- *Risks associated with live electric parts on page 29*
- *Safety risks during installation and service work on robots on page 22*

Check hoses



xx0700000499

| | |
|---|--------------------------|
| A | Air filter inlet. |
| B | Ejector unit |
| C | Air filter inlet vacuum. |
| D | Swivel cup |
| E | Hose clamp |

Continues on next page

Required equipment and references

| Required equipment | Spare part no. | Note |
|---|----------------|--|
| Standard tools | | Standard toolkit on page 268 |
| References | | |
| Replacement of vacuum hoses on page 223 | | |

Interval 500 hours

| | Action | Note |
|---|---|---|
| 1 | Check the entire hose and make sure there are no folds or surface damage. | If necessary, exchange the part as described in Replacement of vacuum hoses on page 223 |

3 Maintenance

3.3.9 Spring units

3.3.9 Spring units

General

This section describes maintenance on the spring units with the interval 500 hours.



DANGER

Turn off all electrical power, hydraulic and pneumatic pressure supplies before entering the workspace of the manipulator.

Also read the safety sections:

- *Safety risks related to pneumatic/hydraulic systems on page 27*
- *Risks associated with live electric parts on page 29*
- *Safety risks during installation and service work on robots on page 22*

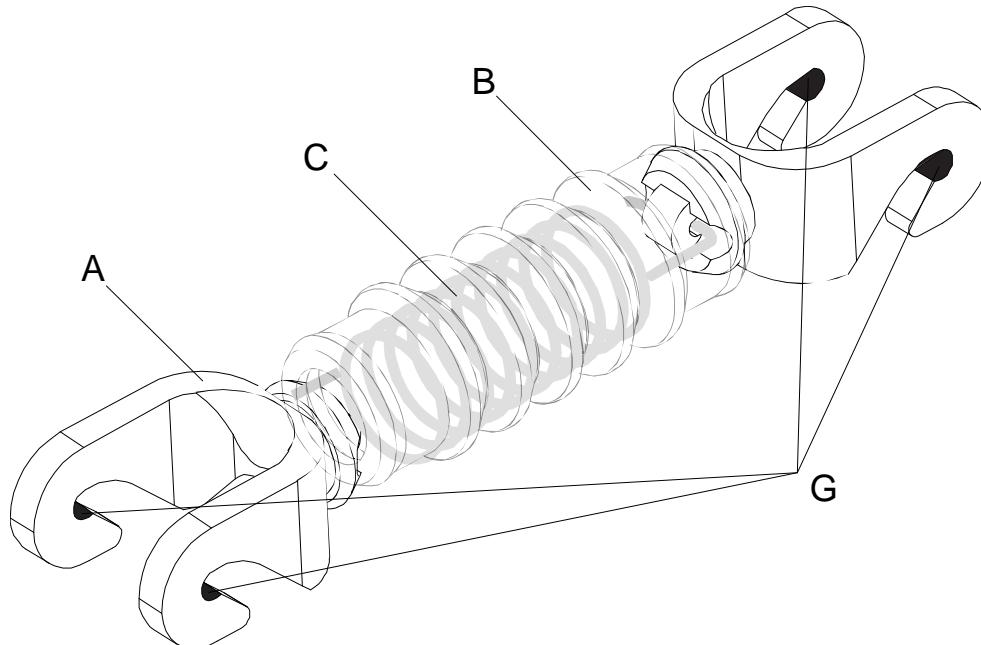


CAUTION

The spring units must be removed according to the description in section *Replacement of parallel arms on page 178* or they will be damaged.

Check spring units

IRB 360 - 1/1130, IRB 360 - 3/1130, IRB 360 - 1/800, IRB 360 - 1/1600

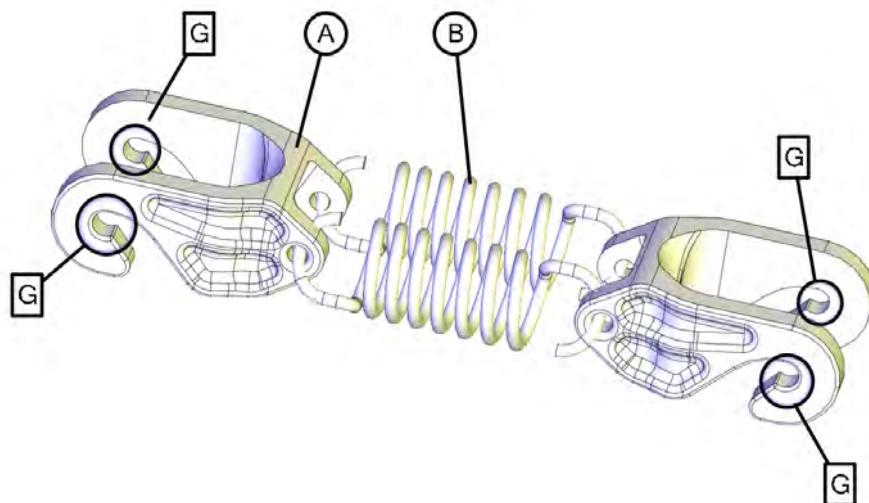


xx070000497

| | |
|---|-----------------|
| A | Hook |
| B | Spring |
| C | Rubber bellow |
| G | Greasing points |

Continues on next page

IRB 360 - 8/1130, IRB 360 - 6/1600



xx1300000162

| | |
|---|-----------------|
| A | Hook |
| B | Spring |
| G | Greasing points |

Required equipment and references

| Required equipment | Spare part no. | Note |
|---|---|------|
| Grease | <i>Grease specification on page 271</i> | |
| Standard tools | <i>Standard toolkit on page 268</i> | |
| Spring | <i>Spare parts - lower arm system, IRB 360.</i> | |
| References | | |
| <i>Replacement of parallel arms on page 178</i> | | |

Interval 500 hours

| | Action | Note |
|---|---|--|
| 1 | Check the forks for wear. | If necessary exchange the part as described in <i>Replacement of parallel arms on page 178</i> |
| 2 | If necessary (if the spring units make a grinding sound) apply grease to all wear surfaces. | Shown in figure as (G) |

3 Maintenance

3.3.10 Movable plate

3.3.10 Movable plate

General

This section describes maintenance on the movable plate, with the interval 4,000 hours.



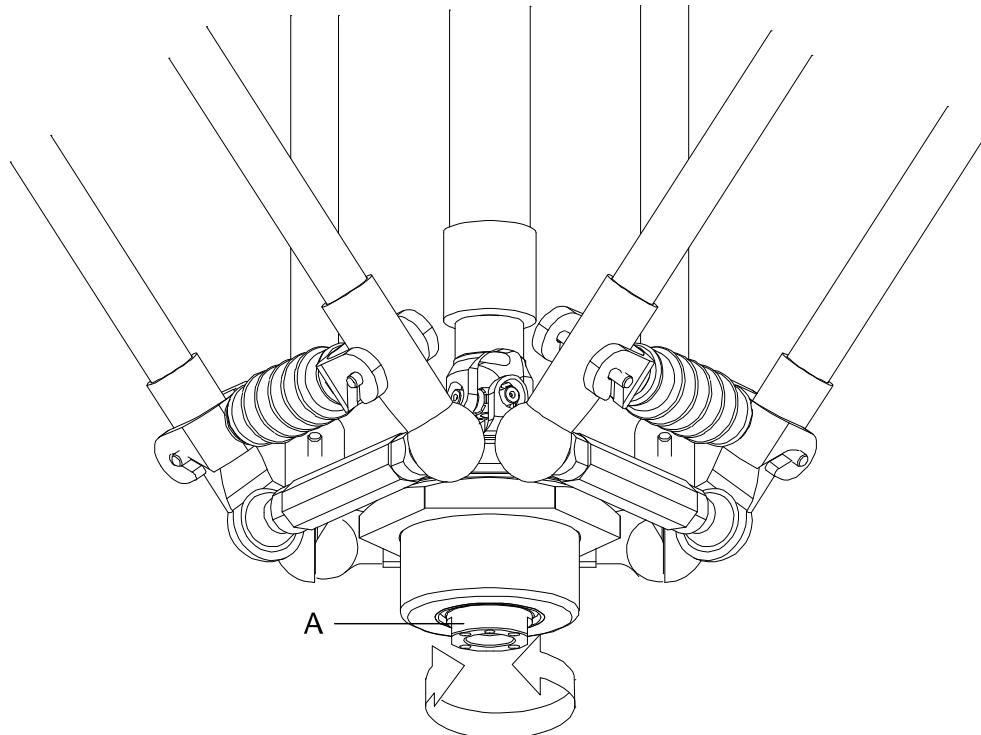
DANGER

Turn off all electrical power, hydraulic and pneumatic pressure supplies before entering the workspace of the manipulator.

Also read the safety sections:

- *Safety risks related to pneumatic/hydraulic systems on page 27*
- *Risks associated with live electric parts on page 29*
- *Safety risks during installation and service work on robots on page 22*

Check movable plate



xx0700000502

| | |
|---|-----------------------|
| A | Tool interface axis 4 |
|---|-----------------------|

Required equipment and references

| Required equipment | Spare part no. | Note |
|--------------------|--------------------------------------|------|
| Movable plate | <i>Spare parts, movable plate.</i> | |
| Standard tools | <i>Standard toolkit on page 268.</i> | |

Continues on next page

| |
|---|
| References |
| <i>Replacement of movable plate on page 190</i> |

Interval 4000 hours



CAUTION

Never force axial movement to the swivel or tool interface without first releasing the brakes, it will damage the telescopic shaft.

| | Action | Note |
|---|--|--|
| 1 | Release the holding brakes on the robot axis 4. | As described in section <i>Manually releasing the brakes on page 79.</i> |
| 2 | Check axis 4 so that the rotation is smooth. | If necessary replace the movable plate as described in <i>Replacement of movable plate on page 190</i> |

3 Maintenance

3.4.1 Changing the battery in the measuring system

3.4 Replacement/changing activities

3.4.1 Changing the battery in the measuring system



Note

The battery low alert (38213 Battery charge low) is displayed when the battery needs to be replaced. The recommendation to avoid an unsynchronized robot is to keep the power to the controller turned on until the battery is to be replaced.

For an SMB board with 3-pole battery contact (RMU101 3HAC044168-001 or RMU102 3HAC043904-001), the lifetime of a new battery is typically 36 months.

For an SMB board with 2-pole battery contact, the typical lifetime of a new battery is 36 months if the robot is powered off 2 days/week or 18 months if the robot is powered off 16 h/day. The lifetime can be extended for longer production breaks with a battery shutdown service routine. See *Operating manual - IRC5 with FlexPendant* for instructions.



DANGER

Turn off all electrical power, hydraulic and pneumatic pressure supplies before entering the workspace of the manipulator.

Also read the safety sections:

- [Safety risks related to pneumatic/hydraulic systems on page 27](#)
- [Risks associated with live electric parts on page 29](#)
- [Safety risks during installation and service work on robots on page 22](#)
- [WARNING - Safety risks during handling of batteries on page 53](#)



CAUTION

Always read the specific instructions for Clean Room robots before doing any repair work, see [Replacing parts on the robot on page 170](#).

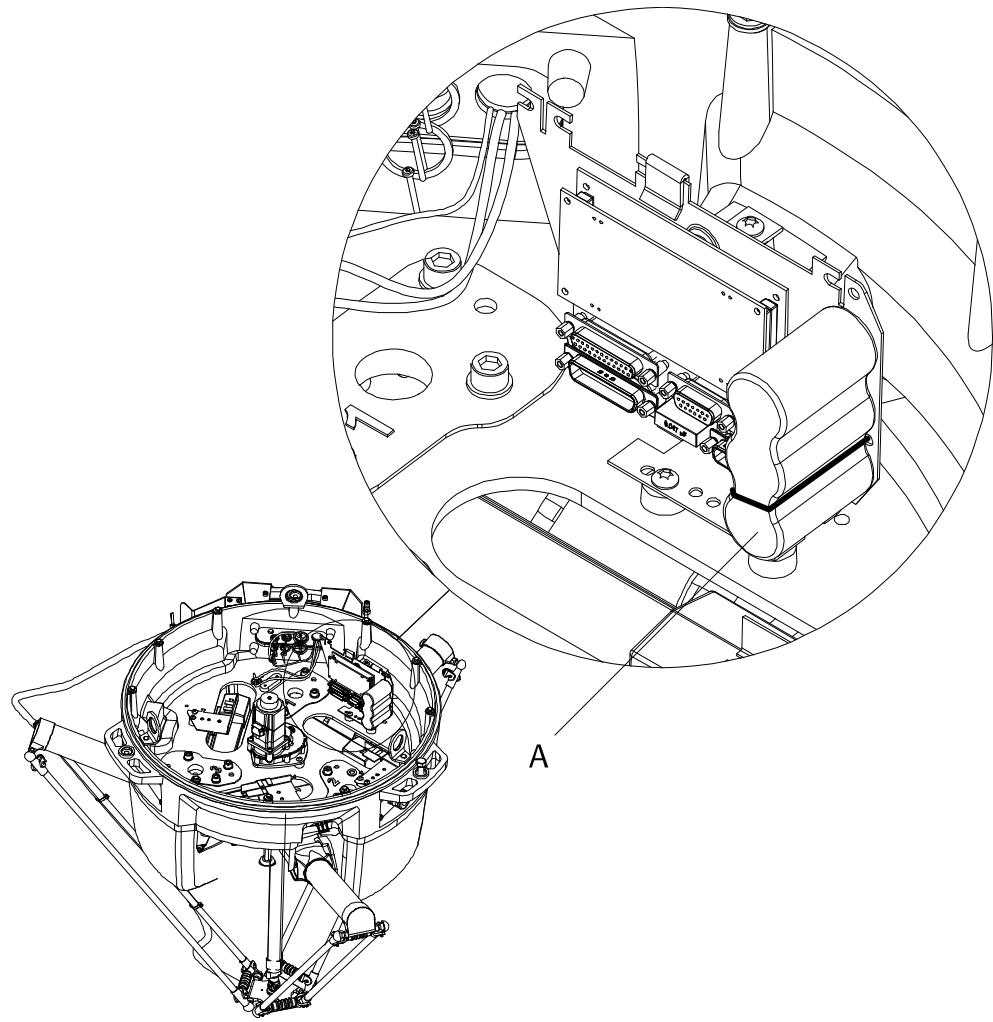
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3.4.1 Changing the battery in the measuring system

Continued

Location SMB

DSQC 633A



xx0700000506

| | |
|---|-------------|
| A | SMB battery |
|---|-------------|

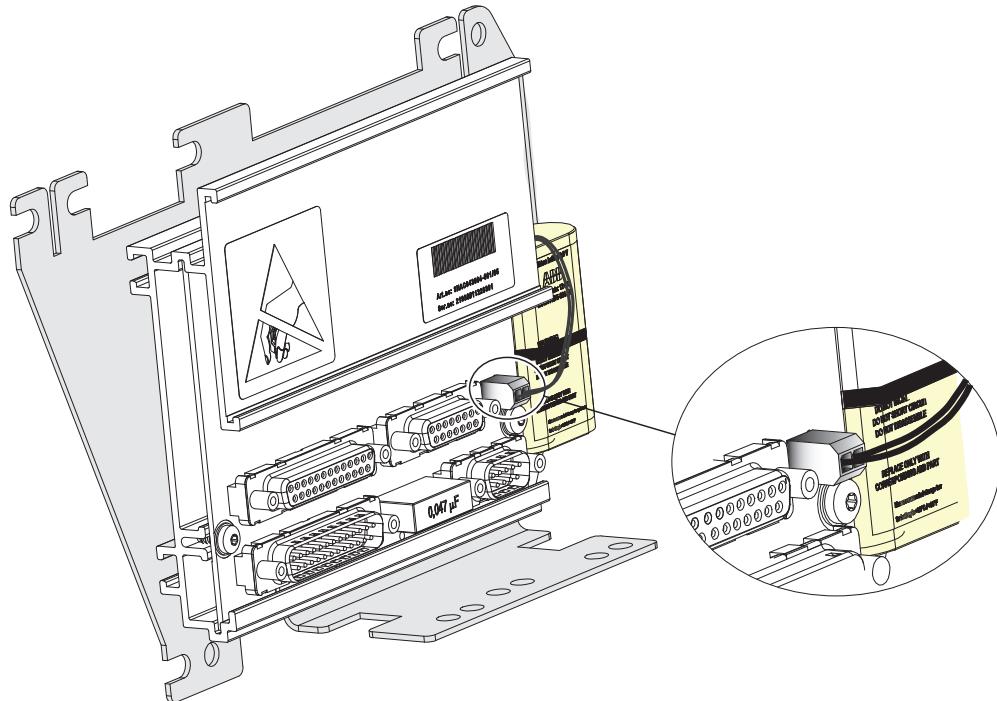
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3 Maintenance

3.4.1 Changing the battery in the measuring system

Continued

RMU 101



xx1300000353

Required equipment and references



Note

There are two variants of SMB units and batteries. One with 2-pole battery contact and one with 3-pole battery contact. The variant with the 3-pole battery contact has longer lifetime for the battery.

It is important that the SMB unit uses the correct battery. Make sure to order the correct spare parts. Do not replace the battery contact!

| Tools and wear parts | Spare part no. | Note |
|--------------------------|--|--|
| Battery unit | See <i>Product manual, spare parts - IRB 360</i> . | Lithium battery |
| Standard tools | | Standard toolkit on page 268 |
| Battery retainer (strap) | | |

References

[Updating revolution counters on page 248](#)

[Replacement of base cover gasket on page 172](#)

Continues on next page

Changing the battery**DANGER**

Turn off all electric power, hydraulic, and pneumatic pressure supplies to the robot.

| | Action | Note |
|---|---|--|
| 1 | Remove the (12pcs) M6 screws holding the base cover. | Described in section Replacement of base cover gasket on page 172 . |
| 2 | Remove the base cover. | |
| 3 | Disconnect the battery from the serial measurement board. Connection (X3). | |
| 4 | Cut the strap and remove the battery pack. Use standard tools. |  Note Used batteries must never be thrown away! They must be handled as hazardous waste! |
| 5 | Connect the new battery to the serial measurement board. Connection (X3). | |
| 6 | Refit the battery to the SMB, using a strap. | |
| 7 | Check the base cover gasket. | Replace if damaged. |
| 8 | Refit the base cover using the (12pcs) M6 screws. | Described in section Replacement of base cover gasket on page 172 . |
| 9 | Update the revolution counters. | Described in section Updating revolution counters on page 248 . |

3 Maintenance

3.4.2 Changing the telescopic shaft including universal joints

General

This section describes maintenance on the telescopic shaft with the interval 4000 hours or 2 years.



DANGER

Turn off all electrical power, hydraulic and pneumatic pressure supplies before entering the workspace of the manipulator.

Also read the safety sections:

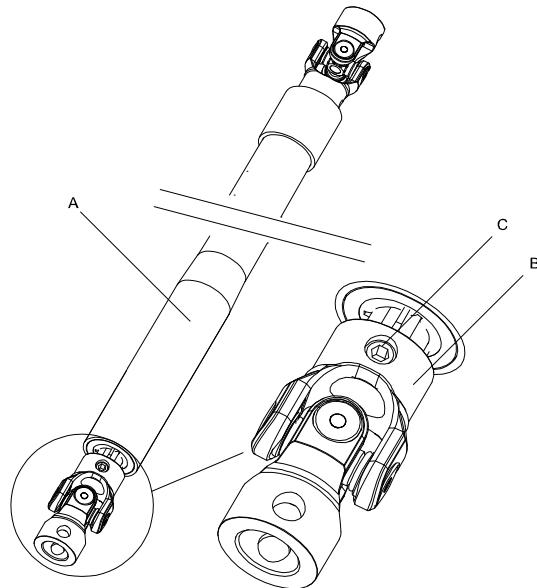
- *Safety risks related to pneumatic/hydraulic systems on page 27*
- *Risks associated with live electric parts on page 29*
- *Safety risks during installation and service work on robots on page 22*



Note

The wear on the bearings depends on the payload, cycle, environment, and lubrication.

Telescopic shaft



xx0700000556

| | |
|---|------------------------|
| A | Telescopic shaft (STD) |
| B | Universal joint |
| C | Set screw, dog point |

Continues on next page

3.4.2 Changing the telescopic shaft including universal joints

Continued

Required equipment and references

| | Required equipment | Note |
|--|--------------------|--------------------------------------|
| | Standard tools | <i>Standard toolkit on page 268.</i> |
| References | | |
| <i>Replacement of telescopic shaft on page 194</i> | | |
| <i>Spare parts, telescopic shaft.</i> | | |

Interval 4,000 h or 2 Years

| | Action | Note |
|---|---|--|
| 1 | Change the telescopic shaft and the universal joints. | Described in section <i>Replacement of telescopic shaft on page 194.</i> |

After a collision and/or if arms have fallen off

See *After a collision and/or if arms have fallen off on page 113.*

3 Maintenance

3.5.1 Type of lubrication in gearboxes

3.5 Lubrication activities

3.5.1 Type of lubrication in gearboxes

Introduction

This section describes where to find information about the *type of lubrication*, *article number* and the *amount of lubrication* in the specific gearbox. It also describes the equipment needed when working with lubrication.



CAUTION

Always read the specific instructions for Clean Room robots before doing any repair work, see [Replacing parts on the robot on page 170](#).

Type and amount of oil in gearboxes

Information about the *type of lubrication*, *article number* as well as the *amount* in the specific gearbox can be found in *Technical reference manual - Lubrication in gearboxes* on the Documentation DVD (released twice a year). The revision of the manual published on the Documentation DVD, will contain the latest updates when the Documentation DVD is released.

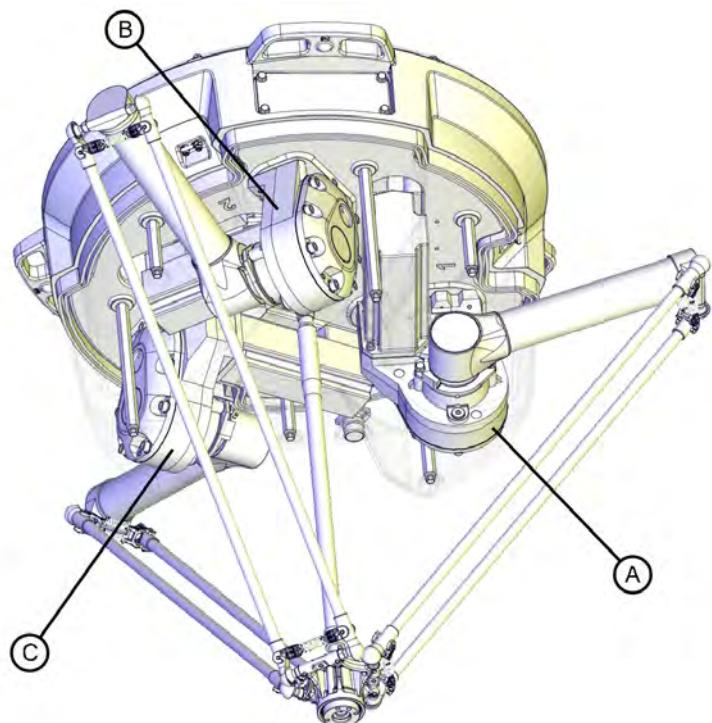
Before starting any inspection, maintenance, or changing activities of lubrication, **always** contact the local ABB Service organization for more information.

For ABB personnel: Always check ABB Library for the latest revision of the manual *Technical reference manual - Lubrication in gearboxes*, in order to always get the latest information of updates about lubrication in gearboxes. A new revision will be published on ABB Library immediately after any updates. Therefore the manual published on the documentation DVD may not contain the latest updates about lubrication.

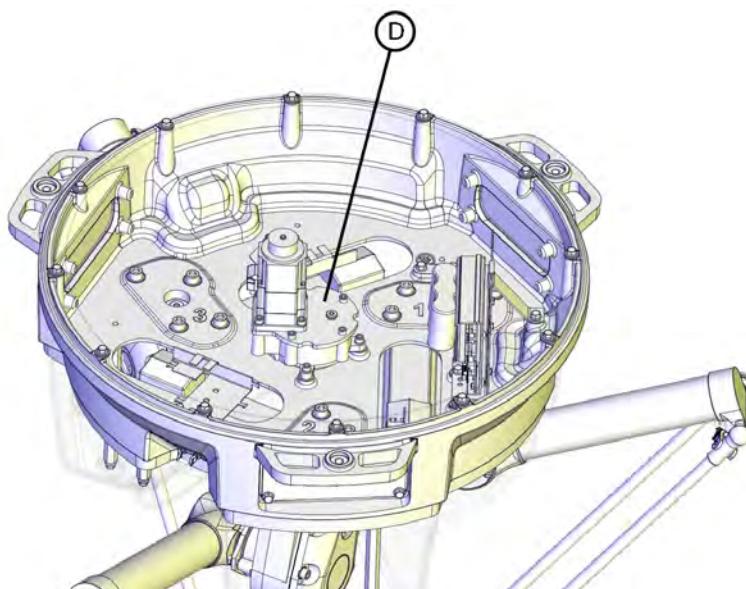
Continues on next page

Location of gearboxes

The figure shows the location of the gearboxes.



xx1300000177



xx1300000178

| | |
|---|----------------|
| A | Axis-1 gearbox |
| B | Axis-2 gearbox |
| C | Axis-3 gearbox |
| D | Axis-4 gearbox |

3 Maintenance

3.5.2 Gearboxes, axes 1- 4

3.5.2 Gearboxes, axes 1- 4

General

This section describes maintenance on axis-1-4 gearboxes regarding oil change (3D version only 1-3).



WARNING

Gearbox oil can be very hot, take necessary measures to collect the oil.



DANGER

Turn off all electrical power, hydraulic and pneumatic pressure supplies before entering the workspace of the manipulator.

Also read the safety sections:

- [Safety risks related to pneumatic/hydraulic systems on page 27](#)
- [Risks associated with live electric parts on page 29](#)
- [Safety risks during installation and service work on robots on page 22](#)

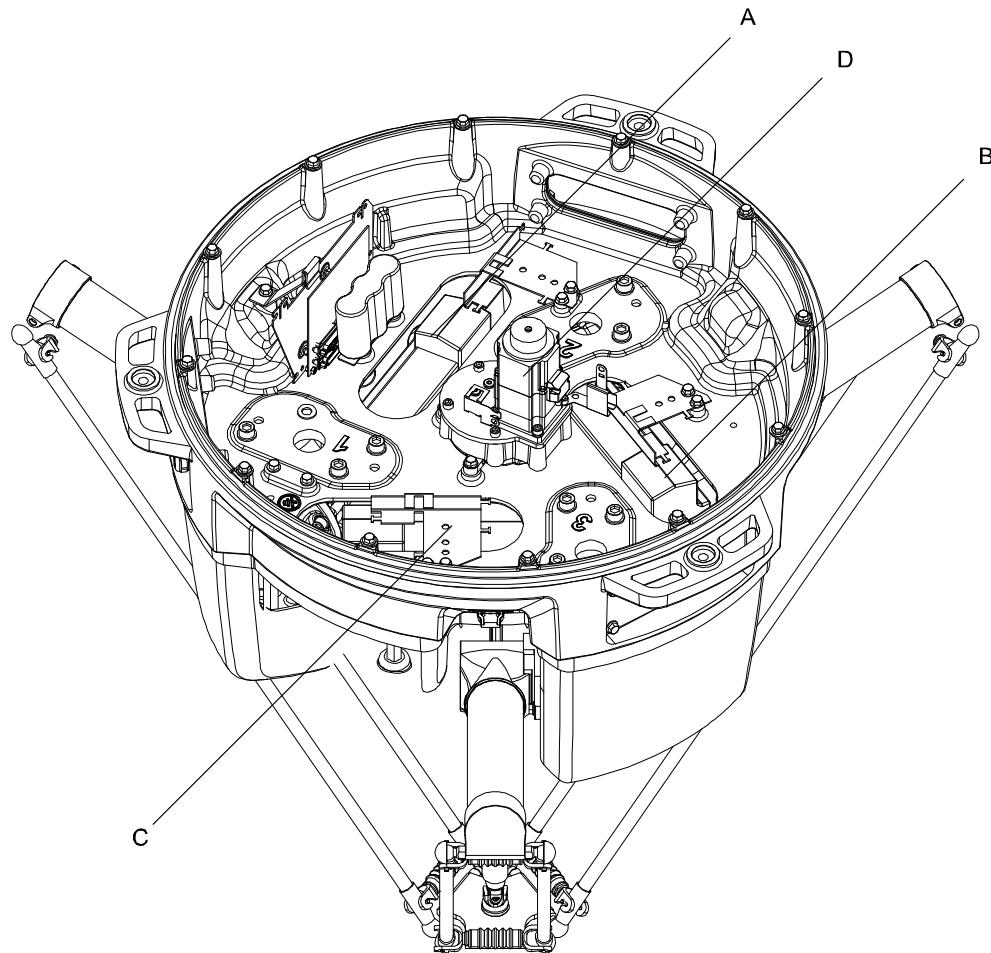


CAUTION

Always read the specific instructions for Clean Room robots before doing any repair work, see [Replacing parts on the robot on page 170](#).

Continues on next page

Location of gearboxes



xx0700000505

| | |
|---|------------------------------------|
| A | Gearbox axis 1 |
| B | Gearbox axis 2 |
| C | Gearbox axis 3 |
| D | Gearbox axis 4 (not in 3D version) |

Required equipment and references

| Required equipment | Spare part No. | Note |
|-----------------------------------|----------------|--|
| Standard tools | | Standard toolkit on page 268 |
| Gaskets base | | <i>Spare parts, gaskets in the base</i> |
| Gaskets cover | | <i>Spare parts, transmission cover</i> |
| Spare parts, gear units axis 1- 3 | | <i>Spare parts, gear units axis 1- 3</i> |
| Spare parts, gear units axis 4 | | <i>Spare parts, gear unit axis 4</i> |
| Locking liquid | | Loctite 243 |
| Sikaflex 521FC | 3HAC031493-001 | |

Continues on next page

3 Maintenance

3.5.2 Gearboxes, axes 1- 4

Continued

| References |
|--|
| Replacement of base cover gasket on page 172 |
| Replacement of parallel arms on page 178 |
| Replacement of telescopic shaft on page 194 |
| Replacement of upper arm on page 183 |

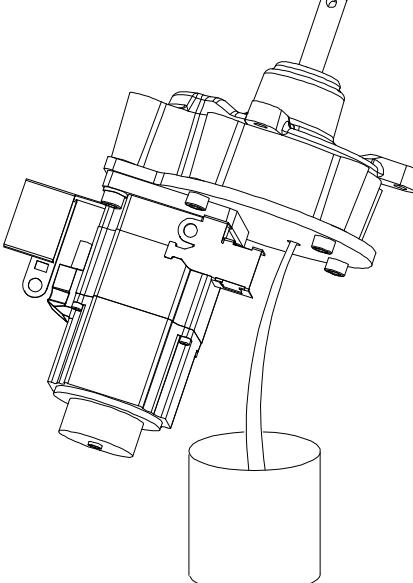
Interval 30,000 hours or 5 years

Oil change in axis 4, (not in 3D version)



Note

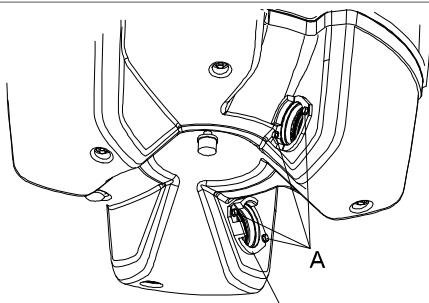
Oil should only be changed once after the first 30,000 h.

| Action | Note |
|---|---|
| 1 Remove the base cover. | Described in section Replacement of base cover gasket on page 172 . |
| 2 Remove the gearbox and motor axis 4. | Described in section Replacement of gearbox unit 4 on page 205 . |
| 3 Remove the oil plug, and drain the oil from gearbox 4. |  xx0700000728 |
| 4 Fill new oil through the plug holes, with specified volume. | Types and volumes of oil are specified in the <i>Technical reference manual - Lubrication in gearboxes - 3HAC042927-001</i> . |
| 5 Refit the oil plugs, apply Loctite 243. | Tightening torque 4 Nm. |
| | |
| | If the sealing ring on the sealing plug is damaged, change the sealing plug. |

Continues on next page

| | Action | Note |
|---|---|---|
| 6 | Refit the (12 pcs) M6 screws holding the base cover. (If necessary, change the sealings) | Described in section Replacement of base cover gasket on page 172 . |

Interval 30,000 hours or 5 years**Oil change in axis 1-3**

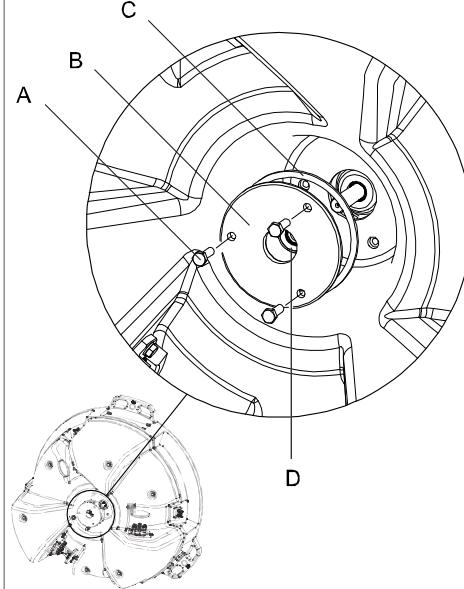
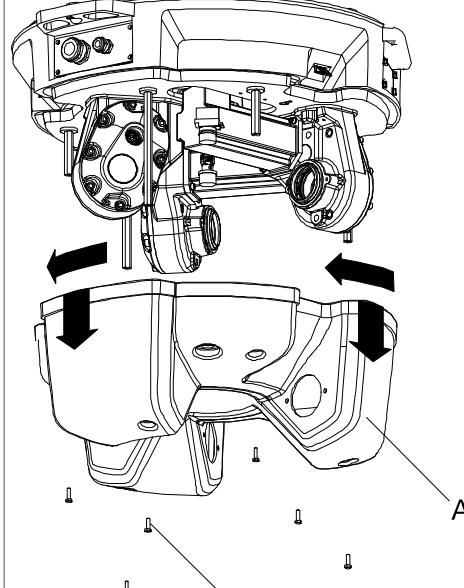
| | Action | Note |
|---|--|---|
| 1 | Remove the (12 pcs) M6 screws holding the base cover. | Described in section Replacement of base cover gasket on page 172 . |
| 2 | Remove the parallel arms. | Described in section Replacement of parallel arms on page 178 . |
| 3 | Remove the telescopic shaft | Described in section Replacement of telescopic shaft on page 194 . |
| 4 | Remove the 3 pcs VK-covers. | Use a screwdriver |
| 5 | Remove the 3x6 pcs M6x40 holding the upper arms. | Described in section Replacement of upper arm on page 183 . |
| 6 | Remove the 6 pcs M6x20 (A) holding the 3 pcs flange (B) and the 3 pcs upper arm sealing rings. |  xx0700000509 A Screw M6x20 B Flange |

Continues on next page

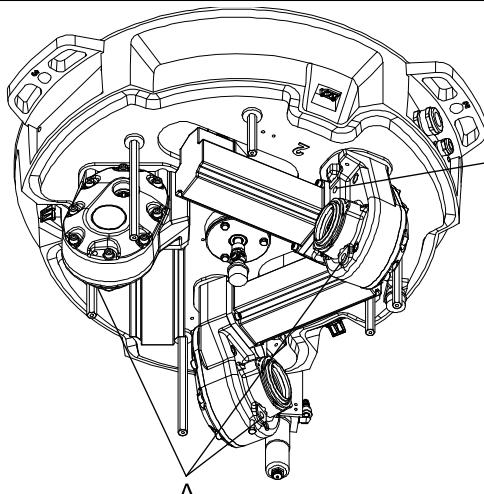
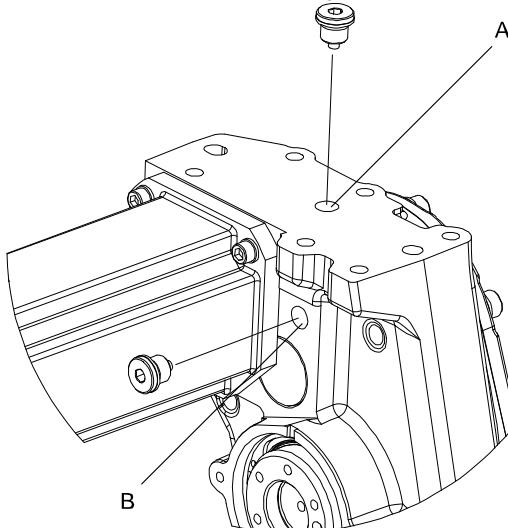
3 Maintenance

3.5.2 Gearboxes, axes 1- 4

Continued

| Action | Note |
|--|---|
| 7 Remove the 3 pcs M6x20 flange screws (A). Remove the flange cover (B). Remove the flange gasket ax 4 (C). Remove the sealing ring (D). |  <p>xx0700000647</p> <p>A M6x20 flange screws. B Flange cover ax 4 (in 3D version without center hole) C Flange gasket ax 4 D Sealing ring w. dust lip (not in 3D version)</p> |
| 8 Remove the 6 pcs M6x20 flange screws (B) holding the transmission cover (A). CAUTION On the WD. or WDS. robots the transmission cover and sealing is glued on to the robot using sikaflex. When removing the transmission cover use a screwdriver to carefully separate the sealing from the sikaflex. Carefully remove the sikaflex from the robot and transmission cover. |  <p>xx0700000510</p> <p>A Transmission cover B Flange screw M6x20</p> |
| 9 Remove the transmission cover. | <p>Note</p> <p>Remove the cables to the brake release, described in section Replacement of brake release button on page 233.</p> |

Continues on next page

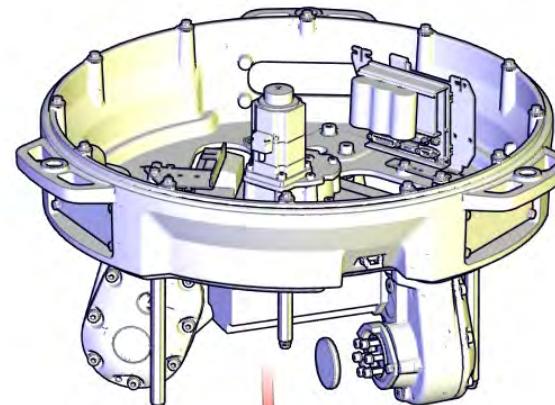
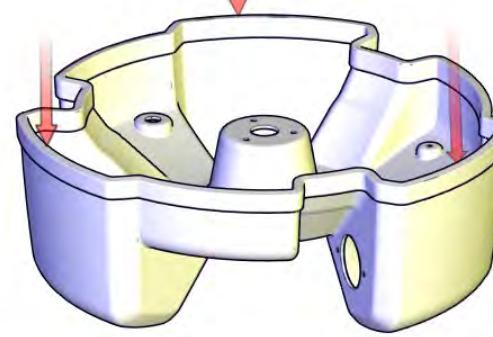
| | Action | Note |
|----|---|--|
| 10 | Remove the magnetic plugs and drain the gearboxes, one by one. |  <p>xx0700000511</p> <p>A Magnetic plugs B Oil level plug</p> |
| 11 |  Note Clean the magnetic plugs before assemble. | |
| 12 | Refit the magnetic plug (A), change the sealing washers if necessary. | Tightening torque 10-12 Nm. |
| 13 | The oil is filled through the plug holes (A) with specified volume, check oil level by removing the oil level plug (B). | <p>Types and volumes of oil are specified in the <i>Technical reference manual - Lubrication in gearboxes - 3HAC042927-001</i>.</p>  <p>xx0700000729</p> |

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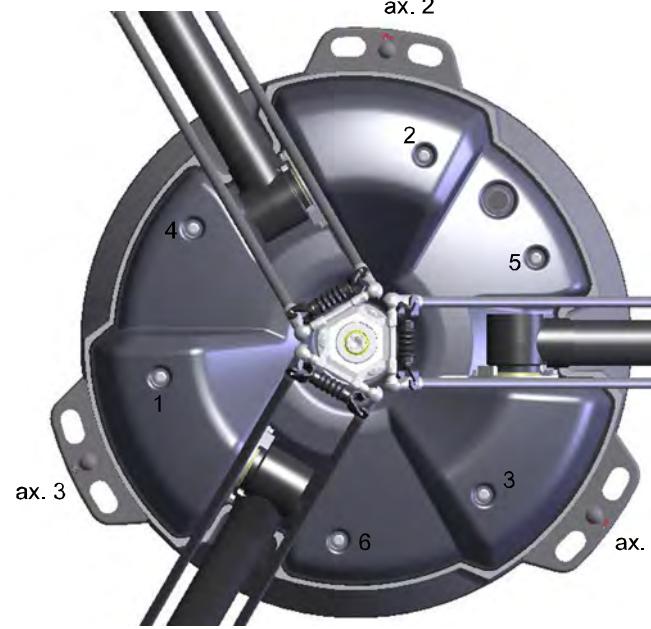
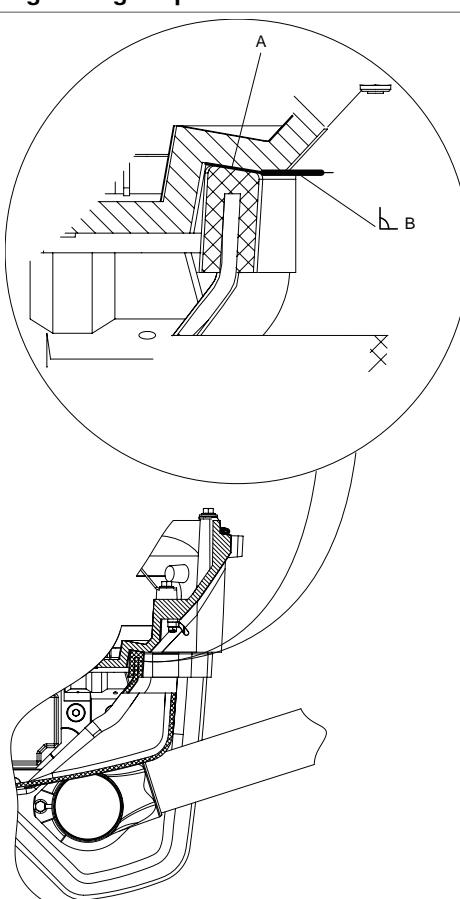
3 Maintenance

3.5.2 Gearboxes, axes 1- 4

Continued

| Action | Note |
|---|---|
| 14  Note On WD. and WDS. Clean the cover sealing upper surface using ethanol. Make sure that all old sikaflex is removed |   xx1100000543 |
| 15 Apply a 5mm string of sikaflex on the sealing upper surface. | |

Continues on next page

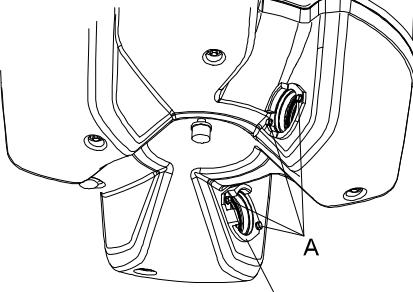
| | Action | Note |
|----|--|--|
| 16 | <p>Refit the transmission cover using the 6pcs M6 x 20 hexagon bolt with flange. Use locking liquid (loc-tite 243).</p> <p>Note Follow the tightening sequence in the figure.</p> |  <p>xx0800000024</p> <p>Tightening torque 4 Nm.</p> |
| 17 | <p>After tightening, check that the sikaflex fill the entyre gap according to figure pos. B, remove superfluous or fill up if needed.</p> |  <p>xx1100000540</p> |

Continues on next page

3 Maintenance

3.5.2 Gearboxes, axes 1- 4

Continued

| | Action | Note |
|----|--|---|
| 18 | Refit the 3 pcs flange and the 3 pcs flange gasket, using the 6 pcs M6x20. Apply locking liquid (Loctite 243). (Change the gaskets if necessary.) | Tightening torque 4 Nm. |
| 19 | Refit the 3 pcs upper arm sealing rings. Apply locking liquid (loctite 243). Change the sealings if necessary. |  xx0700000509 <p style="text-align: center;">A Screw M6x20 B Flange</p> |
| 20 | Refit the 3 upper arms using the 6 x 3 pcs M6x40. Apply locking liquid (loctite 243). | Described in section Replacement of upper arm on page 183 . |
| 21 | Mount new VK-covers on the upper arms. | Apply locking liquid (loctite 243). |
| 22 | Refit all parallel arms. | Described in section Replacement of parallel arms on page 178 . |
| 23 | Refit the telescopic shaft. | Described in section Replacement of telescopic shaft on page 194 |
| 24 | Refit base cover. |  CAUTION The base cover has sharp edges, use protective gloves. Described in section Replacement of base cover gasket on page 172 |

3.6 Cleaning activities

3.6.1 Introduction

Washing standards

The manipulator is tested to fulfill the following standards according to IEC60529:2001.

- Standard: IP54
- Wash down: IP67
- Wash down stainless: IP69K according to ISO 20653:2001
- Clean Room: IP54

Cleaning overview

| Protection type | Cleaning method | | | | |
|---------------------|-----------------|-----------------|------------------|------------------------------|------------|
| | Vacuum Cleaner | Wipe with cloth | Rinse with water | High pressure water or steam | Detergents |
| Standard | Yes | Yes | No | No | No |
| Wash down | Yes | Yes | Yes ⁱ | Yes ⁱⁱ | Yes |
| Wash down stainless | Yes | Yes | Yes | Yes ⁱⁱⁱ | Yes |
| Clean room | Yes | Yes | No | No | No |

ⁱ It is highly recommended that the water contains a rust-prevention solution.

ⁱⁱ It is highly recommended that the water and steam contains rust preventive, without cleaning detergents.

ⁱⁱⁱ See recommended water temperature and pressure.

Continues on next page

3 Maintenance

3.6.1 Introduction

Continued

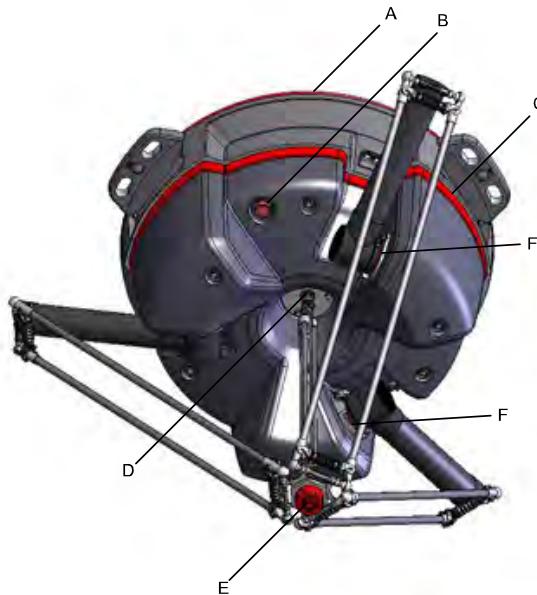
Sensitive spots

Sensitive spots for direct flushing.



Note

This applies for IRB 360 WD and IRB 360 WDS versions. If standard version parts is used in a WD or WDS version robot the robot must be cleaned as a standard version robot.



xx0800000005

| | |
|---|---------------------------|
| A | Base cover gasket |
| B | Brake release button |
| C | Transmission cover gasket |
| D | Axis 4 sealing ring |
| E | Movable plate |
| F | Upper arm sealing rings |

Continues on next page

Cleaning with water and steam

Instructions for rinsing with water

The IRB 360 with protection types Wash down and Wash down stainless can be cleaned by rinsing with water (water cleaner).

The following list defines the prerequisites:

- Maximum water pressure at the nozzle: 700 kN/m² (7 bar)
- Fan jet nozzle should be used, min. 45° spread
- Minimum distance from nozzle to encapsulation: 0.4 meters
- Maximum water temperature: 80 °C
- Maximum flow: 20 liters/min

Instructions for steam or high pressure water cleaning

The IRB 360 with protection types Wash down and Wash down stainless can be cleaned using a steam cleaner or high pressure water cleaner.

The following list defines the prerequisites:

- Maximum water pressure at the nozzle: 2,500 kN/m² (25 bar)
- Fan jet nozzle should be used, min. 45° spread
- Minimum distance from nozzle to encapsulation: 0.4 meters
- Maximum water temperature: 80 °C

3 Maintenance

3.6.2 Standard cleaning

3.6.2 Standard cleaning

Overview

The standard version of IRB 360 is not manufactured for wash down applications, and must not be cleaned with water.



Note

If some part of a standard version robot is stainless the robot must still be cleaned as a standard version robot.

Required equipment

| Equipment | Article number | Note |
|----------------|----------------|------|
| Vacuum cleaner | | |
| Cloth | | |

Cleaning instructions



DANGER

turn off all electrical power, hydraulic and pneumatic pressure supplies before entering the workspace of the manipulator.

Also read the safety sections:

- [Safety risks related to pneumatic/hydraulic systems on page 27](#)
- [Risks associated with live electric parts on page 29](#)
- [Safety risks during installation and service work on robots on page 22](#)

| | Action | Note |
|---|---|------|
| 1 | Use a vacuum cleaner to remove loose particles. | |
| 2 | Use a dry or moistened cloth to wipe off the dirt and dust. | |

3.6.3 Wash down cleaning

Required equipment

| Equipment | Note |
|----------------------|------|
| High pressure washer | |
| Cloth | |

Usable detergents

| Detergent | Type | Old designation |
|--------------|--------------|-----------------|
| Detergent | Topaz LD1 | P3-Topax 12 |
| Disinfective | P3-Topax 990 | P3-Topax 99 |

Cleaning instructions



DANGER

turn off all electrical power, hydraulic and pneumatic pressure supplies before entering the workspace of the manipulator.

Also read the safety sections:

- [Safety risks related to pneumatic/hydraulic systems on page 27](#)
- [Risks associated with live electric parts on page 29](#)
- [Safety risks during installation and service work on robots on page 22](#)

| | Action | Note |
|---|---|--|
| 1 | Pre-rinse with water for removal of rough soil. See figure for Sensitive spots on page 152 . | <ul style="list-style-type: none"> • Water temperature: max. 80 °C |
| 2 | Foam the whole external surface with detergent. | <ul style="list-style-type: none"> • Detergent: Topaz LD1, • Concentration: 3 % • Water temperature: 40 - 60 °C |
| 3 | Let the detergent work for approx 20 minutes to retain effective cleaning properties. Ensure that the solvent does not dry on the surface. | |
| 4 | Rinse thoroughly with water. | |
| 5 | Apply the disinfectant. Time, concentration, and water temperature are chosen to reach the desired effect. | <ul style="list-style-type: none"> • Detergent: P3-topactive DES • Concentration: 1 - 2%. • Water temperature: 10 - 40 °C • Time approx. 20 min. |
| 6 | Rinse thoroughly with water. | |
| 7 | After cleaning bearing races and swivel cup sealing, lubricate them with provision classified grease. | |

Continues on next page

3 Maintenance

3.6.3 Wash down cleaning

Continued

| | Action | Note |
|---|---|--|
| 8 | If the labels on the robot are damaged in the cleaning procedure, apply new labels. | Described in section Replacement of labels on page 217 |

3.6.4 Wash down stainless cleaning

Required equipment

| Equipment | Note |
|----------------------|------|
| High pressure washer | |

Usable detergents

The stainless version is verified against the following detergents.

| Detergent | Type | Old designation |
|--------------|------------------|-----------------|
| Detergent | Topaz MD4 | Topmaxx 421 |
| Detergent | Topaz CL2 | P3-topax M 55 |
| Detergent | Topaz AC3 | P3-topax 56 |
| Disinfective | P3-topactive DES | |

Cleaning instructions



DANGER

turn off all electrical power, hydraulic and pneumatic pressure supplies before entering the workspace of the manipulator.

Also read the safety sections:

- [Safety risks related to pneumatic/hydraulic systems on page 27](#)
- [Risks associated with live electric parts on page 29](#)
- [Safety risks during installation and service work on robots on page 22](#)

| | Action | Note |
|---|---|--|
| 1 | Pre-rinse with water for removal of rough soil with low pressure. See figure for Sensitive spots on page 152 . | <ul style="list-style-type: none"> • Water temperature: max. 80 °C |
| 2 | Foam the whole external surface with detergent. | <ul style="list-style-type: none"> • Detergent: TOPAZ MD4, • Concentration: 3 % • Water temperature: 40 - 60 °C |
| 3 | Let the detergent work for approx 20 minutes to retain effective cleaning properties. Ensure that the solvent does not dry on the surface. | |
| 4 | Rinse thoroughly with water. | |
| 5 | Apply the disinfectant. Time, concentration, and water temperature are chosen to reach the desired effect. | <ul style="list-style-type: none"> • Detergent: P3-topactive DES • Concentration: 1 - 2%. • Water temperature: 10 - 40 °C • Time approx. 20 min. |
| 6 | Rinse thoroughly with water. | |

Continues on next page

3 Maintenance

3.6.4 Wash down stainless cleaning

Continued

| | Action | Note |
|---|---|--|
| 7 | After cleaning bearing races and swivel cup sealing, lubricate them with provision classified grease. | |
| 8 | If the labels on the robot are damaged in the cleaning procedure, apply new labels. | Described in section Replacement of labels on page 217 |

3.6.5 Clean room cleaning

Required equipment

| Equipment | Note |
|----------------|------|
| Vacuum cleaner | |
| Cloth | |

Usable detergents

| Detergent | Note |
|--------------------------|------|
| Light cleaning detergent | |
| Isopropyl alcohol | |

Cleaning instructions



DANGER

turn off all electrical power, hydraulic and pneumatic pressure supplies before entering the workspace of the manipulator.

Also read the safety sections:

- [Safety risks related to pneumatic/hydraulic systems on page 27](#)
- [Risks associated with live electric parts on page 29](#)
- [Safety risks during installation and service work on robots on page 22](#)

| | Action | Note |
|---|---|------|
| 1 | Use a vacuum cleaner to remove loose particles. | |
| 2 | Use a cloth with cleaning detergent or Isopropyl alcohol to wipe off the dirt and dust. | |

3 Maintenance

3.7.1 Measuring backlash axis 4

3.7 Measuring activities

3.7.1 Measuring backlash axis 4

General

This section describes measuring of the backlash on axis 4.



DANGER

Turn off all electrical power, hydraulic and pneumatic pressure supplies before entering the workspace of the manipulator.

Also read the safety sections:

- [Safety risks related to pneumatic/hydraulic systems on page 27](#)
- [Risks associated with live electric parts on page 29](#)
- [Safety risks during installation and service work on robots on page 22](#)

Required equipment and references

| Required equipment | Note |
|--------------------|-------------------------------------|
| Indicator clock | |
| Dynamometer | |
| Tool | (square tube, length = min. 250 mm) |

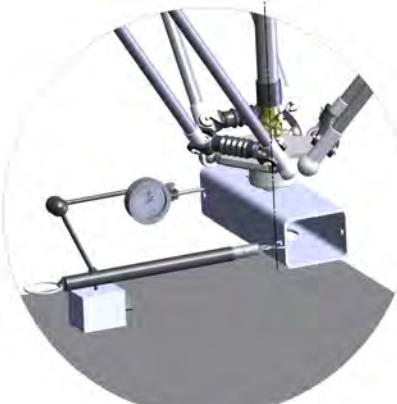
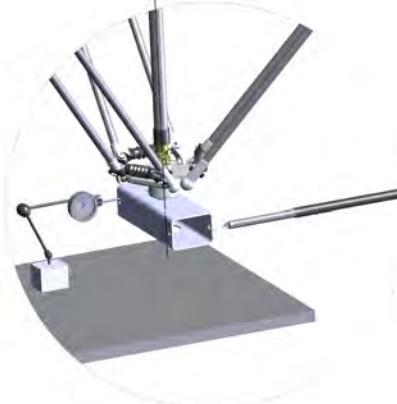
Measuring backlash

| | Action | Note |
|---|--|---|
| 1 | Attache the tool on manipulator. | For fastening of tool on robot, see hole pattern in Fitting equipment on robot on page 82 . |
| 2 | Place the indicator clock on a metallic surface placed underneath the manipulator. | |
| 3 | Apply torque 1 Nm, i.e. 10N on a distance of 100 mm from center of rotation. |  xx1700000046 |

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3.7.1 Measuring backlash axis 4

Continued

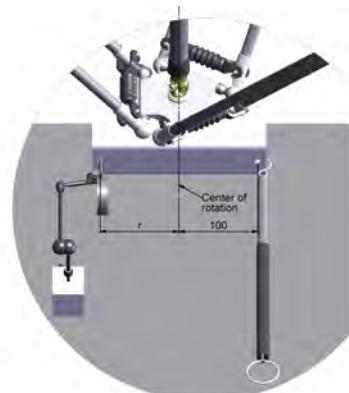
| Action | Note |
|--|---|
| 4 Decrease force to 0N. |  xx1700000047 |
| 5 Apply torque 0,2 Nm, i.e. 2N on a distance of 100 mm from center of rotation. |  xx1700000048 |
| 6 Register first measurement point. | |
| 7 Apply torque 1 Nm in the other direction, i.e. 10 N on a distance of 100 mm from center of rotation. |  xx1700000049 |
| 8 Decrease force to 0N. | |

Continues on next page

3 Maintenance

3.7.1 Measuring backlash axis 4

Continued

| Action | Note |
|---|---|
| 9 Apply torque 0,2 Nm, i.e. 2 N on a distance of 100 mm from center of rotation. |  xx1700000050 |
| 10 Register second measurement point. 11 Calculate the angular backlash as the difference between measurement point 1 and 2 divided by $2\pi r$.  Note r is the distance from center of rotation to where the measurement is done. |  xx1700000051 |

4 Repair

4.1 Introduction

Structure of this chapter

This chapter describes all repair activities recommended for the IRB 360 and any external unit.

It is made up of separate procedures, each describing a specific repair activity. Each procedure contains all the information required to perform the activity, for example spare parts numbers, required special tools, and materials.



WARNING

Repair activities not described in this chapter must only be carried out by ABB. Otherwise damage to the mechanics and electronics may occur.

Required equipment

The details of the equipment required to perform a specific repair activity are listed in the respective procedures.

The details of equipment are also available in different lists in the chapter [Reference information on page 263](#).

Safety information

There are general safety information and specific safety information. The specific safety information describes the danger and safety risks while performing specific steps in a procedure. Make sure to read through the chapter [Safety on page 17](#) before commencing any service work.



Note

If the IRB 360 is connected to power, always make sure that the IRB 360 is connected to earth before starting any repair work.

For more information see:

- *Product manual - IRC5*

4 Repair

4.2.1 Mounting instructions for bearings

4.2 General procedures

4.2.1 Mounting instructions for bearings

General

This section describes how to mount and grease different types of bearings on the robot.

Equipment

| Equipment, etc. | Article number | Note |
|-----------------|--|------|
| Grease | <i>Grease specification on page 271.</i> | |

Assembly of all bearings

Follow the following instructions while mounting a bearing on the robot.

| | Action | Note |
|---|---|------|
| 1 | To avoid contamination, let a new bearing remain in its wrapping until it is time for fitting. | |
| 2 | Ensure that the parts included in the bearing fitting are free from burrs, grinding waste, and other contamination. Cast components must be free of foundry sand. | |
| 3 | Bearing rings, inner rings, and roller elements must not be subjected to direct impact. The roller elements must not be exposed to any stresses during the assembly work. | |

Assembly of tapered bearings

Follow the preceding instructions for the assembly of the bearings when mounting a tapered bearing on the robot.

In addition to those instructions, the following procedure must be carried out to enable the roller elements to adjust to the correct position against the race flange.

| | Action | Note |
|---|---|------|
| 1 | Tension the bearing gradually until the recommended pre-tension is achieved.  Note The roller elements must be rotated a specified number of turns before pre-tensioning is carried out and also rotated during the pre-tensioning sequence. | |
| 2 | Make sure the bearing is properly aligned as this will directly affect the durability of the bearing. | |

Greasing of bearings

The bearings must be greased after assembly according to the following instructions:

- The bearings must not be completely filled with grease. However, if space is available beside the bearing fitting, the bearing may be totally filled with

Continues on next page

4.2.1 Mounting instructions for bearings

Continued

grease when mounted, as excessive grease will be pressed out from the bearing when the robot is started.

- During operation, the bearing should be filled to 70-80% of the available volume.
- Ensure that grease is handled and stored properly to avoid contamination.

Grease the different types of bearings as following description:

- *Grooved ball bearings* must be filled with grease from both sides.
- *Tapered roller bearings* and axial needle bearings must be greased in the split condition.

4 Repair

4.2.2 Mounting instructions for seals

4.2.2 Mounting instructions for seals

General

This section describes how to mount different types of seals onto the robot.

Equipment

| Equipment, etc. | Article number | Note |
|-----------------|--|------|
| Grease | Grease specification on page 271 . | |

Rotating seals

The procedure below describes how to fit rotating seals.



CAUTION

Please observe the following before commencing any assembly of seals:

- Protect the sealing surfaces during transport and mounting.
- Keep the seal in its original wrappings or protect it well before actual mounting.
- The fitting of seals and gears must be carried out on clean workbenches.
- Use a protective sleeve for the sealing lip during mounting, when sliding over threads, keyways, etc.

| Action | Note |
|---|--|
| 1 Check the seal to ensure that: <ul style="list-style-type: none">• The seal is of the correct type (provided with cutting edge).• There is no damage to the sealing edge (feel with a fingernail). | |
| 2 Inspect the sealing surface before mounting. If scratches or damage are found, the seal must be replaced since it may result in future leakage. | |
| 3 Lubricate the seal with grease just before fitting. (Not too early - there is a risk of dirt and foreign particles adhering to the seal.) Fill 2/3 of the space between the dust tongue and sealing lip with grease. The rubber coated external diameter must also be greased, unless otherwise specified. | Article number is specified in Equipment on page 166 . |
| 4 Mount the seal correctly with a mounting tool. Never hammer directly on the seal as this may result in leakage. | |
| 5 Make sure no grease left on the robot surface. | |

Continues on next page

Flange seals and static seals

The following procedure describes how to fit flange seals and static seals.

| Action | |
|--------|---|
| 1 | Check the flange surfaces. They must be even and free from pores. It is easy to check flatness using a gauge on the fastened joint (without sealing compound). If the flange surfaces are defective, the parts may not be used because leakage could occur. |
| 2 | Clean the surfaces properly in accordance with the recommendations of ABB. |
| 3 | Distribute the sealing compound evenly over the surface, preferably with a brush. |
| 4 | Tighten the screws evenly when fastening the flange joint. |

O-rings

The following procedure describes how to fit o-rings.

| Action | Note |
|---|---|
| 1 Ensure that the correct o-ring size is used. | |
| 2 Check the o-ring for surface defects, burrs, shape accuracy, and so on. | Defective o-rings may not be used. |
| 3 Check the o-ring grooves. The grooves must be geometrically correct and should be free of pores and contamination. | Defective o-rings may not be used. |
| 4 Lubricate the o-ring with grease. |  CAUTION Do not lubricate the hollow o-ring for the base cover, it may slip out of its position in the cleaning process. |
| 5 Tighten the screws evenly while assembling. | |
| 6 Make sure that no grease is left on the robot surface. | |

4 Repair

4.2.3 Screw joints

4.2.3 Screw joints

General

This section describes how to tighten the various types of screw joints on the IRB 360.

The instructions and torque values are valid for screw joints comprised of metallic materials and do *not* apply to soft or brittle materials.

Gleitmo treated screws

Gleitmo is a special surface treatment to reduce the friction when tightening the screw joint. Screws treated with Gleitmo may be reused 3-4 times before the coating disappears. After this the screw must be discarded and replaced with a new one.

When handling screws treated with Gleitmo, protective gloves of **nitrile rubber** type should be used.

Tightening torque

Before tightening any screw, note the following:

- Determine whether a **standard** tightening torque or **special** torque is to be applied. The **standard torques** are specified in the following tables. Any **special torques** are specified in the repair, maintenance or installation procedure descriptions. **Any special torque specified overrides the standard torque!**
- Use the *correct tightening torque* for each type of screw joint.
- Only use *correctly calibrated* torque keys.
- Always *tighten the joint by hand*, and never use pneumatic tools.
- Use the *correct tightening technique*, that is *do not jerk*. Tighten the screw in a slow, flowing motion.
- Maximum allowed total deviation from the specified value is 10%!

Oil-lubricated screws with allen head screws

The following table specifies the recommended standard tightening torque for *oil-lubricated screws with allen head screws*. Any special torque specified in the repair, maintenance or installation procedure overrides the standard torque!

| Dimension | Tightening torque (Nm) Class 8.8, oil-lubricated | Tightening torque (Nm) Class 10.9, oil-lubricated | Tightening torque (Nm) Class 12.9, oil-lubricated |
|-----------|---|--|--|
| M5 | 6 | - | - |
| M6 | 10 | - | - |
| M8 | 24 | 34 | 40 |
| M10 | 47 | 67 | 80 |
| M12 | 82 | 115 | 140 |
| M16 | 200 | 290 | 340 |
| M20 | 400 | 560 | 670 |
| M24 | 680 | 960 | 1150 |

Continues on next page

Lubricated screws (Molykote, Gleitmo or equivalent) with allen head screws

The following table specifies the recommended standard tightening torque for screws *lubricated with Molykote 1000, Gleitmo 603 or equivalent with allen head screws*. Any special torque specified in the repair, maintenance or installation procedure overrides the standard torque!

| Dimension | Tightening torque (Nm) Class 10.9, lubricated ⁱ | Tightening torque (Nm) Class 12.9, lubricated ⁱ |
|-----------|---|---|
| M8 | 28 | 35 |
| M10 | 55 | 70 |
| M12 | 96 | 120 |
| M16 | 235 | 280 |
| M20 | 460 | 550 |
| M24 | 790 | 950 |

ⁱ Lubricated with Molykote 1000, Gleitmo 603 or equivalent

Water and air connectors

The following table specifies the recommended standard tightening torque for *water and air connectors* when *one or both* connectors are made of *brass*. Any special torque specified in the repair, maintenance or installation procedure overrides the standard torque!

| Dimension | Tightening torque Nm - Nominal | Tightening torque Nm - Min. | Tightening torque Nm - Max. |
|-----------|--------------------------------|-----------------------------|-----------------------------|
| 1/8 | 12 | 8 | 15 |
| 1/4 | 15 | 10 | 20 |
| 3/8 | 20 | 15 | 25 |
| 1/2 | 40 | 30 | 50 |
| 3/4 | 70 | 55 | 90 |

4 Repair

4.2.4 Replacing parts on the robot

4.2.4 Replacing parts on the robot

General

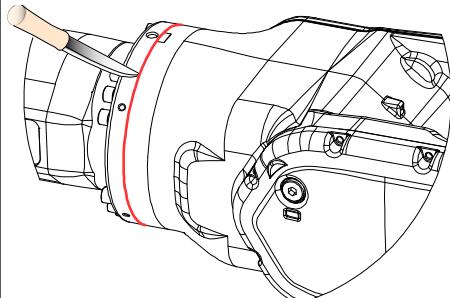
Follow the procedures in this section whenever breaking the surface paint of the robot during replacement of parts.

When replacing parts on a robot with protection type Clean Room, it is important to make sure that after the replacement, no particles will be emitted from the joint between the structure and the new part, and that the easy cleaned surface is retained.

Required equipment

| Equipment | Spare parts | Note |
|----------------------------------|----------------|-------------------------------|
| Sealing compound | | Sikaflex 521 FC. Color white. |
| Tooling pin | | Width 6-9 mm, made of wood. |
| Cleaning agent | | Ethanol |
| Knife | | |
| Lint free cloth | | |
| Touch up paint Clean Room, White | 3HAC036639-001 | |

Removing

| | Action | Description |
|---|--|--|
| 1 | Cut the paint with a knife in the joint between the part that will be removed and the structure, to avoid that the paint cracks. |  xx0900000121 |
| 2 | Carefully grind the paint edge that is left on the structure to a smooth surface. | |

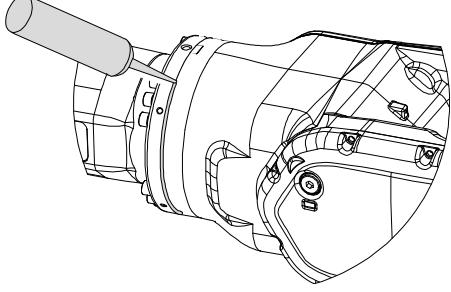
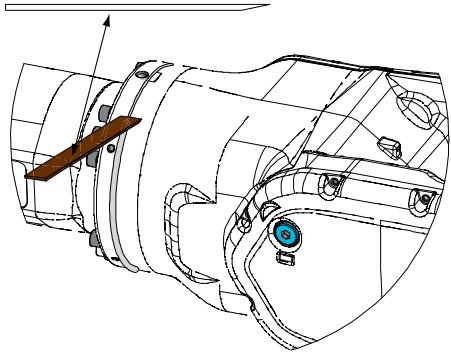
Refitting

| | Action | Description |
|---|--|-----------------------------------|
| 1 | Before the parts are refitted, clean the joint so that it is free from oil and grease. | Use ethanol on a lint free cloth. |
| 2 | Place the tooling pin in hot water. | |

Continues on next page

4.2.4 Replacing parts on the robot

Continued

| Action | Description |
|---|---|
| 3 Seal all refitted joints with Sikaflex 521FC. |  xx0900000122 |
| 4 Use the tooling pin to even out the surface of the Sikaflex seal. |  xx0900000125 |
| 5 Wait 15 minutes. | Sikaflex 521FC skin dry time (15 minutes). |
| 6  Note Always read the instruction in the product data sheet in the paint repair kit for Foundry Prime. | 3HAC035355-001 |
| 7 Use Touch up paint Clean Room, white to paint the joint.  Note Always read the instruction in the product data sheet in the paint repair kit for Clean Room. | 3HAC036639-001 |
|  Note After all repair work, wipe the robot free from particles with spirit on a lint free cloth. | |

4 Repair

4.3.1 Replacement of base cover gasket

4.3 Complete robot

4.3.1 Replacement of base cover gasket

General

This section describes how to replace the base cover gasket.



DANGER

Turn off all electrical power, hydraulic and pneumatic pressure supplies before entering the workspace of the manipulator.

Also read the safety sections:

- [*Safety risks related to pneumatic/hydraulic systems on page 27*](#)
- [*Risks associated with live electric parts on page 29*](#)
- [*Safety risks during installation and service work on robots on page 22*](#)



CAUTION

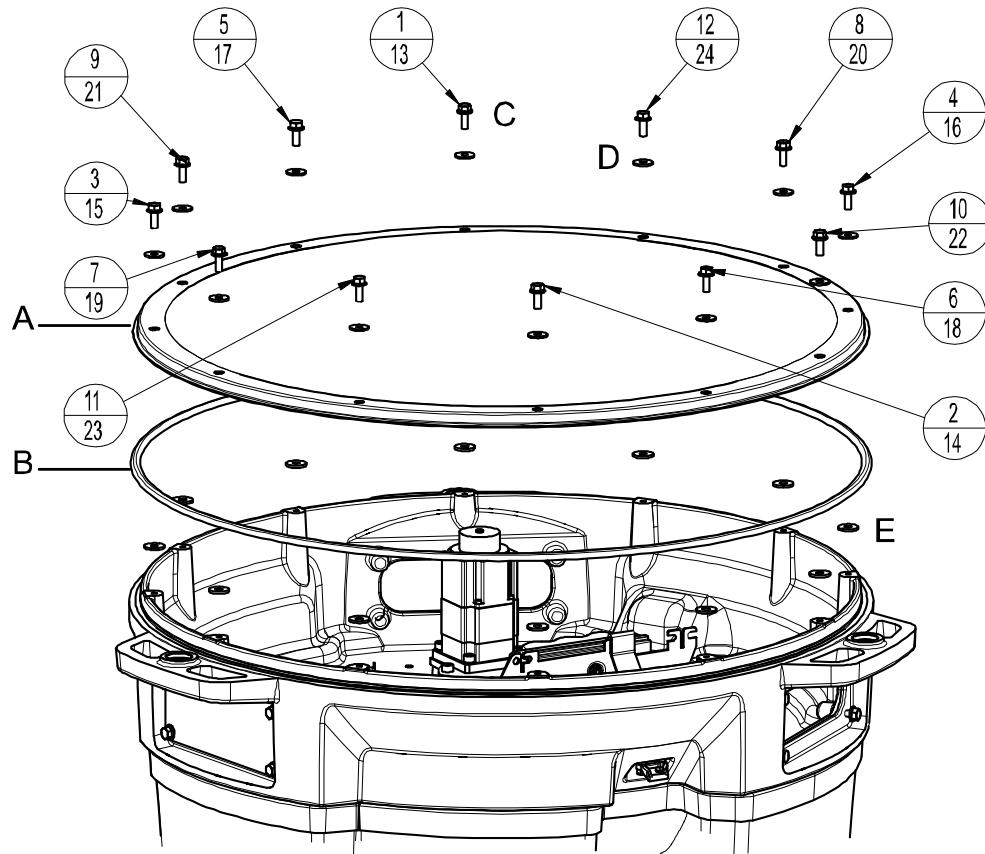
Always read the specific instructions for Clean Room robots before doing any repair work, see [*Replacing parts on the robot on page 170*](#).

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4.3.1 Replacement of base cover gasket

Continued

Location and tightening sequence



xx0700000553

| | |
|---|-----------------------------|
| A | Base cover |
| B | Hollow o-ring (Base cover) |
| C | Flange screw M6x20 (12 pcs) |
| D | Plastic washer (12 pcs) |
| E | Rubber gasket (12 pcs) |

Required equipment and references

| Equipment | Spare part number | Note |
|---------------------------------|--|-------------------------------------|
| Hollow o-ring (base cov- er) | See <i>Product manual, spare parts - IRB 360</i> . | |
| Standard tools | | <i>Standard toolkit on page 268</i> |
| Plastic washer | See <i>Product manual, spare parts - IRB 360</i> . | |
| Rubber gasket | See <i>Product manual, spare parts - IRB 360</i> . | |

Continues on next page

4 Repair

4.3.1 Replacement of base cover gasket

Continued

Removal

| Action | Note |
|---|--|
| 1 Remove the <i>flange screws and washers</i> and check them. | If necessary, change them. |
| 2 Remove the <i>base cover</i> . |  CAUTION The base cover has sharp edges, use protective gloves. |
| 3 Remove and discard the <i>hollow o-ring</i> . | See article number in <i>Product manual, spare parts - IRB 360</i> . |
| 4 Remove and discard the <i>rubber gaskets</i> . | See article number in <i>Product manual, spare parts - IRB 360</i> . |

Refitting

| Action | Note |
|---|---|
| 1 Refit new <i>rubber gaskets</i> . | |
| 2 Refit a new <i>hollow o-ring</i> . |  Note Do not lubricate the hollow o-ring for the base cover, it can slip out of position when cleaning. |
| 3 Refit the <i>base cover</i> . |  CAUTION The base cover has sharp edges, use protective gloves. |
| 4 Refit the <i>flange screws with plastic washers</i> . |  Note Check that the washers are not damaged. Replace if needed.  Note Always tighten the base cover screws in two rounds. |

4.3.2 Replacement of serial measurement board

General

This section describes how to replace the SMB unit (serial measurement board).



DANGER

Turn off all electrical power, hydraulic and pneumatic pressure supplies before entering the workspace of the manipulator.

Also read the safety sections:

- *Safety risks related to pneumatic/hydraulic systems on page 27*
- *Risks associated with live electric parts on page 29*
- *Safety risks during installation and service work on robots on page 22*



CAUTION

Always read the specific instructions for Clean Room robots before doing any repair work, see *Replacing parts on the robot on page 170*.

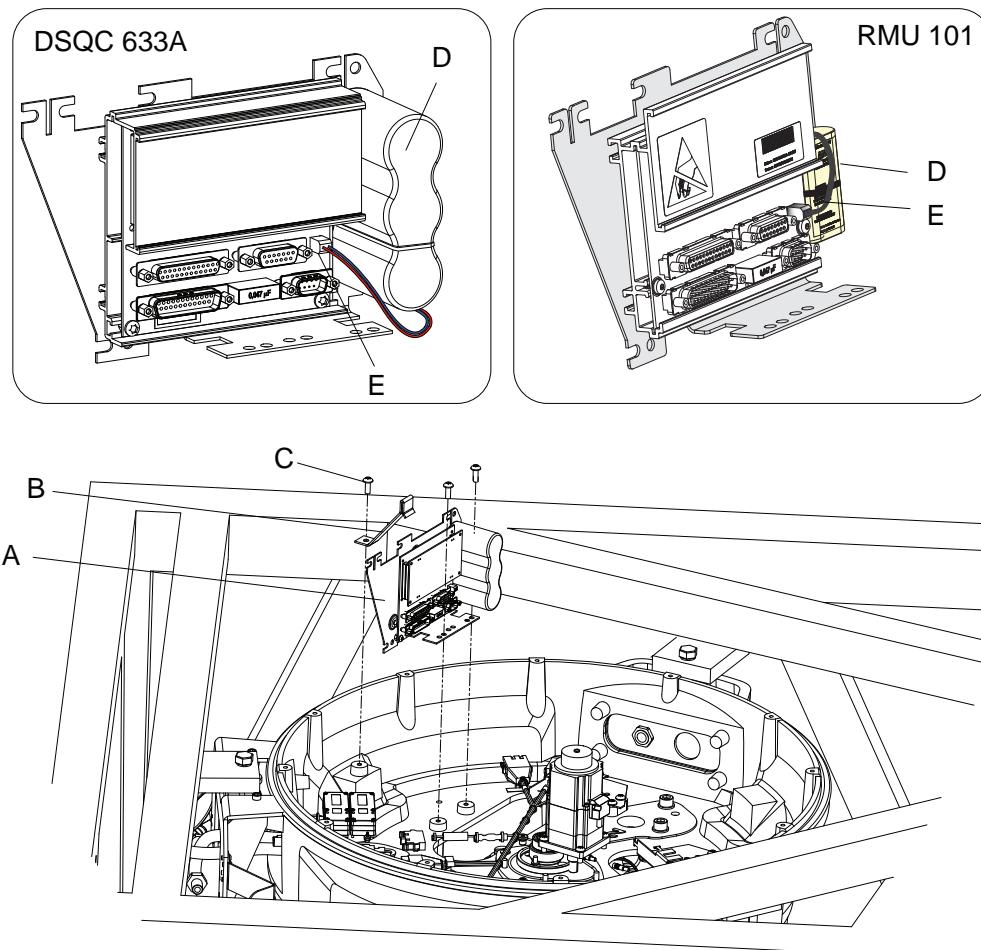
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4 Repair

4.3.2 Replacement of serial measurement board

Continued

Location



xx1300000354

| | |
|---|----------------------------|
| A | SMB unit |
| B | Bracket SMB unit |
| C | 3 pcs flange screw M6 x 20 |
| D | SMB battery |
| E | SMB battery contact (X3) |

Required equipment and references



Note

There are different variants of SMB units and batteries. The variant with the 3-pole battery contact has longer lifetime for the battery.

It is important that the SMB unit uses the correct battery. Make sure to order the correct spare parts. Do not replace the battery contact!

| Equipment | Spare part no. | Note |
|----------------|----------------|--|
| Standard tools | | Standard toolkit on page 268 |

Continues on next page

4.3.2 Replacement of serial measurement board

Continued

| Equipment | Spare part no. | Note |
|-------------------------|--|--------------|
| Serial measurement unit | See <i>Product manual, spare parts - IRB 360</i> . | |
| Base cover gasket | See <i>Product manual, spare parts - IRB 360</i> . | (If damaged) |
| Plastic washer | See <i>Product manual, spare parts - IRB 360</i> . | (If damaged) |

| References |
|---|
| <i>Circuit diagram - IRB 360</i> |
| <i>Updating revolution counters on page 248</i> . |
| <i>Replacement of base cover gasket on page 172</i> |

Removal SMB unit

| | Action | Note |
|---|---|--|
| 1 | Remove the base cover. | Described in section <i>Replacement of base cover gasket on page 172</i> |
| 2 | Remove the three(3) flange screws holding the bracket for the SMB unit. | Use standard tools |
| 3 | Disconnect all the cables from the SMB unit. | |
| 4 | Remove the SMB unit. | |

**Note**

This product contains certain materials considered hazardous. This product **must** be disposed of in accordance with the current legislation of the country in which the robot and control unit is installed.

Refitting SMB unit**Note**

Check the new battery, using a voltmeter. It should read approx +12V.

| | Action | Note |
|---|---|--|
| 1 | Refit the new SMB unit. | |
| 2 | Connect all cables. | As described in circuit diagram 3HAC028647-009 |
| 3 | Refit the bracket using the three(3) flange screws. | Tightening torque 4 Nm |
| 4 | Refit the base cover. | Described in section <i>Replacement of base cover gasket on page 172</i> |
| 5 | Update the revolution counters | Described in section <i>Updating revolution counters on page 248</i> |

4.3.3 Replacement of parallel arms

General

This section describes how to change the parallel arms.



DANGER

Turn off all electrical power, hydraulic and pneumatic pressure supplies before entering the workspace of the manipulator.

Also read the safety sections:

- [*Safety risks related to pneumatic/hydraulic systems on page 27*](#)
- [*Risks associated with live electric parts on page 29*](#)
- [*Safety risks during installation and service work on robots on page 22*](#)



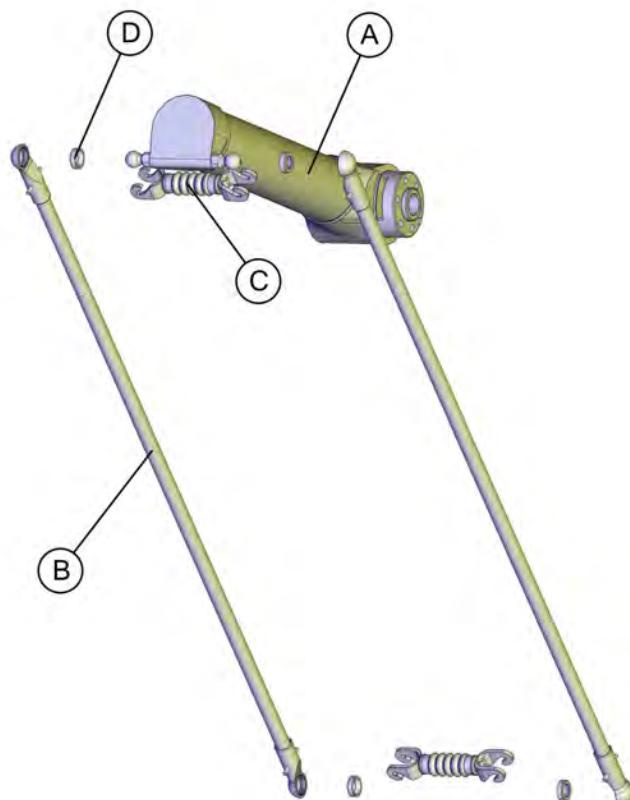
CAUTION

Always read the specific instructions for Clean Room robots before doing any repair work, see [*Replacing parts on the robot on page 170*](#).

Continues on next page

Location

IRB 360 - 1/1130, IRB 360 - 3/1130, IRB 360 - 1/800, IRB 360 - 1/1600



xx0700000488

| | |
|---|--------------|
| A | Upper arm |
| B | Parallel arm |
| C | Spring unit |
| D | Bearing ring |

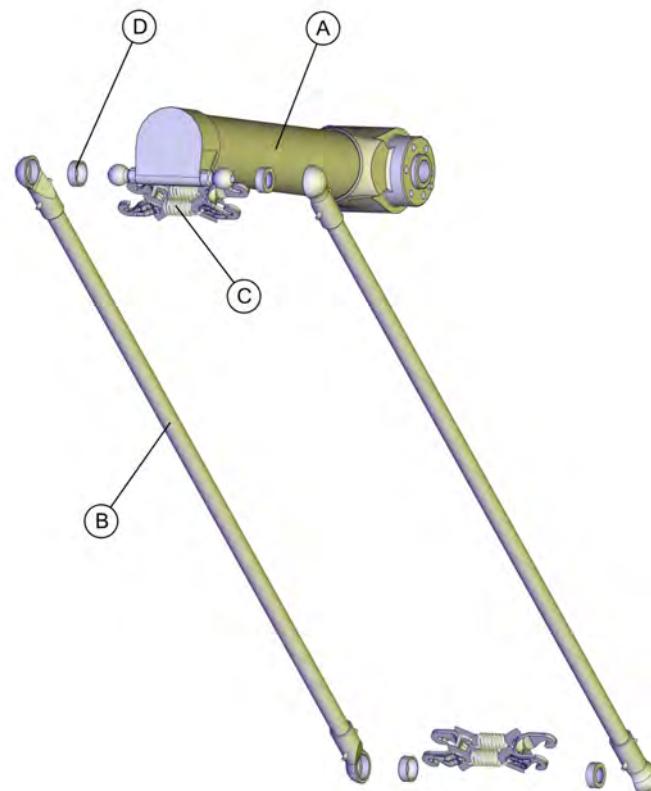
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4 Repair

4.3.3 Replacement of parallel arms

Continued

IRB 360 - 8/1130, IRB 360 - 6/1600



xx1300000163

| | |
|---|--------------|
| A | Upper arm |
| B | Parallel arm |
| C | Spring unit |
| D | Bearing ring |

Required equipment and references

| Equipment | Spare part no. | Note |
|--------------------------|---|--|
| Standard tools | | Standard toolkit on page 268 |
| Pliers for parallel arms | 3HAC6194-1 | |
| Parallel arms | See Product manual, spare parts - IRB 360 . | |

| References |
|---|
| Spring units on page 130 |
| Special tools on page 269 |

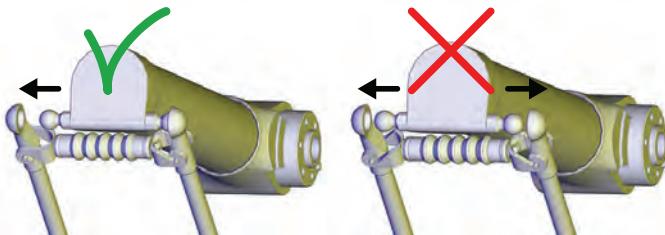
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**CAUTION**

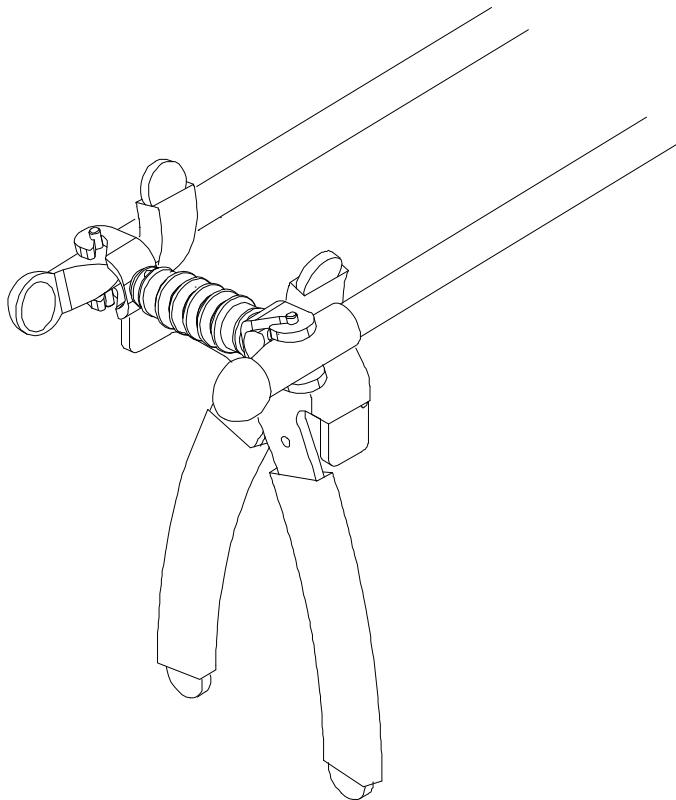
Never use unnecessary force when removing the springs. Only work on one side or the spring will be overstressed.

Removing the parallel arms**Removing by hand****CAUTION**

Never use unnecessary force when removing the springs. Only work on one side or the spring will be overstressed.



xx0700000525

Removing by using a tool

xx0700000555

Continues on next page

4 Repair

4.3.3 Replacement of parallel arms

Continued

Removing the parallel arms

Use the procedure to remove the parallel arms.

| | Action | Note |
|---|--|---------------------------------------|
| 1 | Remove the parallel arms by hand or using tool, either on the left side or the right side, not both . | By hand or tool according to figures. |
| 2 | Remove the springs. | By hand. |

Refitting the parallel arms



CAUTION

Never use unnecessary force when refitting the springs. Only work on one side or the spring will be overstressed.

Refitting the parallel arms

Use the procedure to refit the parallel arms.

| | Action | Note |
|---|---|---|
| 1 | Fit the springs on the parallel arms. | By hand. Apply grease according to section Spring units on page 130 |
| 2 | Refit the parallel arm to the upper arm by hand or using tool, either on the left side or the right side, not both . | By hand or tool according to figures. Note Press with the tool on the aluminum surface, not on the carbon fiber, or the parallel arms may be damaged. |
| 3 | Refit the parallel arm to the movable plate by hand or using tool, either on the left side or the right side, not both . | By hand or tool according to figures Note Always mount the movable plate with the axis 4 calibration mark in direction axis 1. |
| 4 | Recalibrate the robot. | See Calibration information on page 237 . |

4.3.4 Replacement of upper arm

General

This section describes replacement of upper arm.



DANGER

Turn off all electrical power, hydraulic and pneumatic pressure supplies before entering the workspace of the manipulator.

Also read the safety sections:

- *Safety risks related to pneumatic/hydraulic systems on page 27*
- *Risks associated with live electric parts on page 29*
- *Safety risks during installation and service work on robots on page 22*



CAUTION

Always read the specific instructions for Clean Room robots before doing any repair work, see *Replacing parts on the robot on page 170*.

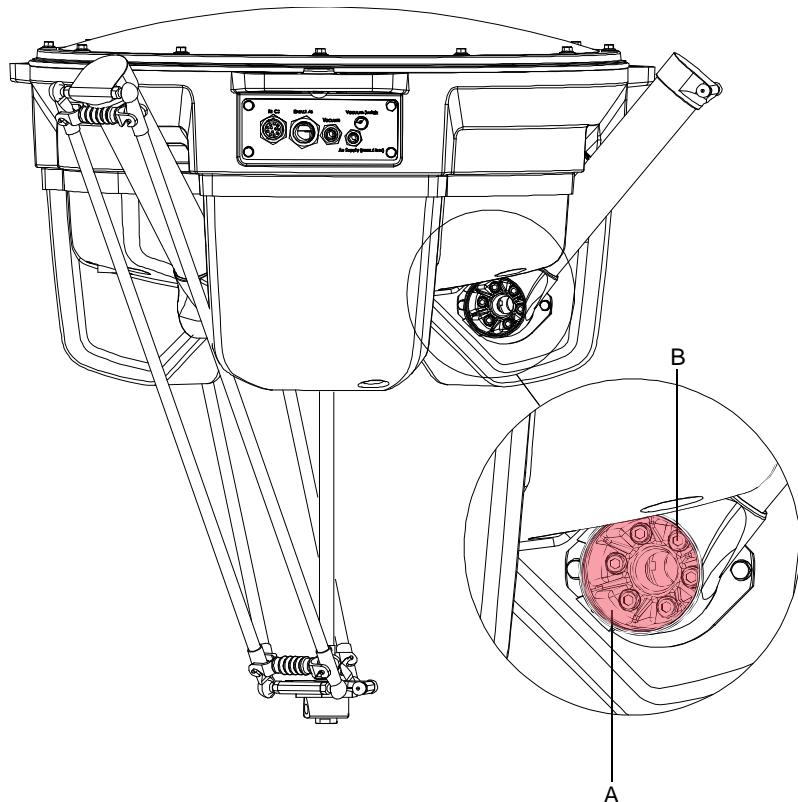
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4 Repair

4.3.4 Replacement of upper arm

Continued

Location



xx0700000595

| | |
|---|--|
| A | VK-cover |
| B | 6x hex socket head cap screw M6 x 40 (12.9 gleitmo) and 6x plain washer 6.4x12x1.6 steel A2-F |

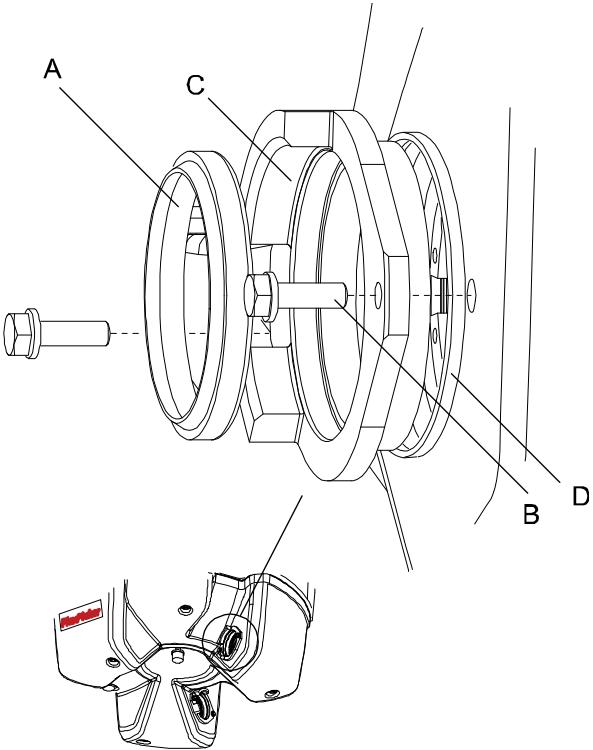
Required equipment and references

| Equipment | Spare part No. | Note |
|----------------------|--|--|
| Standard tools | | Standard toolkit on page 268 |
| Upper arm | See <i>Product manual, spare parts - IRB 360</i> . | |
| Sealing ring | See <i>Product manual, spare parts - IRB 360</i> . | |
| Flange gasket ax.1-3 | See <i>Product manual, spare parts - IRB 360</i> . | |
| VK-cover | See <i>Product manual, spare parts - IRB 360</i> . | |
| Locking liquid | | Loctite 243 |

| References |
|---|
| Standard toolkit on page 268 |
| Replacement of parallel arms on page 178 |
| Mounting instructions for seals on page 166 |

Continues on next page

Removal

| | Action | Note |
|---|---|---|
| 1 | Remove the parallel arm on the specific upper arm. | Described in section Replacement of parallel arms on page 178 |
| 2 | Remove the VK-cover | Use a screwdriver. |
| 3 | Remove the six screws | 6x Hex socket head cap screw M6 x 40 (12.9 gleitmo) and 6x plain washer 6.4x12x1.6 Steel A2-F |
| 4 | Remove the upper arm. | |
| 5 | <p> Note Always check the condition of the sealing ring and the flange gasket</p> | |
| 6 | <p>Remove the two flangescrews (B) holding the flange (C). If necessary, change the sealing ring (A) and the flange gasket (D).</p> <p> Note Do not use the sealing ring (A) on robots with protection Clean Room or Stainless Clean Room.</p> |  xx0700000601 |

Refitting

| | Action | Note |
|---|--|--------------------------------|
| 1 | <p>Refit the flange with the new mounted sealing ring, using the two screws with Loctite 243 and the new flange gasket.</p> <p> Tip</p> <p>Mounting instructions for seals on page 166</p> | Tightening torque 4 Nm. |

Continues on next page

4 Repair

4.3.4 Replacement of upper arm

Continued

| | Action | Note |
|---|--|--|
| 2 | Refit the upper arm using the 6x hex socket head cap screw M6 x 40 (12.9 Gleitmo) and 6x plain washer 6.4x12x1.6 steel A2-F. | Tightening torque 11 Nm. |
| 3 | Fit a new VK-cover. | By hand. |
| 4 | Refit the parallel arm. | Described in section <i>Replacement of parallel arms on page 178</i> . |
| 5 | Recalibrate the robot. | See <i>Calibration information on page 237</i> . |

4.3.5 Replacement of bearing rings

General

This section describes how to change bearing rings in the parallel arms.



DANGER

Turn off all electrical power, hydraulic and pneumatic pressure supplies before entering the workspace of the manipulator.

Also read the safety sections:

- [Safety risks related to pneumatic/hydraulic systems on page 27](#)
- [Risks associated with live electric parts on page 29](#)
- [Safety risks during installation and service work on robots on page 22](#)



CAUTION

Always read the specific instructions for Clean Room robots before doing any repair work, see [Replacing parts on the robot on page 170](#).

Required equipment and references

| Equipment | Spare part no. | Note |
|--|---|---|
| Bearing ring | See Product manual, spare parts - IRB 360 . | |
| Standard tools | | Standard toolkit on page 268 . |
| Drifter | | Only required for robot versions: IRB 360 - 1/800, IRB 360 - 1/1130, IRB 360 - 3/1130 and IRB 360 - 1/1600. |
| Dolly | | Special tools on page 269 |
| Pliers for parallel arms | | Special tools on page 269 |
| Grease | - | Valid for robot versions: IRB 360 - 1/1130, IRB 360 - 3/1130, IRB 360 - 1/800, IRB 360 - 1/1600. Required for non-maintenance free bearing rings. <ul style="list-style-type: none">• Mobilgrease FM 102• Optimol Obeen UF 2 See Different versions of bearing rings require different maintenance procedures on page 122 . |
| References | | |
| Replacement of parallel arms on page 178 | | |
| Special tools on page 269 | | |

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4 Repair

4.3.5 Replacement of bearing rings

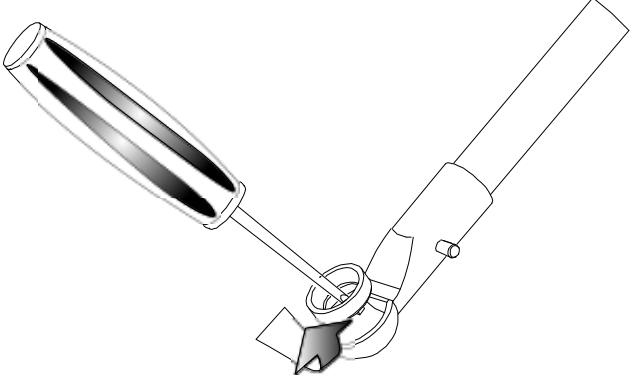
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CAUTION

Never use unnecessary force when removing the springs. Only work on one side or the spring will be overstressed.

Removal

| | Action | Note |
|---|---|---|
| 1 | Remove the parallel arms by hand or using tool, left or right side, not both . | According to section <i>Replacement of parallel arms on page 178</i> . |
| 2 | Remove the bearing ring using a screwdriver. |  xx0700000486 |

Refitting



CAUTION

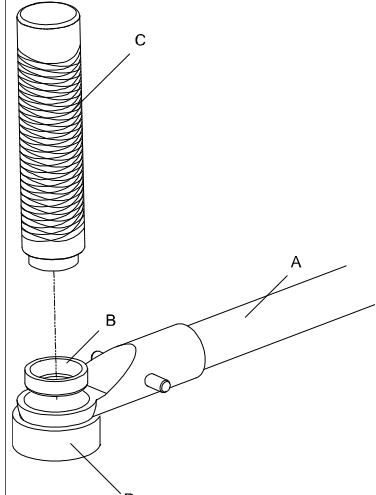
Never use unnecessary force when refitting the springs. Only work on one side or the spring will be overstressed.

| | Action | Note |
|---|---|------|
| 1 | Place a new bearing ring into the joint socket. | |

Continues on next page

4.3.5 Replacement of bearing rings

Continued

| Action | Note |
|---|--|
| <p>2 Valid for robot versions: IRB 360 - 1/1130, IRB 360 - 3/1130, IRB 360 - 1/800, IRB 360 - 1/1600.</p> <ol style="list-style-type: none"> 1 Place the parallel arm in the dolly. 2 Put the drifter into the bearing ring and knock it gently down to its resting position. 3 Lubricate bearing rings that are not maintenance-free (see <i>Different versions of bearing rings require different maintenance procedures on page 122</i>). |  <p>xx0700000524</p> <p>A Parallel arm B Bearing ring C Drifter D Dolly</p> <p>Type of grease for non-maintenance-free bearing rings, see <i>Required equipment and references on page 187</i>.</p> |
| 3 Valid for robot versions: IRB 360 - 8/1130, IRB 360 - 6/1600. Push the bearing ring into its resting position by hand. | |
| 4 Refit the parallel arms to the upper arm, left or right side, not both . | By hand or using tool according to section <i>Replacement of parallel arms on page 178</i> |
| 5 Run the robot for six (6) hours for the bearing rings to wear in. | |
| 6 Wipe clean the joint balls and the bearing rings. | |

4 Repair

4.3.6 Replacement of movable plate

4.3.6 Replacement of movable plate

General

This section describes how to replace the movable plate.



DANGER

Turn off all electrical power, hydraulic and pneumatic pressure supplies before entering the workspace of the manipulator.

Also read the safety sections:

- [Safety risks related to pneumatic/hydraulic systems on page 27](#)
- [Risks associated with live electric parts on page 29](#)
- [Safety risks during installation and service work on robots on page 22](#)

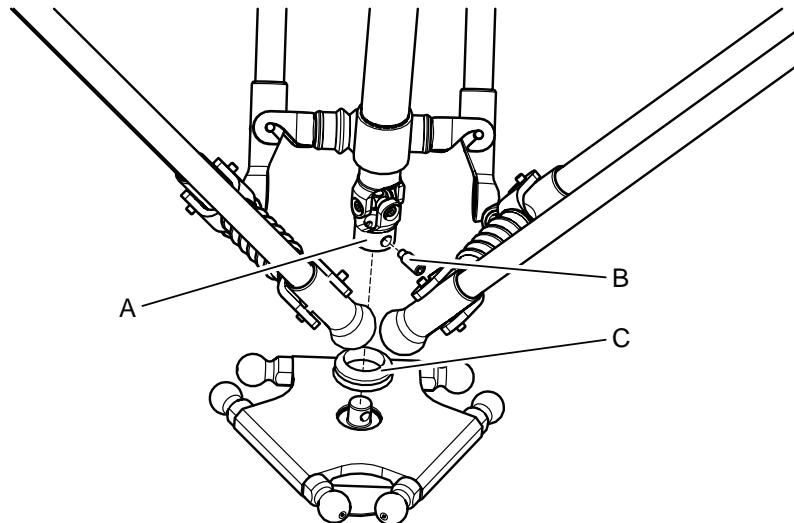


CAUTION

Always read the specific instructions for Clean Room robots before doing any repair work, see [Replacing parts on the robot on page 170](#).

Location

IRB 360 - 1/1130, IRB 360 - 3/1130, IRB 360 - 1/800, IRB 360 - 1/1600

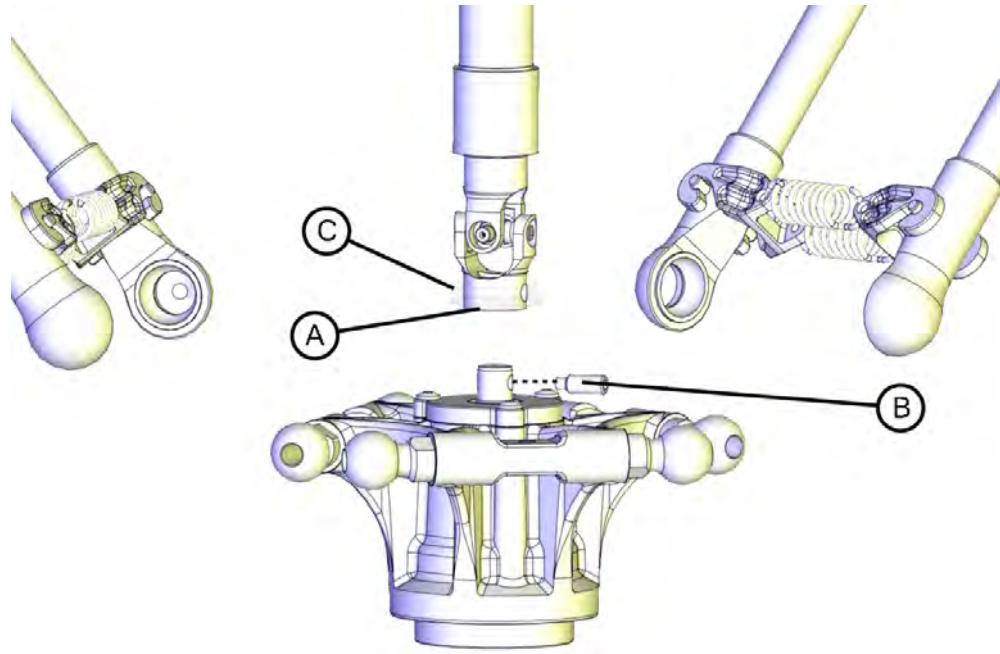


xx0700000532

| | |
|---|-----------------------|
| A | Universal joint |
| B | Set screw, dog point |
| C | Sealing ring (V-ring) |

Continues on next page

IRB 360 - 8/1130, IRB 360 - 6/1600



xx1300000165

| | |
|---|--|
| A | Universal joint |
| B | Set screw, dog point |
| C | V-ring sealing (transparent in the figure) |

Required equipment and references

| Equipment | Spare part number | Note |
|----------------------------|--|-------------------------------------|
| Spare parts, movable plate | See <i>Product manual, spare parts - IRB 360</i> . | |
| Locking liquid | - | Loctite 243. |
| Standard tools | - | <i>Standard toolkit on page 268</i> |

| References |
|---|
| <i>Replacement of parallel arms on page 178</i> |
| <i>Replacement of vacuum hoses on page 223</i> |

Removal



CAUTION

The spring units must be removed according to the description in section *Replacement of parallel arms on page 178* or they will be damaged.

| | Action | Note |
|---|---|---|
| 1 | Remove all air / vacuum hoses from the swivel cup on the movable plate. | Described in section <i>Replacement of vacuum hoses on page 223</i> |

Continues on next page

4 Repair

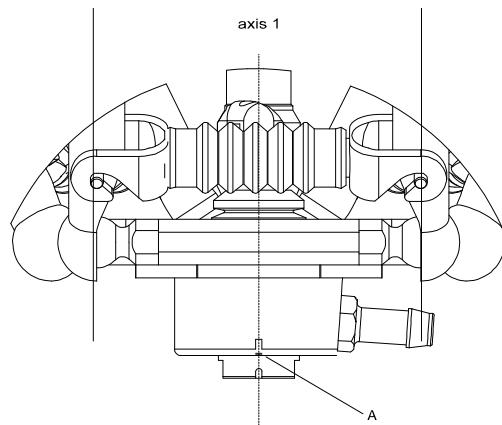
4.3.6 Replacement of movable plate

Continued

| Action | Note |
|--|---|
| 2 Remove all three parallel arms from the movable plate. | Described in section Replacement of parallel arms on page 178 . |
| 3 Hold the movable plate while raising the sealing ring (C) and removing the set screw (B) that locks the universal joint. Remove the movable plate from the telescopic shaft. | Use standard tools. |

Calibration mark, axis 4

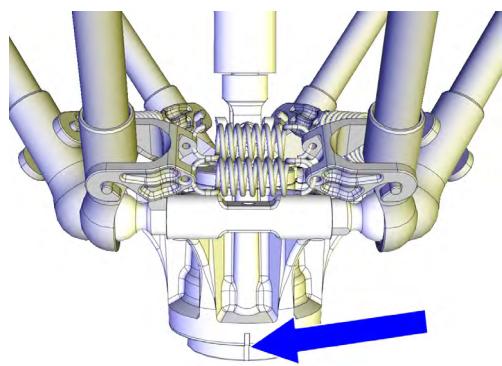
IRB 360 - 1/1130, IRB 360 - 3/1130, IRB 360 - 1/800, IRB 360 - 1/1600



xx0700000629

| | |
|---|-------------------------|
| A | Axis 4 calibration mark |
|---|-------------------------|

IRB 360 - 8/1130, IRB 360 - 6/1600



Refitting



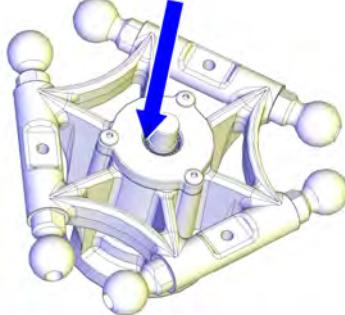
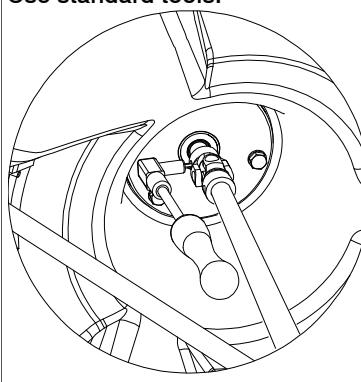
CAUTION

Never use unnecessary force when refitting the springs. Only work on one side or the spring will be overstressed.

Continues on next page

4.3.6 Replacement of movable plate

Continued

| Action | Note |
|--|---|
| 1 For robot versions IRB 360 - 8/1130, IRB 360 - 6/1600: Check the radial seal. |  xx1300000202 |
| 2 Refit the movable plate to the telescopic shaft and lock the universal joint by refitting the set screw (B). Use locking liquid (Loctite 243). | Use standard tools.  xx0700000613 Tightening torque for set screw 3HAC12846-2 (M6x16 A2): 7 Nm Tightening torque for set screw 3HAC12846-3 (M6x16 FZB): 9.5 Nm Tightening torque for set screw 3HAC12846-4 (M6x16 A4): 8.5 Nm  Tip Use a 90° angled bit holder. |
| 3 Push the sealing ring (C) back in place. | |
| 4 Refit the parallel arms to the movable plate. | Described in section Replacement of parallel arms on page 178 |
| 5 Refit the air / vacuum hoses to the swivel cup on the movable plate. | Described in section Replacement of vacuum hoses on page 223 . |

4 Repair

4.3.7 Replacement of telescopic shaft

General

This section describes how to change the telescopic shaft.



DANGER

Turn off all electrical power, hydraulic and pneumatic pressure supplies before entering the workspace of the manipulator.

Also read the safety sections:

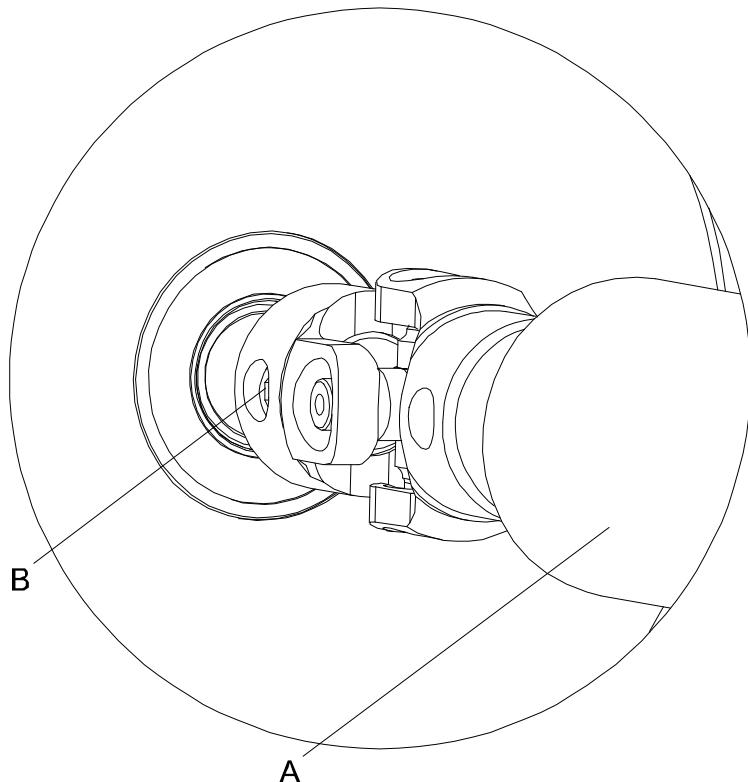
- *Safety risks related to pneumatic/hydraulic systems on page 27*
- *Risks associated with live electric parts on page 29*
- *Safety risks during installation and service work on robots on page 22*



CAUTION

Always read the specific instructions for Clean Room robots before doing any repair work, see *Replacing parts on the robot on page 170*.

Location



xx0700000538

| | |
|---|------------------|
| A | Telescopic shaft |
| B | Set screw |

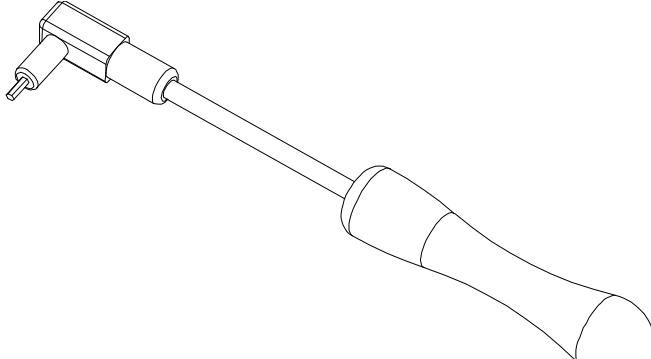
Continues on next page

Required equipment and references

| Equipment | Spare part no. | Note |
|-----------------------|--|--|
| Standard tools | | Standard toolkit on page 268 |
| Telescopic shaft | See <i>Product manual, spare parts - IRB 360</i> . | |
| Universal joint | See <i>Product manual, spare parts - IRB 360</i> . | |
| 90° angled bit holder | | |
| Locking liquid | | Loctite 243 |

| References |
|--|
| Replacement of parallel arms on page 178 |
| Replacement of movable plate on page 190 |

Removal

| | Action | Note |
|---|------------------------------|--|
| 1 | Remove the parallel arms. | Described in section Replacement of parallel arms on page 178 |
| 2 | Remove the movable plate. | Described in section Replacement of movable plate on page 190 |
| 3 | Remove the upper set screw. |  xx0700000612  Tip Use a 90° angled bit holder. |
| 4 | Remove the telescopic shaft. | |

Refitting

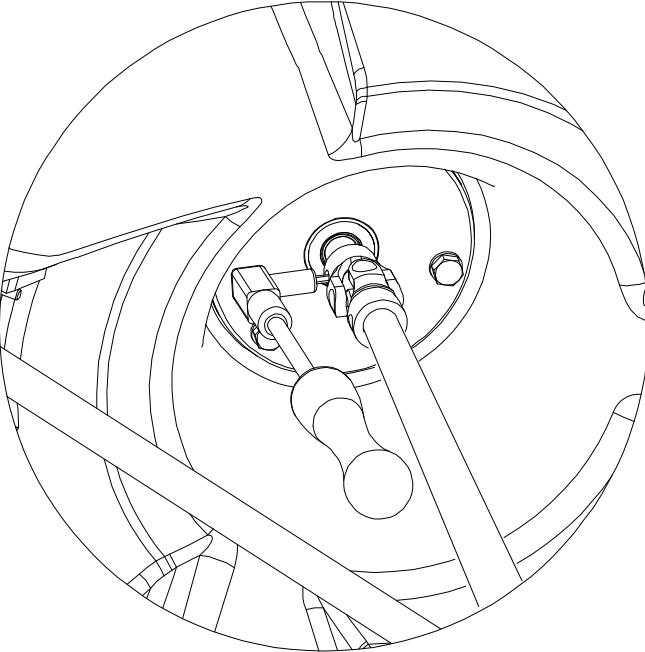
| | Action | Note |
|---|-----------------------------|------|
| 1 | Refit the telescopic shaft. | |

Continues on next page

4 Repair

4.3.7 Replacement of telescopic shaft

Continued

| Action | Note |
|--|---|
| 2 Refit the upper set screw, use locking liquid (Loctite 243). |  xx0700000613 Tightening torque for set screw 3HAC12846-2 (M6x16 A2): • 7 Nm. Tightening torque for set screw 3HAC12846-3 (M6x16 FZB): • 9.5 Nm. Tightening torque for set screw 3HAC12846-4 (M6x16 A4): • 8.5 Nm.  Tip Use a 90° angled bit holder. |
| 3 Refit the movable plate, use locking liquid (Loctite 243). | Described in section Replacement of movable plate on page 190 . |
| 4 Refit the parallel arms. | Described in section Replacement of parallel arms on page 178 . |

4.3.8 Replacement of universal joint

General

This section describes how to change the universal joint.



DANGER

Turn off all electrical power, hydraulic and pneumatic pressure supplies before entering the workspace of the manipulator.

Also read the safety sections:

- *Safety risks related to pneumatic/hydraulic systems on page 27*
- *Risks associated with live electric parts on page 29*
- *Safety risks during installation and service work on robots on page 22*



CAUTION

Always read the specific instructions for Clean Room robots before doing any repair work, see *Replacing parts on the robot on page 170*.

Location



xx0800000020

Continues on next page

4 Repair

4.3.8 Replacement of universal joint

Continued

Required equipment and references

| Equipment | Spare part no. | Note |
|-----------------|--|-------------|
| Standard tools | Standard toolkit on page 268. | |
| Locking liquid | | Loctite 243 |
| Universal joint | See Product manual, spare parts - IRB 360. | |

Removal

| | Action | Note |
|---|---|--|
| 1 | Remove the telescopic shaft | See section Replacement of telescopic shaft on page 194. |
| 2 | Remove the set screw locking the universal joint on the telescopic shaft. | Use standard tools. |
| 3 | Remove the universal joint. | |

Refitting

| | Action | Note |
|---|---|---|
| 1 | Refit the universal joint. | Use locking liquid (Loctite 243). |
| 2 | Refit the set screw in order to lock the universal joint to the telescopic shaft. | Use locking liquid (Loctite 243). Tightening torque for set screw 3HAC12846-2 (M16x6 A2): <ul style="list-style-type: none">• 7 Nm. Tightening torque for set screw 3HAC12846-3 (M16x6 FZB): <ul style="list-style-type: none">• 9.5 Nm. Tightening torque for set screw 3HAC12846-4 (M16x6 A4): <ul style="list-style-type: none">• 8.5 Nm. |
| 3 | Refit the telescopic shaft. | See section Replacement of telescopic shaft on page 194. |

4.3.9 Replacement of joint balls

General

This section describes how to change the joint balls.



DANGER

Turn off all electrical power, hydraulic and pneumatic pressure supplies before entering the workspace of the manipulator.

Also read the safety sections:

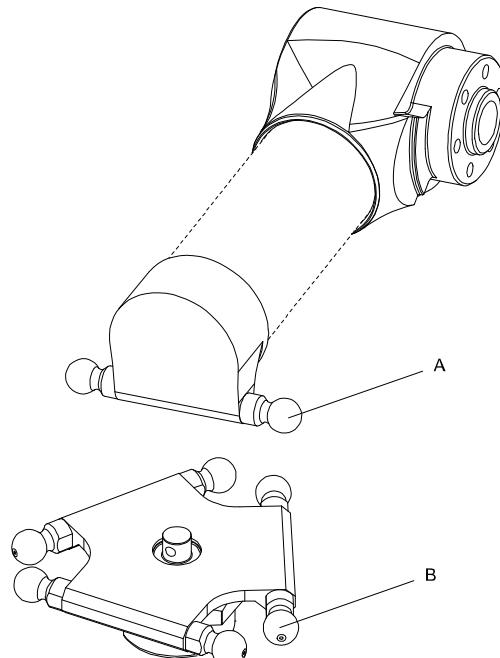
- *Safety risks related to pneumatic/hydraulic systems on page 27*
- *Risks associated with live electric parts on page 29*
- *Safety risks during installation and service work on robots on page 22*



CAUTION

Always read the specific instructions for Clean Room robots before doing any repair work, see *Replacing parts on the robot on page 170*.

Location



xx0700000534

| | |
|---|------------|
| A | Joint ball |
| B | Joint ball |

Continues on next page

4 Repair

4.3.9 Replacement of joint balls

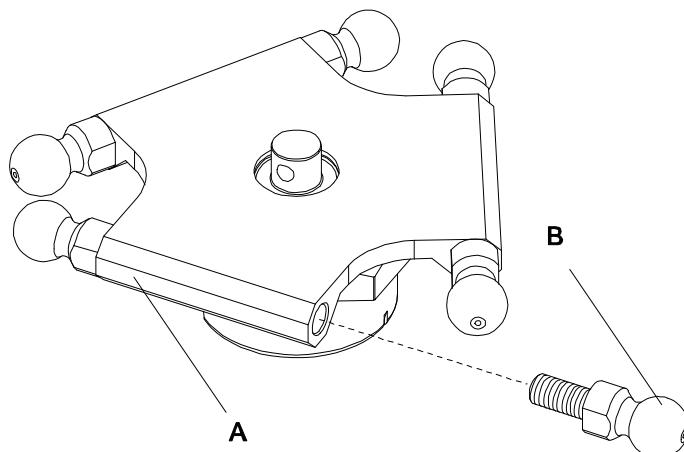
Continued

Required equipment and references

| Equipment | Spare part no. | Note |
|--------------------------|--|--|
| Standard tools | | Standard toolkit on page 268 |
| Joint ball | See <i>Product manual, spare parts - IRB 360</i> . | |
| Pliers for parallel arms | 3HAC6194-1 | |
| Locking liquid | | Loctite 243 |
| Activator | | Loctite 7649 |

| References |
|--|
| Replacement of parallel arms on page 178 |
| Replacement of movable plate on page 190 |

Removal



xx0700000500

| | |
|---|--------------------------|
| A | Movable plate |
| B | Joint ball movable plate |



CAUTION

Never use unnecessary force when removing the springs. Only work on one side or the spring will be overstressed.

| Action | Note |
|-----------------------------|---|
| 1 Remove the parallel arms. | Described in section Replacement of parallel arms on page 178 . |
| 2 Remove the movable plate. | Described in section Replacement of movable plate on page 190 |
| 3 Remove the joint balls. | Use standard tools. |

Continues on next page

Refitting**CAUTION**

Never use unnecessary force when refitting the springs. Only work on one side or the spring will be overstressed.

| | Action | Note |
|---|--|---|
| 1 | Refit the joint balls using loctite 243. For the best result, use spray activator (Loctite 7649) on the stainless joint balls. | Tightening torque 11 Nm. |
| 2 | Refit the movable plate. | Described in section Replacement of movable plate on page 190 . |
| 3 | Refit the parallel arms. | Described in section Replacement of parallel arms on page 178 . |
| 4 | Run the robot for six (6) hours for the bearing rings to wear in. | |
| 5 | Wipe clean the joint balls and the bearing rings. | |

4.3.10 Replacement of gearbox unit 1- 3

General

This section describes replacing gearbox 1-3 with motor (gearbox unit).



DANGER

Turn off all electrical power, hydraulic and pneumatic pressure supplies before entering the workspace of the manipulator.

Also read the safety sections:

- [*Safety risks related to pneumatic/hydraulic systems on page 27*](#)
- [*Risks associated with live electric parts on page 29*](#)
- [*Safety risks during installation and service work on robots on page 22*](#)



Note

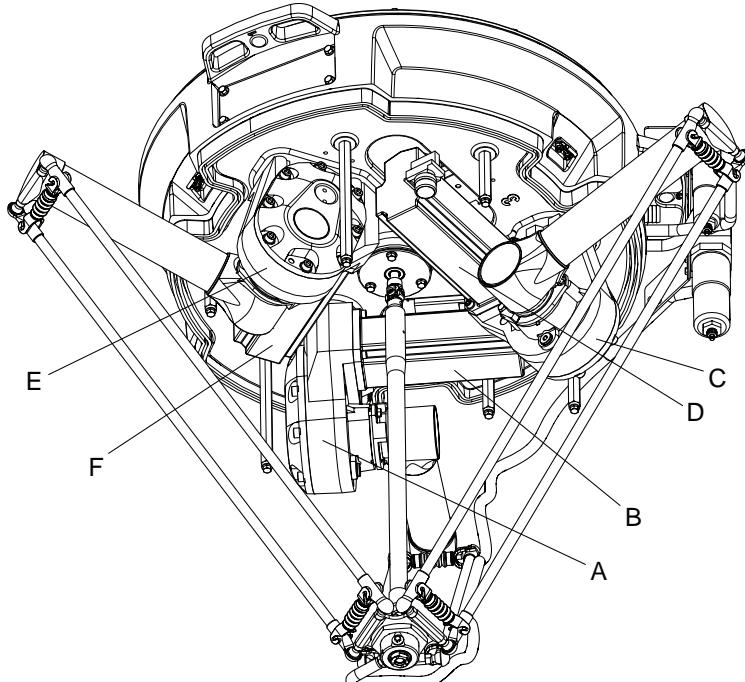
This action demands standard calibration of the robot. Described in section [*Calibration method on page 238*](#).



CAUTION

Always read the specific instructions for Clean Room robots before doing any repair work, see [*Replacing parts on the robot on page 170*](#).

Continues on next page

Location

xx0700000540

| | |
|----------|--------------|
| A | Gearbox ax 1 |
| B | Motor ax 1 |
| C | Gearbox ax 2 |
| D | Motor ax 2 |
| E | Gearbox ax 3 |
| F | Motor ax 3 |

Required equipment and references

| Equipment | Spare part no. | Note |
|-------------------------------|--|------|
| Standard tools | Standard toolkit on page 268. | |
| Gearbox with motor (axes 1-3) | See Product manual, spare parts - IRB 360. | |
| Gaskets | See Product manual, spare parts - IRB 360. | |

| References |
|--|
| Gearboxes, axes 1- 4 on page 142 |
| Circuit diagram 3HAC028647-009 |
| Calibration method on page 238 |

Removal

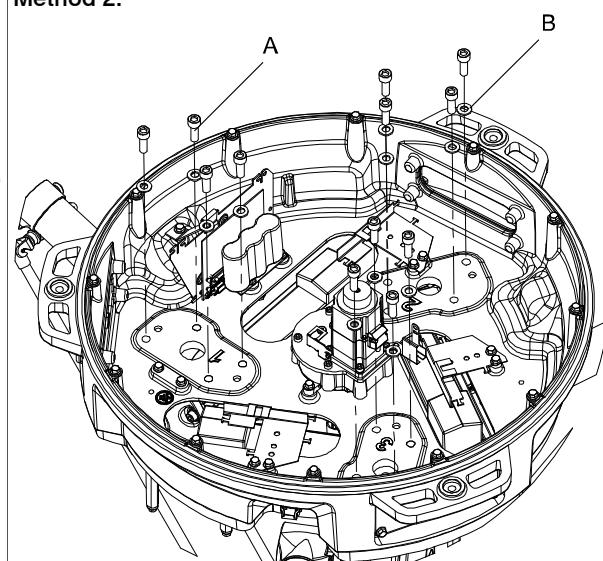
| | Action | Note |
|---|--------------------|--|
| 1 | Remove arm system. | Replacement of bearing rings on page 187 |

Continues on next page

4 Repair

4.3.10 Replacement of gearbox unit 1- 3

Continued

| Action | Note |
|--|---|
| 2 Remove the transmission cover | Described in section Gearboxes, axes 1- 4 on page 142 , Method 2. |
| 3 Remove the base cover | Described in section Replacement of base cover gasket on page 172 |
| 4 Disconnect the motor connectors, R3.FB1-3 and R3.MP1-3. | |
| 5 Remove the four hex socket head cap screw M10 x 30 with washers. | <p>Described in section Gearboxes, axes 1- 4 on page 142, Method 2.</p> <p>WARNING This action will loosen the gearbox unit weight 16 kg.</p>  <p>xx0700000539</p> <p>A Hex socket head cap screw M10 x 30 B Plain washer 16.5x20x2 steel A3F</p> |

Refitting

| Action | Note |
|--|---|
| 1 Refit the gearbox unit, using the four hex socket head cap screw M10 x 30 with washer 16.5x20x2 steel A3F. | Tightening torque 33 Nm. |
| <p>i Note</p> <p>Gearbox unit weight 16 Kg.</p> | |
| 2 Connect the motor connectors, R3.FB1-3 and R3.MP1-3. | Described in circuit diagram, see Circuit diagrams on page 277 . |
| 3 Refit the base cover | Described in section Replacement of base cover gasket on page 172 |
| 4 Refit the transmission cover. | Described in section Gearboxes, axes 1- 4 on page 142 , Method 2. |
| 5 Refit the arm system. | Described in section Gearboxes, axes 1- 4 on page 142 , Method 2. |
| 6 Recalibrate the robot. | See Calibration information on page 237 . |

4.3.11 Replacement of gearbox unit 4

General

This section describes replacing gearbox 4 with motor (gearbox unit)



DANGER

Turn off all electrical power, hydraulic and pneumatic pressure supplies before entering the workspace of the manipulator.

Also read the safety sections:

- [Safety risks related to pneumatic/hydraulic systems on page 27](#)
- [Risks associated with live electric parts on page 29](#)
- [Safety risks during installation and service work on robots on page 22](#)



Note

This action demands standard calibration of the robot. Described in section [Calibration method on page 238](#).



CAUTION

Always read the specific instructions for Clean Room robots before doing any repair work, see [Replacing parts on the robot on page 170](#).

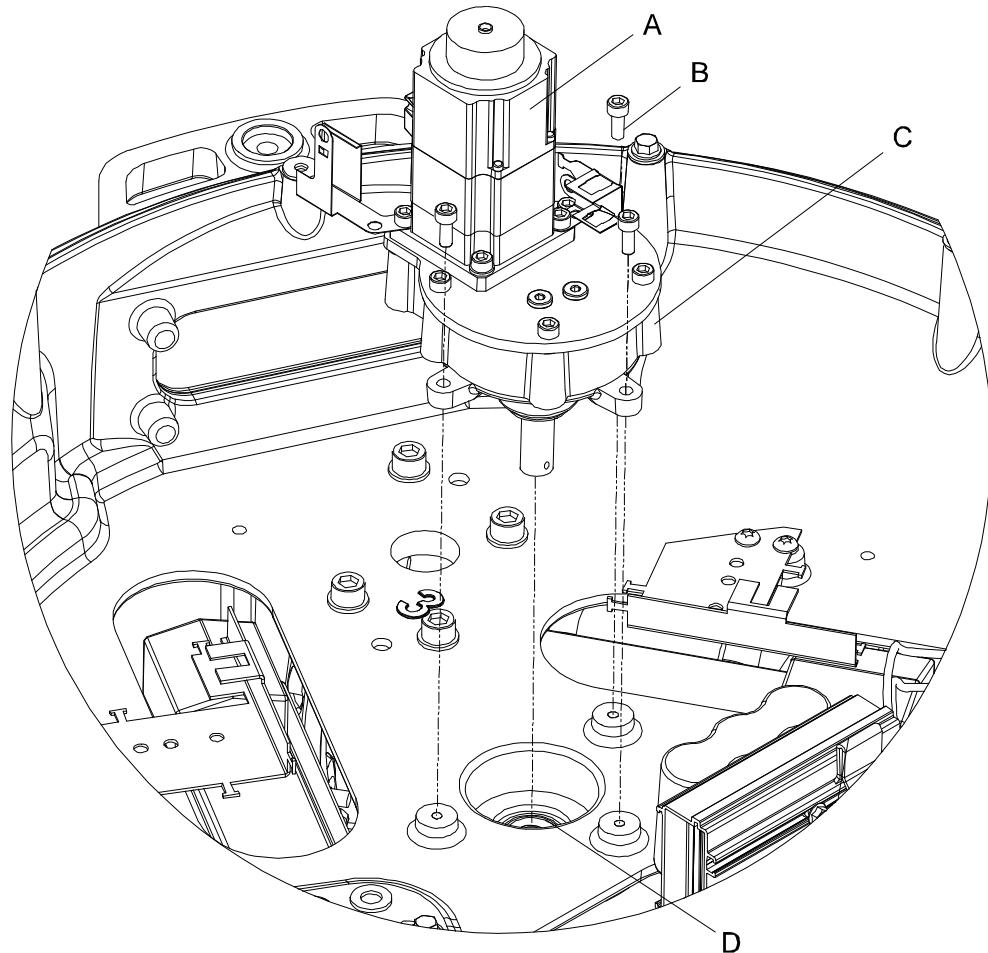
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4 Repair

4.3.11 Replacement of gearbox unit 4

Continued

Location



xx0700000547

| | |
|---|---|
| A | Gearbox motor axis 4 |
| B | Hexagon socket head screw 3x (M6x25) with plain washer 6,4x12x1,6 steel A2F |
| C | Gearbox axis 4 |
| D | Sealing ring w. dust lip |

Required equipment and references

| Equipment | Spare Part No. | Note |
|---------------------|--|-------------|
| Gearbox unit axis 4 | See <i>Product manual, spare parts - IRB 360</i> . | |
| Standard tools | Standard toolkit on page 268 . | |
| Sealing rings | See <i>Product manual, spare parts - IRB 360</i> . | |
| Locking liquid | | Loctite 243 |

| References |
|--|
| Replacement of telescopic shaft on page 194 |
| Replacement of base cover gasket on page 172 |

Continues on next page

| References |
|--|
| Calibration method on page 238 |

Removal

| | Action | Note |
|---|--|---|
| 1 | Remove the (12 pcs) M6 flange screws holding the base cover. | Use standard tools. Described in section Replacement of base cover gasket on page 172 |
| 2 | Disconnect the motor connectors: R3.FB4 and R3.MP4. | |
| 3 | Remove the telescopic shaft. | Described in section Replacement of telescopic shaft on page 194 . |
| 4 | Remove the 3x hexagon socket head screw (M6x25) with plain washer 6,4x12x1,6 steel A2F(B). | Shown in figure |
| 5 | Remove the gearbox unit axis 4. | |
| 6 | Remove the sealing ring w. dust lip. | |

Refitting

| | Action | Note |
|---|---|---|
| 1 | Refit a new sealing ring, apply grease. | See section Grease on sealings on page 272 . |
| 2 | Refit the axis 4 gearbox unit. | |
| 3 | Refit the 3x hexagon socket head screw (M6x25) with plain washer 6,4x12x1,6 steel A2F(B). | Tightening torque 9 Nm. |
| 4 | Refit the telescopic shaft. | Described in section Replacement of telescopic shaft on page 194 . |
| 5 | Reconnect the motor connectors, R3.FB4 and R3.MP4. | |
| 6 | Refit the (12 pcs) M6 screws holding the base cover. | Use standard tools. Described in section Replacement of base cover gasket on page 172 |
| 7 | Calibrate the robot. | Described in section Calibration information on page 237 . |

4.3.12 Replacement of motor axis 1-3

General

This section describes replacement of motor axis 1-3.



DANGER

Turn off all electrical power, hydraulic and pneumatic pressure supplies before entering the workspace of the manipulator.

Also read the safety sections:

- [*Safety risks related to pneumatic/hydraulic systems on page 27*](#)
- [*Risks associated with live electric parts on page 29*](#)
- [*Safety risks during installation and service work on robots on page 22*](#)



Note

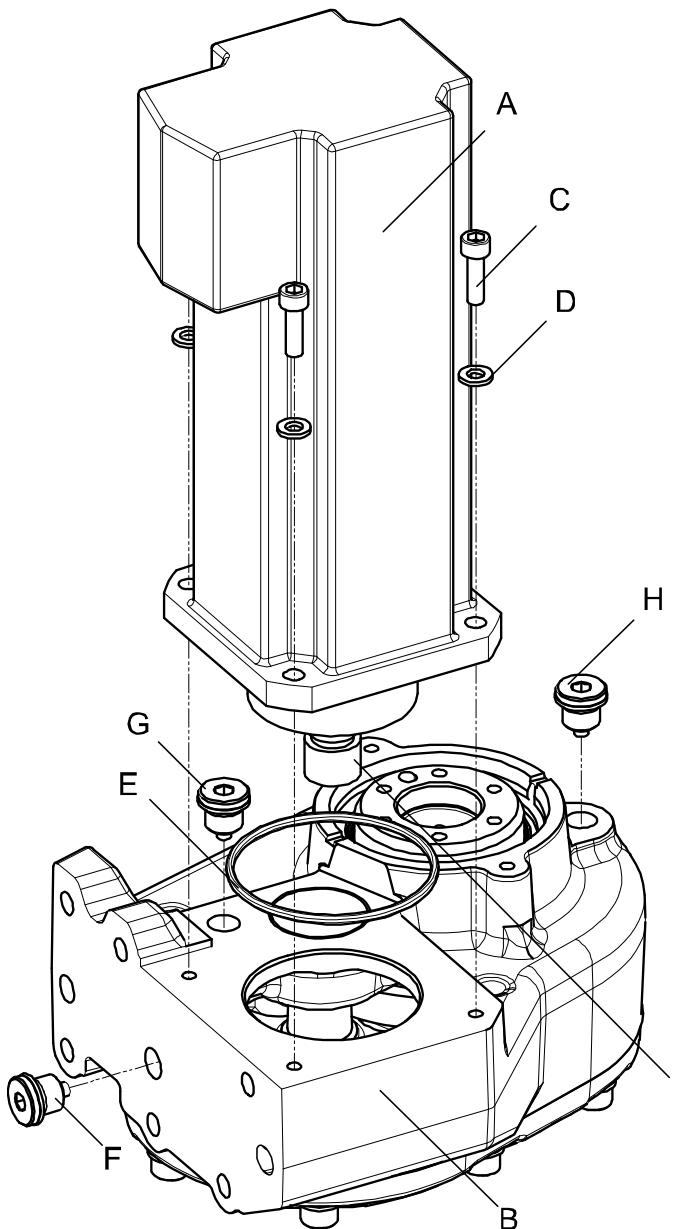
This action demands standard calibration of the robot. Described in section [*Calibration method on page 238*](#).



CAUTION

Always read the specific instructions for Clean Room robots before doing any repair work, see [*Replacing parts on the robot on page 170*](#).

Continues on next page

Location

xx0700000541

| | |
|----------|--|
| A | Motor 1-3 |
| B | Gearbox 1-3 |
| C | Hex socket head cap screw M6x20 8.8 gleitmo605 |
| D | Washer 6,4x12x1,6 steel A2F |
| E | Nitrile rubber O-ring 67,5x3,0 |
| F | Oil plug |
| G | Oil plug (upper oil level hole) |
| H | Oil plug |
| I | Gear Z1/1-3, 16 cog |

Continues on next page

4 Repair

4.3.12 Replacement of motor axis 1-3

Continued

Required equipment and references

| Equipment | Spare part no. | Note |
|----------------|--|--|
| Standard tools | | Standard toolkit on page 268 |
| O-ring | See <i>Product manual, spare parts - IRB 360</i> . | |
| AC motor | See <i>Product manual, spare parts - IRB 360</i> . | |
| Locking liquid | | Loctite 243 |

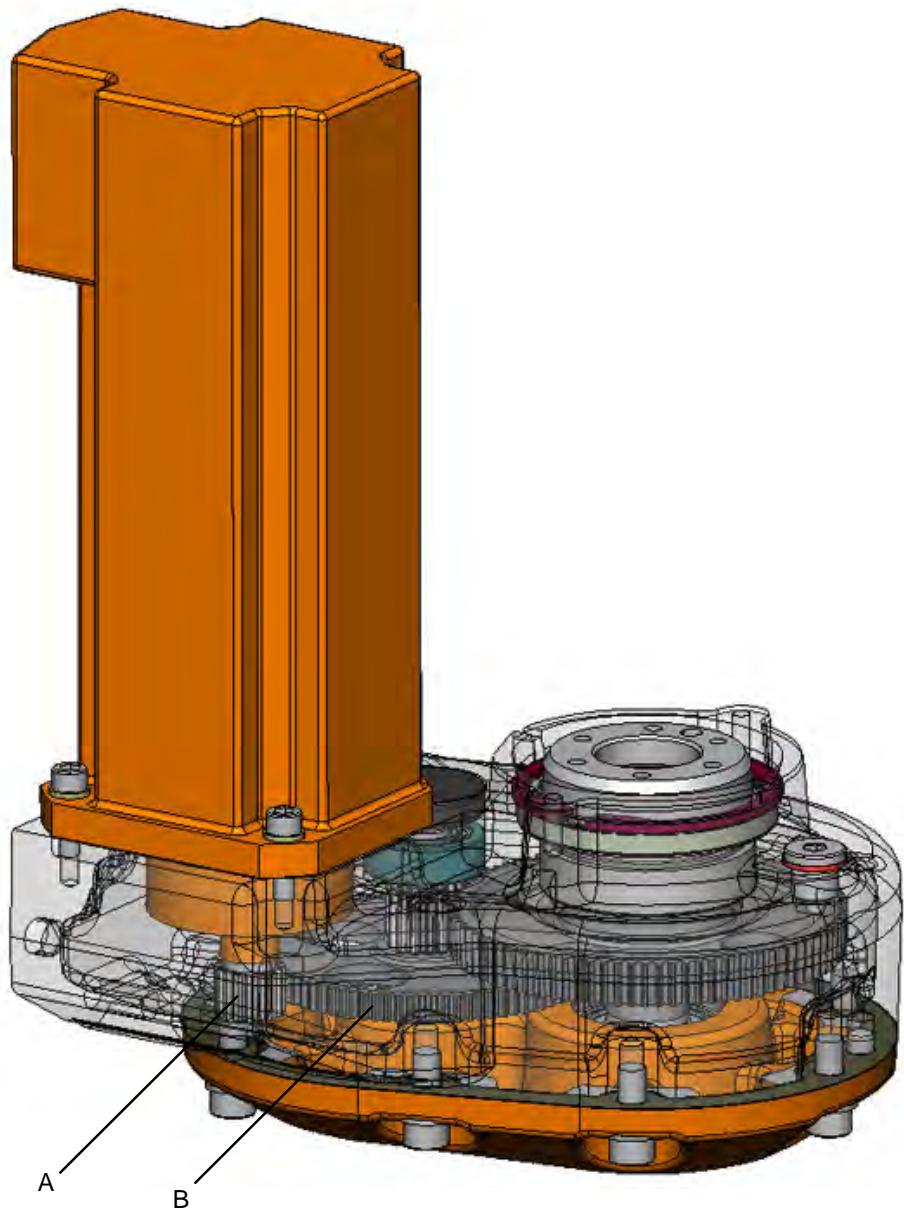
| References |
|---|
| Replacement of gearbox unit 1-3 on page 202 |
| Grease specification on page 271 |

Removal

| | Action | Note |
|---|---|--|
| 1 | Remove the gearbox unit 1-3. | Described in section Replacement of gearbox unit 1-3 on page 202 . |
| 2 | Unscrew the three screws (C) holding the motor. | Shown in figure Location on page 209 |
| 3 | Remove the motor. |  DANGER Oil will be running out of the motor attachment hole when removing the motor! The oil can be hot. Take any necessary measures to collect the oil. |

Continues on next page

Refitting



xx0700000616

| | |
|---|---------------------|
| A | Motor pinion |
| B | Gear Z2/1-3, 90 cog |

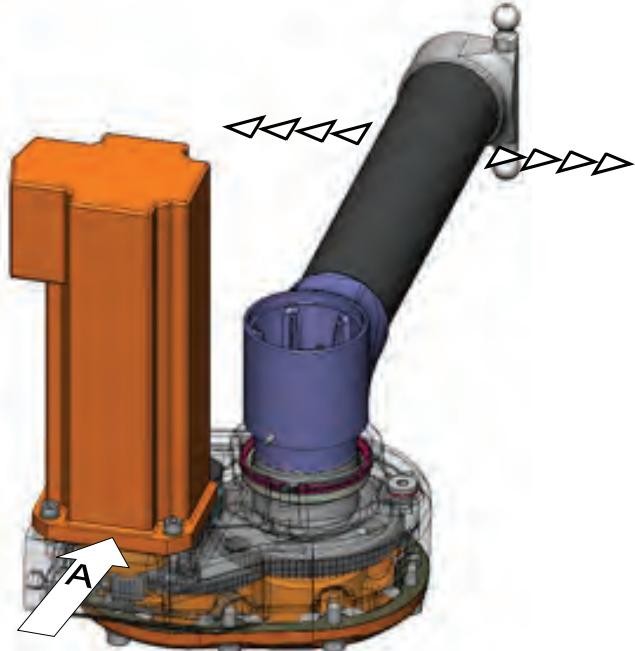
| | Action | Note |
|---|---|--|
| 1 | Fit a new O-ring (E) onto the motor flange, lubricate the o-ring with grease FM222. | Shown in figure Location on page 209 . |

Continues on next page

4 Repair

4.3.12 Replacement of motor axis 1-3

Continued

| Action | Note |
|---|--|
| 2 Insert the new motor, do not tighten the screws. |  CAUTION Fit the motor, making sure the motor pinion is properly mated to the gear wheel, do not use force or the motor pinion may get damaged. |
| 3 Refit the upper arm temporarily, to be used to feel the backlash. | |
| 4 Push on the motor flange gently in direction A, at the same time as you feel for the backlash by moving the upper arm back and forward. |  xx0700000620 |
| 5 Ensure that the gear is kept absolutely still. Apply loctite 243 and tighten the screws (C). | Shown in figure Location on page 209 Tightening torque 9 Nm. |
| 6 Check through the upper oil level hole that gear wheel (B) is axially movable | Shown in figure Refitting on page 211 . |
| 7 Fill the gearbox with oil. | Specified in section Grease specification on page 271 . |
| 8 Refit the gearbox unit 1-3 | Described in section Replacement of gearbox unit 1- 3 on page 202 . |
| 9 Recalibrate the robot. | See Calibration information on page 237 . |

4.3.13 Replacement of motor axis 4

General

This section describes replacement of motor axis 4.



Note

This action demands standard calibration of the robot. Described in section [Calibration method on page 238](#).



DANGER

Turn off all electrical power, hydraulic and pneumatic pressure supplies before entering the workspace of the manipulator.

Also read the safety sections:

- [Safety risks related to pneumatic/hydraulic systems on page 27](#)
- [Risks associated with live electric parts on page 29](#)
- [Safety risks during installation and service work on robots on page 22](#)



CAUTION

Always read the specific instructions for Clean Room robots before doing any repair work, see [Replacing parts on the robot on page 170](#).

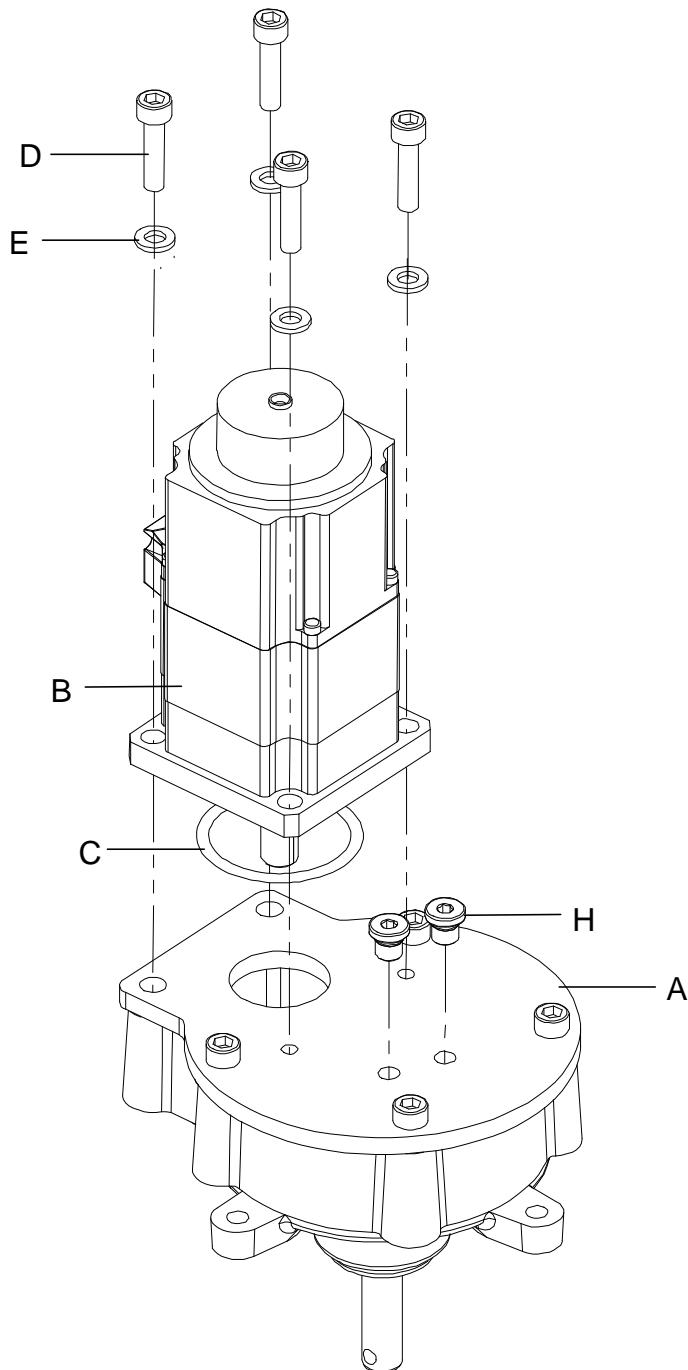
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4 Repair

4.3.13 Replacement of motor axis 4

Continued

Location



xx0700000615

| | |
|---|-------------------------------------|
| A | Gear box axis 4 |
| B | Rotational ac motor |
| C | O-ring, nitrile rubber |
| D | Hex socket head cap screw M6x25 8.8 |
| E | Washer 6,4x12x1,6 A2F |
| H | Oil plug |

Continues on next page

Required equipment and references

| Equipment | Spare part no. | Note |
|------------------------|--|-------------------------------------|
| Standard tools | | <i>Standard toolkit on page 268</i> |
| O-ring, nitrile rubber | See <i>Product manual, spare parts - IRB 360</i> . | |
| Loctite 243 | See <i>Product manual, spare parts - IRB 360</i> . | |

| References |
|---|
| <i>Replacement of base cover gasket on page 172</i> |
| <i>Replacement of gearbox unit 4 on page 205</i> |
| <i>Standard toolkit on page 268</i> |
| <i>Grease specification on page 271</i> |

Removal

| | Action | Note |
|---|-----------------------------|--|
| 1 | Remove base cover. | Described in section <i>Replacement of base cover gasket on page 172</i> . |
| 2 | Remove gear box with motor. | Described in section <i>Replacement of gearbox unit 4 on page 205</i> . |
| 3 | Remove motor. |  DANGER Oil will be running out of the motor attachment hole when removing the motor! The oil can be hot. Take any necessary measures to collect the oil. |

Refitting

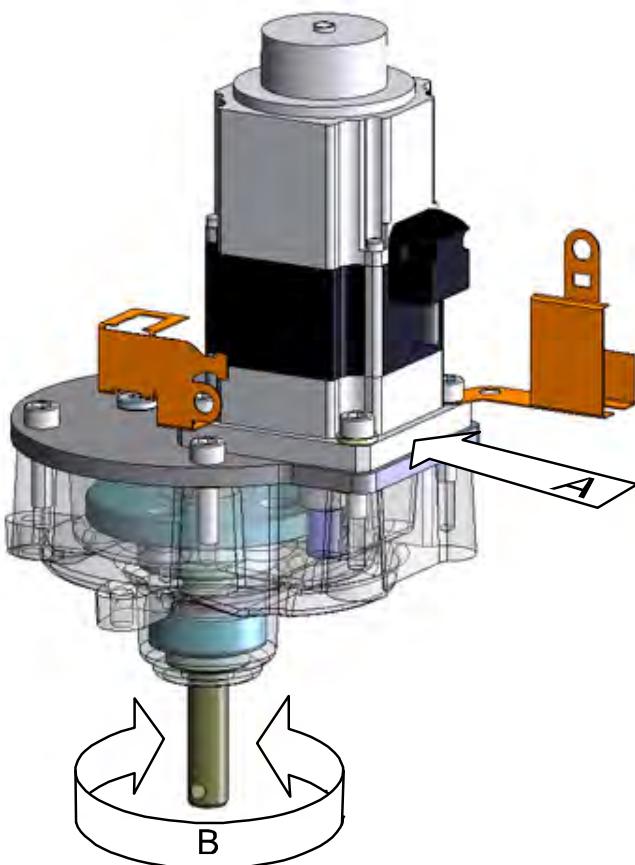
| | Action | Note |
|---|--|--|
| 1 | Fit the new o-ring (C) onto the motor flange, lubricate the o-ring with grease FM 222. | Lubrication specified in section <i>Grease specification on page 271</i> . |
| 2 | Insert the new motor, do not tighten the screws. |  CAUTION Fit the motor, making sure the motor pinion is properly mated to the gear wheel, do not use force or the motor pinion may get damaged. |

Continues on next page

4 Repair

4.3.13 Replacement of motor axis 4

Continued

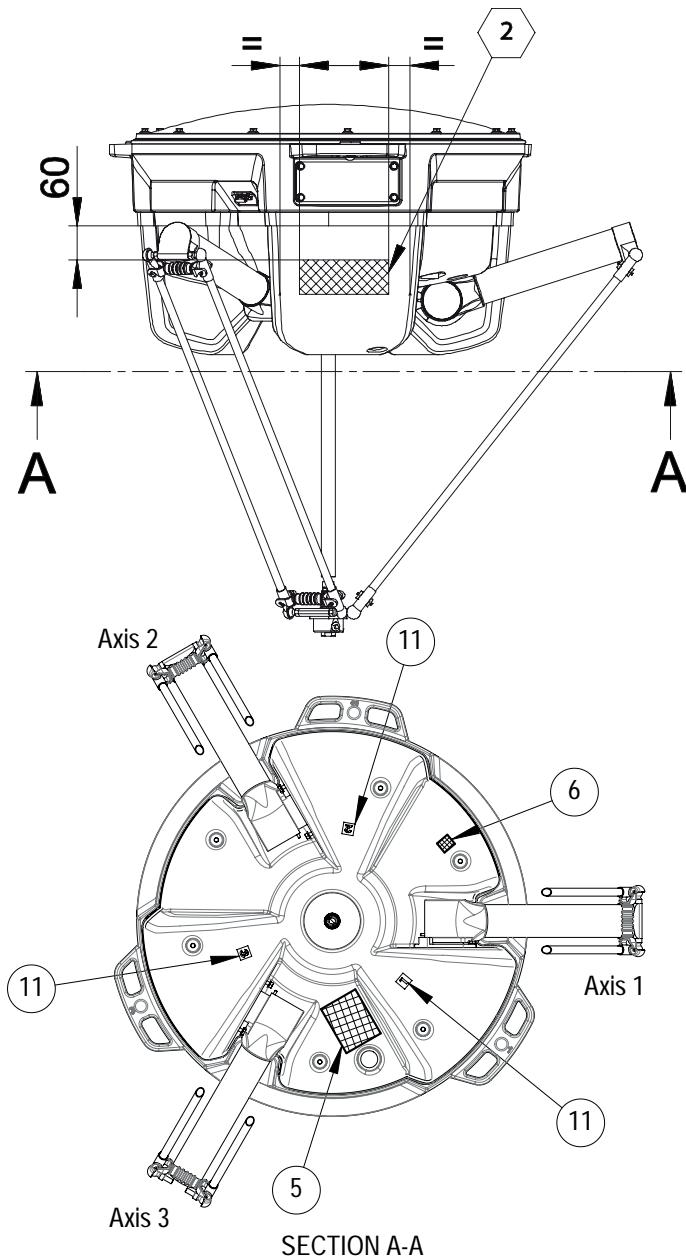
| Action | Note |
|---|---|
| 3 Push on the motor flange gently in direction A, at the same time as you feel for the backlash by moving the outgoing axis (B) back and forward. |  xx0700000621 |
| 4 Make sure that the gear is kept absolutely still. Apply Loctite 243 and tighten the screw (D). In figure Location on page 214 . | Tightening torque: 10 Nm. |
| 5 Check the play again. | If there is a backlash, loosen the screws (D) and go back to step 3. |
| 6 Fill the gearbox with oil. | Lubrication specified in section Grease specification on page 271 . |
| 7 Refit the gear box with motor. | Described in section Replacement of gearbox unit 4 on page 205 . |
| 8 Refit the base cover. | Described in section Replacement of base cover gasket on page 172 . |

4.3.14 Replacement of labels

General

This section describes replacement and positioning of labels on the IRB 360.

Label positioning



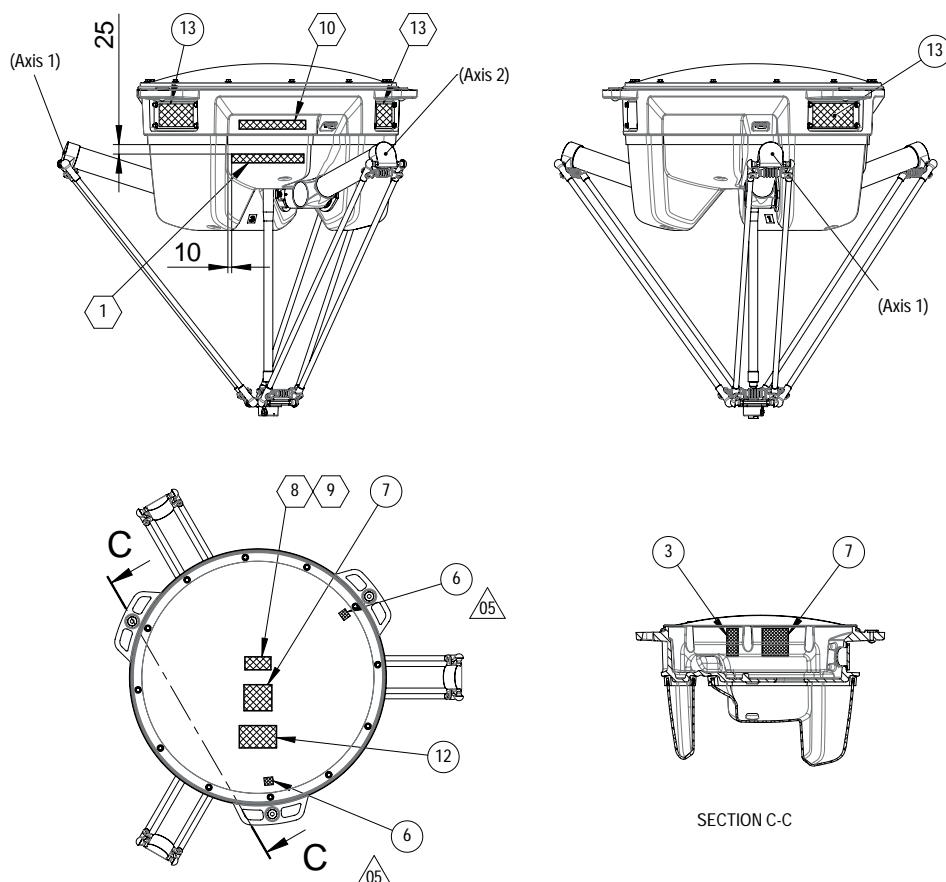
xx0700000691

Continues on next page

4 Repair

4.3.14 Replacement of labels

Continued



xx0700000692

| | |
|----|---------------------------------------|
| 1 | Label, Flex Picker-red 190x23 |
| 2 | ABB-Logotype 69x157 |
| 3 | Calibration values |
| 5 | Instruction plate (brake release) |
| 6 | Warning sign 24x21 (electric warning) |
| 7 | Rating label |
| 8 | UL-label 70x35 |
| 9 | UL-label 70x35 |
| 10 | Cleanroom Logotype |
| 11 | Axis marks |
| 12 | Instruction plate |
| 13 | Transport protection label |

Required equipment and references

| Equipment | Spare part no. | Note |
|-----------|--|------|
| Label-set | See <i>Product manual, spare parts - IRB 360</i> . | |

Continues on next page

Assemble

| | Action | Note |
|---|---|------|
| 1 | Make sure the surface is clean. | |
| 2 | Assemble the labels according to the illustrations. | |

4.3.15 Replacing of calibration marks

Overview

This section describes replacement of calibration marks on an IRB 360.

Replace a calibration mark if it is damaged.



DANGER

Turn off all electrical power, hydraulic and pneumatic pressure supplies before entering the workspace of the manipulator.

Also read the safety sections:

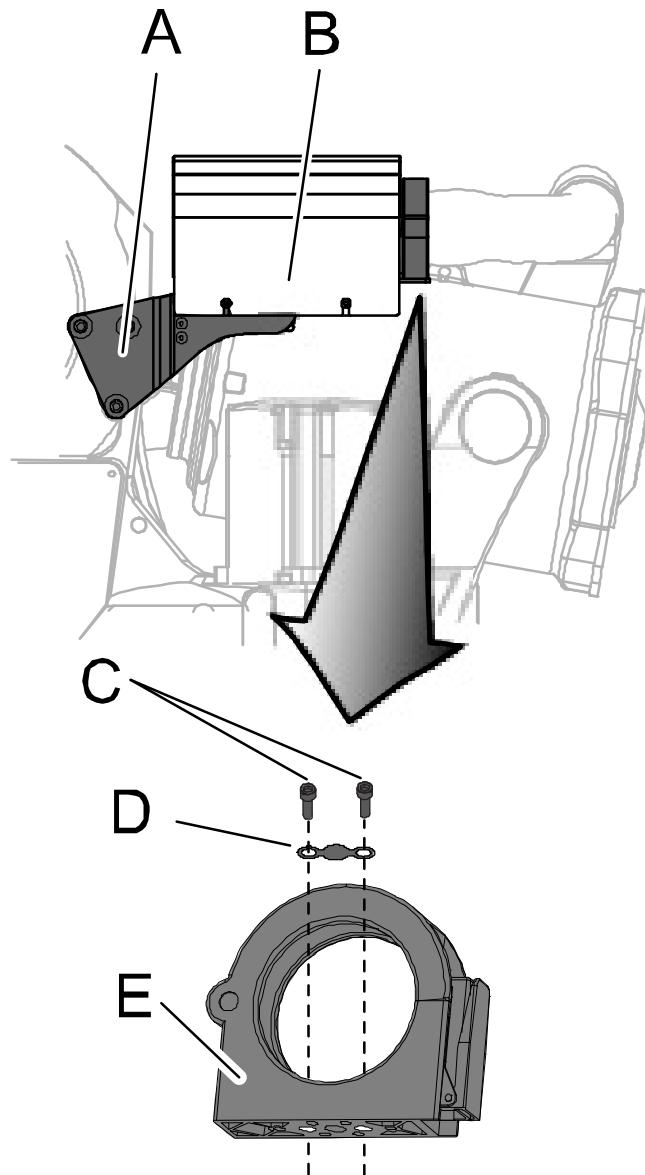
- [*Safety risks related to pneumatic/hydraulic systems on page 27*](#)
- [*Risks associated with live electric parts on page 29*](#)
- [*Safety risks during installation and service work on robots on page 22*](#)



CAUTION

Always read the specific instructions for Clean Room robots before doing any repair work, see [*Replacing parts on the robot on page 170*](#).

Continues on next page

Location

xx0800000008

| | |
|---|---|
| A | Dowel for calibration mark |
| B | Calibration mark (plastic) |
| C | 2 pcs M5 prevailing torque type hexagon nut non metallic insert style1. |

Required equipment and references

| Equipment | Spare part no. | Note |
|------------------|--|------|
| Standard tools | Standard toolkit on page 268. | |
| Calibration mark | See Product manual, spare parts - IRB 360. | |

Continues on next page

4 Repair

4.3.15 Replacing of calibration marks

Continued

Remove

| | Action | Note |
|---|------------------------------|---------------------|
| 1 | Remove the two M5 nuts. | Use standard tools. |
| 2 | Remove the calibration mark. | |

Refitting

| | Action | Note |
|---|-------------------------------|------------------------|
| 1 | Refit a new calibration mark. | |
| 2 | Refit the two M5 nuts. | Tightening torque 4Nm. |

4.4 Vacuum system

4.4.1 Replacement of vacuum hoses

General

This section describes replacement of hoses in the vacuum system.



DANGER

Turn off all electrical power, hydraulic and pneumatic pressure supplies before entering the workspace of the manipulator.

Also read the safety sections:

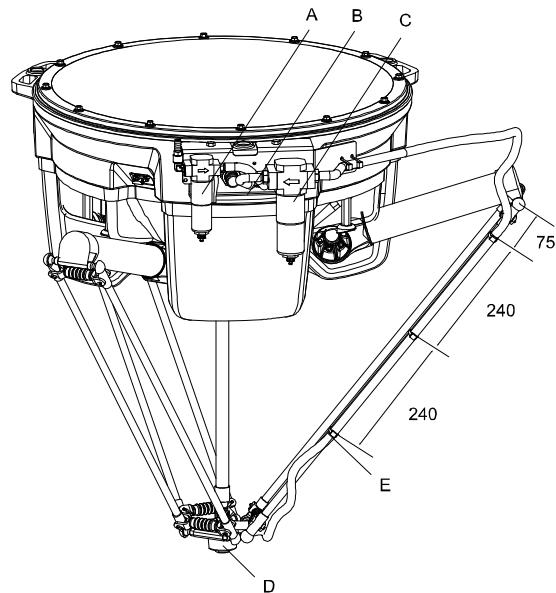
- [Safety risks related to pneumatic/hydraulic systems on page 27](#)
- [Risks associated with live electric parts on page 29](#)
- [Safety risks during installation and service work on robots on page 22](#)



CAUTION

Always read the specific instructions for Clean Room robots before doing any repair work, see [Replacing parts on the robot on page 170](#).

Location



xx0700000499

| | |
|---|--------------------------|
| A | Air filter inlet. |
| B | Ejector unit |
| C | Air filter inlet vacuum. |
| D | Swivel cup |
| E | Hose clamp |

Continues on next page

4 Repair

4.4.1 Replacement of vacuum hoses

Continued

Required equipment

| Equipment | Spare part no. | Note |
|----------------|----------------|------|
| Standard tools | | |
| Spare hose set | | |

Removal

| | Action | Note |
|---|--|------|
| 1 | Open all straps. | |
| 2 | Pull the hose out from the swivel. | |
| 3 | Pull the hose out from the air filter. | |

Refitting

| | Action | Note |
|---|---|------|
| 1 | Fit a new hose on the swivel. | |
| 2 | Fix the hose, do not tighten, against the three clamps on the parallel arm. | |
| 3 | Twist the hose and fit it on the air filter. | |
| 4 | Adjust the hose. | |
| 5 | Tighten the straps. | |
| 6 | Make a small program (low velocity) and check that the hose runs freely. | |
| 7 | Fit a new hose on the swivel. | |
| 8 | Fix the hose, do not tighten, against the three clamps on the parallel arm. | |

4.4.2 Draining of water separation filter

General

This section describes:

- Air filter change in the vacuum system
- Emptying water separation filter



DANGER

Turn off all electrical power, hydraulic and pneumatic pressure supplies before entering the workspace of the manipulator.

Also read the safety sections:

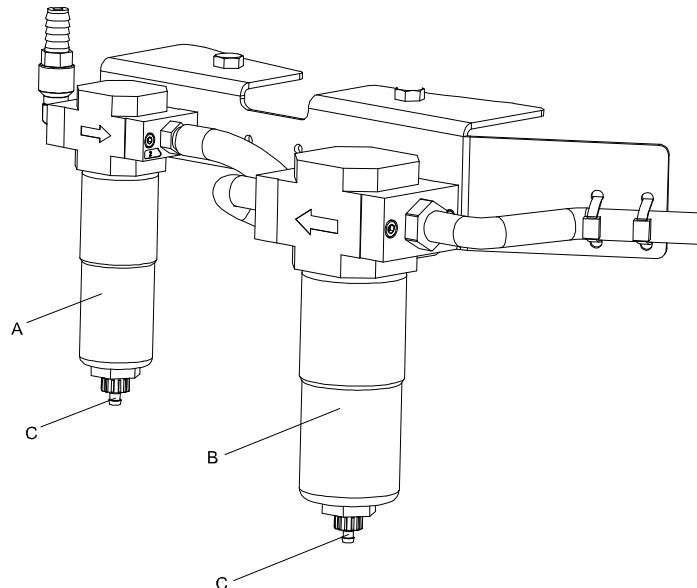
- *Safety risks related to pneumatic/hydraulic systems on page 27*
- *Risks associated with live electric parts on page 29*
- *Safety risks during installation and service work on robots on page 22*



CAUTION

Always read the specific instructions for Clean Room robots before doing any repair work, see *Replacing parts on the robot on page 170*.

Location



xx0700000544

| | |
|---|--------------------------------|
| A | Air filter (comp) |
| B | Air filter (Vac) |
| C | Water separation bottom nipple |

Continues on next page

4 Repair

4.4.2 Draining of water separation filter

Continued

Removal water

| | Action |
|---|---|
| 1 | Drain the water separation filter, opening the bottom nipple (C). |

4.4.3 Replacement of ejector unit

General

This section describes replacement of ejector unit.



DANGER

Turn off all electrical power, hydraulic and pneumatic pressure supplies before entering the workspace of the manipulator.

Also read the safety sections:

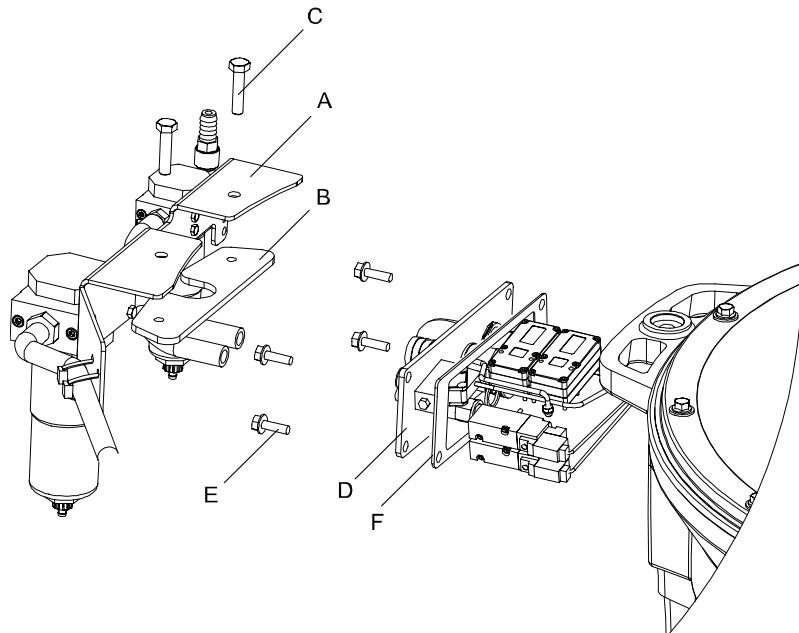
- *Safety risks related to pneumatic/hydraulic systems on page 27*
- *Risks associated with live electric parts on page 29*
- *Safety risks during installation and service work on robots on page 22*



CAUTION

Always read the specific instructions for Clean Room robots before doing any repair work, see *Replacing parts on the robot on page 170*.

Location



xx0700000714

| | |
|---|--|
| A | Attachment |
| B | Bracket |
| C | Hexagon head screw, M8x35 (Steel 8.8-A2F) |
| D | Ejector unit |
| E | Hexagon bolt with flange, M6 x 20 (A2 DIN6921) |
| F | Gasket |

Continues on next page

4 Repair

4.4.3 Replacement of ejector unit

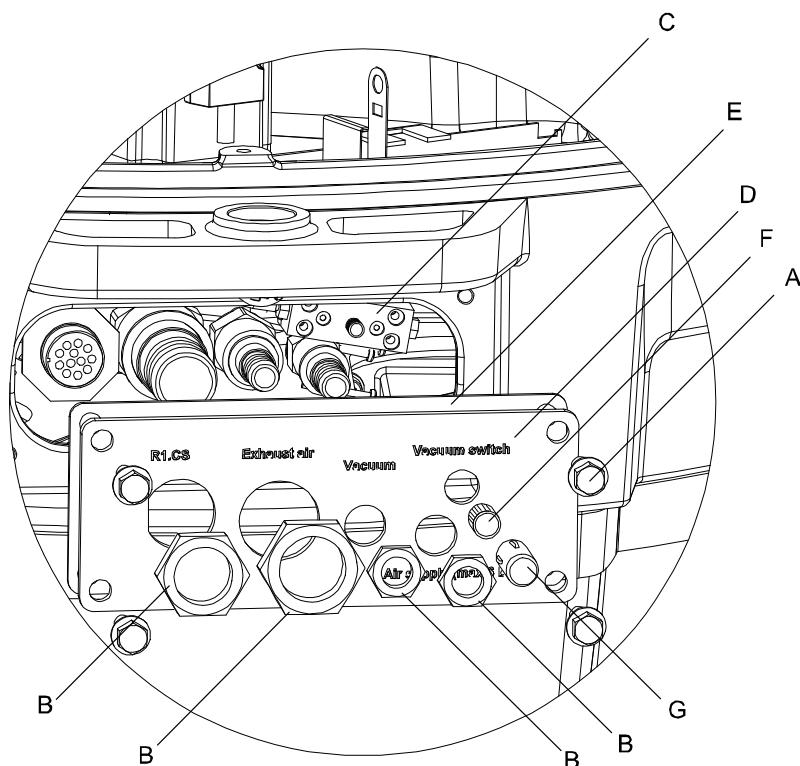
Continued

Required equipment and references

| Equipment | Spare part no. | Note |
|----------------|-----------------------------------|------|
| Standard tools | | |
| Spare parts | <i>Spare parts, ejector unit.</i> | |

| References |
|--|
| <i>Spare parts, ejector unit.</i> |
| <i>Replacement of base cover gasket on page 172.</i> |

Illustration



xx0700000704

| | |
|---|---|
| A | Hexagon bolt with flange M6x20 (A2 DIN6921) |
| B | Nuts for the air nozzles |
| C | Ejector unit |
| D | Front plate |
| E | Gasket |
| F | Pressure guard nut |
| G | Pressure guard cap |

Removal

| | Action | Note |
|---|--|------|
| 1 | Disconnect the air supply, vacuum hoses, and signal cable from the ejector unit. | |

Continues on next page

4.4.3 Replacement of ejector unit

Continued

| Action | Note |
|--|---|
| 2 Remove the base cover. | Described in section Replacement of base cover gasket on page 172 . |
| 3 Remove the 2x hexagon socket head cap screw M8x35 holding the filter holder, and remove the filters. | Use standard tools. |
| 4 Remove all the nuts for the air nozzles, pressure guard cap and the pressure guard nut. | |
| 5 Remove the ejector unit inwards direction. | |
| 6 Remove the 4x hexagon bolt with flange M6x20 holding the front plate, and remove the plate and the gasket. | |

Refitting

| Action | Note |
|---|--|
| 1 Refit the front plate and the gasket using the 4x hexagon bolt with flange M6x20. (if needed, replace the gasket) | Tightening torque 4 Nm. |
| 2 Refit the ejector unit from the inside. | |
| 3 Refit all the nuts for the air nozzles, pressure guard cap and the pressure guard nut. | Tightening torque 4 Nm. |
| 4 Refit the filters using the 2x hexagon socket head cap screw M8x35. | Use standard tools. |
| 5 Reconnect the air supply, vacuum hoses and signal cable from the ejector unit. | |
| 6 Refit the base cover. | Replacement of base cover gasket on page 172 |

4 Repair

4.5.1 Replacement of cable harness

4.5 Cable harness

4.5.1 Replacement of cable harness

General

This section describes replacement of complete cable harness.



DANGER

Turn off all electrical power, hydraulic and pneumatic pressure supplies before entering the workspace of the manipulator.

Also read the safety sections:

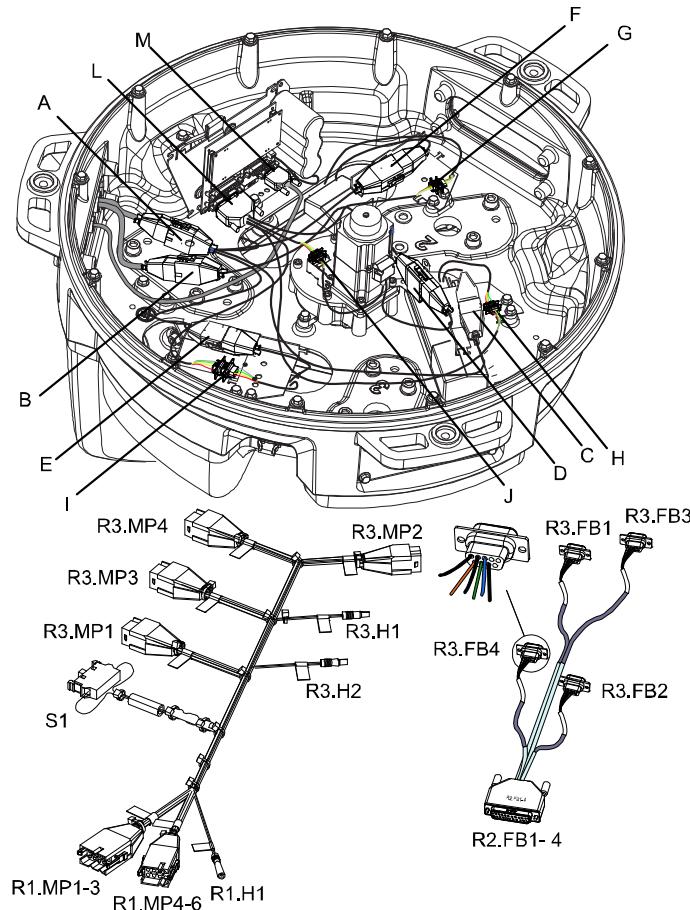
- [*Safety risks related to pneumatic/hydraulic systems on page 27*](#)
- [*Risks associated with live electric parts on page 29*](#)
- [*Safety risks during installation and service work on robots on page 22*](#)



CAUTION

Always read the specific instructions for Clean Room robots before doing any repair work, see [*Replacing parts on the robot on page 170*](#).

Continues on next page

Location

xx0700000562

| | |
|---|--------------------|
| A | R1.MP 1-3 |
| B | R1.MP 4-6 |
| C | R3.MP2 |
| D | R3.MP4 |
| E | R3.MP3 |
| F | R3.MP1 |
| G | R3.FB1 |
| H | R3.FB2 |
| I | R3.FB3 |
| J | R3.FB4 |
| M | X1(SMB) |
| L | X2(SMB) - R3.FB1-4 |

Required equipment and references

| Equipment | Spare part no. | Note |
|----------------|----------------|---|
| Standard tools | | Standard toolkit on page 268. |

Continues on next page

4 Repair

4.5.1 Replacement of cable harness

Continued

| Equipment | Spare part no. | Note |
|---|----------------|-------------------------------------|
| Cable harness | | <i>Spare parts - cable harness.</i> |
| Cut-off pliers | | |
| References | | |
| Replacement of base cover gasket on page 172. | | |
| Circuit diagram 3HAC028647-009. | | |

Removal

| | Action | Note |
|---|--|---|
| 1 | Remove the base cover. | Described in section Replacement of base cover gasket on page 172 |
| 2 | Remove the cable straps holding the cable harness, using a cut-off pliers. | |
| 3 | Disconnect all connections. | |
| 4 | Remove the cable harness. | |

Refitting

| | Action | Note |
|---|--|---|
| 1 | Refit the new cable harness. | |
| 2 | Connect all connections. | Described in circuit diagram, see Circuit diagrams on page 277 . |
| 3 | Strap all cable connections to their connector brackets. | |
| 4 | Refit the base cover. | Described in section Replacement of base cover gasket on page 172 . |

4.5.2 Replacement of brake release button

Introduction

This section describes replacement of brake release button on the IRB 360.



DANGER

Turn off all electrical power, hydraulic and pneumatic pressure supplies before entering the workspace of the manipulator.

Also read the safety sections:

- *Safety risks related to pneumatic/hydraulic systems on page 27*
- *Risks associated with live electric parts on page 29*
- *Safety risks during installation and service work on robots on page 22*



CAUTION

Always read the specific instructions for Clean Room robots before doing any repair work, see *Replacing parts on the robot on page 170*.

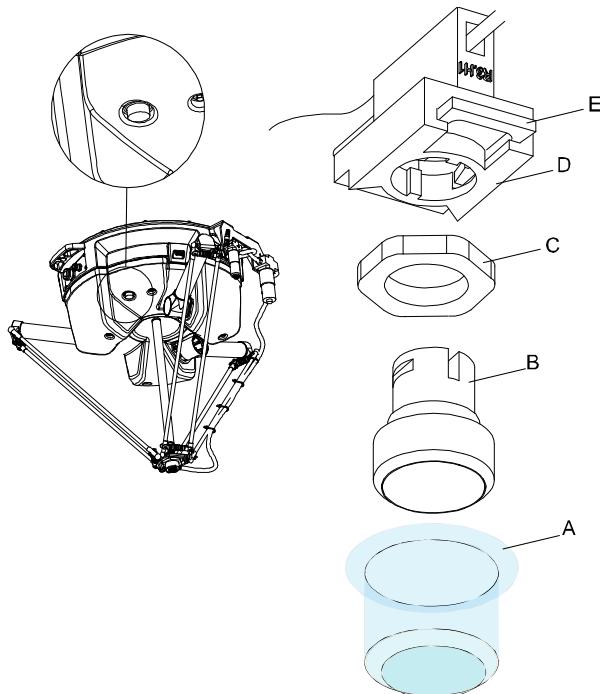
Continues on next page

4 Repair

4.5.2 Replacement of brake release button

Continued

Location



xx0700000650

| | |
|---|----------------------|
| A | Cover |
| B | Brake release button |
| C | Plastic nut |
| D | Contact |
| E | Locking device |

Required equipment

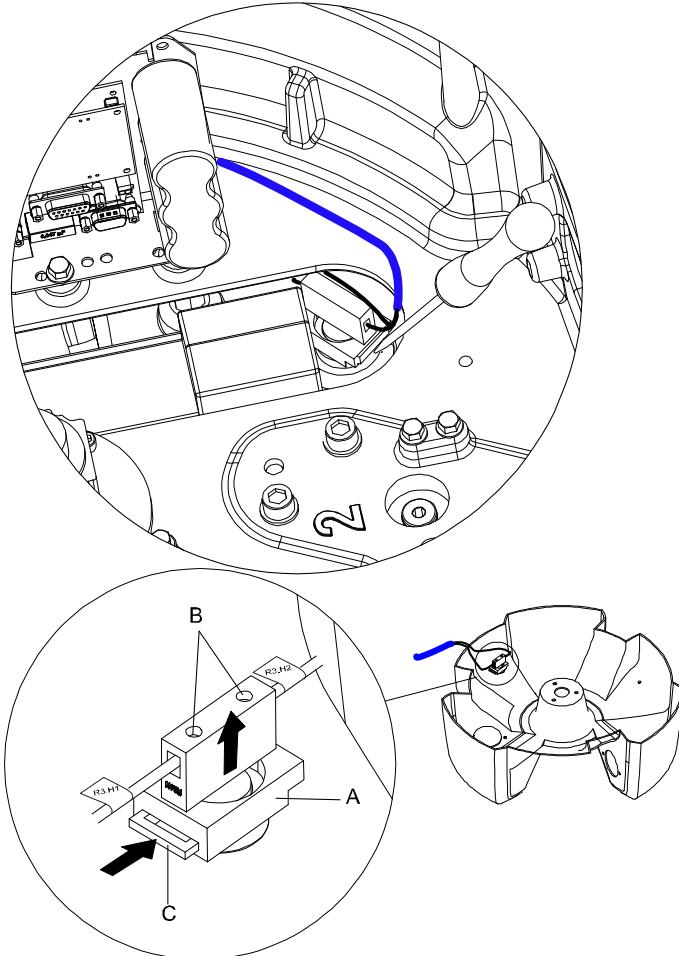
| Equipment | Spare Part no. | Note |
|----------------|---|---|
| Standard tools | Standard toolkit on page 268. | <i>Spare parts, Brake release button.</i> |

Continues on next page

4.5.2 Replacement of brake release button

Continued

Removal



xx0700000644

| | |
|---|-----------------------|
| A | Brake release contact |
| B | Cable locking screw |
| C | Locking device |

| | Action | Note |
|---|--|---|
| 1 | Remove the base cover. | <p><i>Replacement of base cover gasket on page 172.</i></p> <p>CAUTION</p> <p>The base cover has sharp edges, use protective gloves.</p> |
| 2 | Remove the <i>contact</i> from the push button, pushing in the <i>locking device</i> . | <p>Tip</p> <p>Use a screw driver to push in the locking device.</p> |
| 3 | Loosen the plastic nut and remove the push button from the transmission cover. | Use standard tools. |

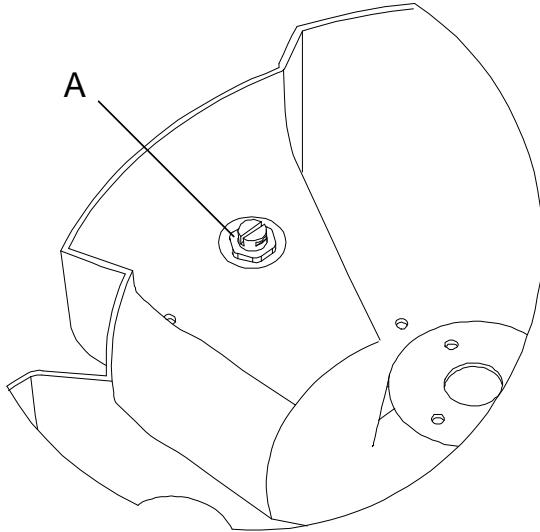
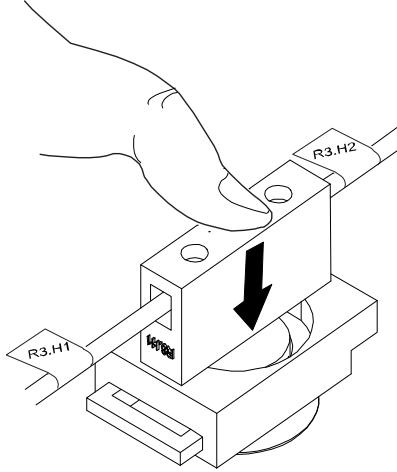
Continues on next page

4 Repair

4.5.2 Replacement of brake release button

Continued

Refitting

| Action | Note |
|--|--|
| 1 Refit the push button to the transmission cover using the <i>plastic nut</i> .  Note Mount the button cover or the robot will not fulfill the IP67 and IP69K classification. |  xx0700000651 |
| 2 Press to refit the contact. |  xx0800000011  Tip Refit the cables to the contact before this step. |
| 3 Refit the base cover. | Replacement of base cover gasket on page 172  CAUTION The base cover has sharp edges, use protective gloves. |

5 Calibration information

5.1 When to calibrate

When to calibrate

The system must be calibrated if any of the following situations occur.

The resolver values are changed

If resolver values are changed, the robot must be recalibrated using the calibration methods supplied by ABB. Calibrate the robot carefully with standard calibration, according to information in this manual.

The resolver values will change when parts affecting the calibration position are replaced on the robot, for example motors or parts of the transmission.

The revolution counter memory is lost

If the revolution counter memory is lost, the counters must be updated. See [Updating revolution counters on page 248](#). This will occur when:

- The battery is discharged
- A resolver error occurs
- The signal between a resolver and measurement board is interrupted
- A robot axis is moved with the control system disconnected

The revolution counters must also be updated after the robot and controller are connected at the first installation.

The robot is rebuilt

If the robot is rebuilt, for example, after a crash or when the reach ability of a robot is changed, it needs to be recalibrated for new resolver values.

The resolver values must be updated if the robot is stopped with the emergency stop or by breaking a safety chain, and after running into a mechanical stop.

5 Calibration information

5.2 Calibration method

5.2 Calibration method

Overview

This section specifies the different types of calibration and the calibration methods that are supplied by ABB.

Types of calibration

| Type of calibration | Description | Calibration method |
|----------------------|--|--|
| Standard calibration | <p>Standard calibration is performed if resolver values are changed or the robot is rebuilt (see When to calibrate on page 237).</p> <p>The robot is positioned at calibration position, that is when the positions of the axes 1-3 (angles) are set to parameter values found in <i>Calibration Position</i>, see type <i>Arm</i>, topic <i>Motion</i> in <i>Technical reference manual - System parameters</i>.</p> <p>Standard calibration data is found on the SMB (serial measurement board) in the robot.</p> <p>For robots with RobotWare 5.04 or older, the calibration data is delivered in a file, calib.cfg, supplied with the robot at delivery. The file identifies the correct resolver/motor position corresponding to the robot home position.</p> | Calibration by hand with activated brake release, using the calibration marks. |
| Factory reset | <p>A factory reset (calibration with a calibration ring) can be performed after a gearbox or an upper arm has been replaced to ensure enhanced robot arm accuracy than when performing standard calibration. Factory reset alters the robot's unique production settings for axis 1-3.</p> <p>To perform ring calibration, the parallel arms must first be removed from the robot. The upper arms must then be positioned vertically so that the calibration ring can be fitted to them.</p> <p>Making a factory reset with the calibration ring requires specific calibration equipment and software, and is performed by ABB. Please contact ABB.</p> <p>The parameter <i>Calibration Position</i> (cal_position) is set at the ABB factory, and is a robot specific parameter. For more information about parameter <i>Calibration Position</i>, see topic <i>Motion</i>, type <i>Arm</i> in <i>Technical reference manual - System parameters</i>.</p> | Ring calibration |

Calibration methods

The calibration method for the IRB 360 is different from other robots, and normal calibration methods are not applicable.

Calibration by hand

Standard calibration is detailed in section [Calibrating axis 1-3 on page 242](#).

Continues on next page

Ring calibration

A factory reset using ring calibration requires specific calibration equipment and is performed by ABB. Please contact ABB.

Ring calibration is measuring each contact point for axis 1-3 and modifies cal_position. The Ring calibration method gives a better nominal kinematics and the modified cal_positions will help to get back to the same points when calibrating with Standard calibration.

5 Calibration information

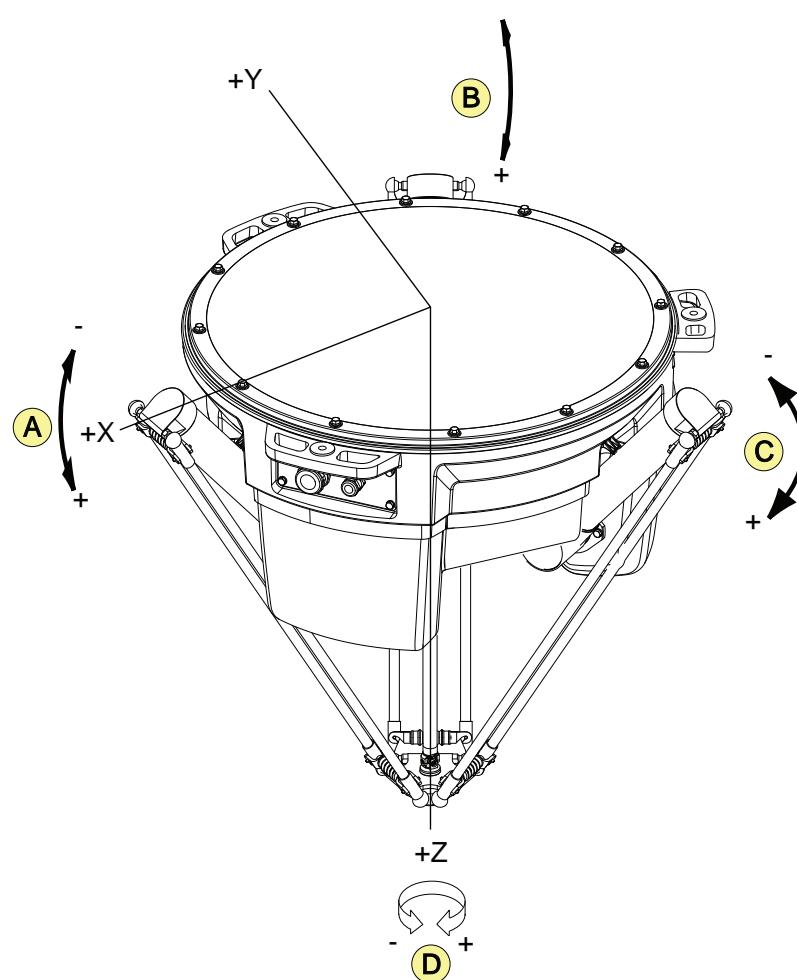
5.3 Calibration movement directions for all axes

Overview

When calibrating, the axis must consistently be run towards the calibration position in the same direction in order to avoid position errors caused by backlash in gears and so on. Positive directions are shown in the graphic below.

Calibration movement and jogging directions

The following graphic shows the positive and negative directions for each axis and the linear directions when jogging the robot in the base coordinate system.



xx0700000448

| | |
|---|--------|
| A | Axis 1 |
| B | Axis 2 |
| C | Axis 3 |
| D | Axis 4 |

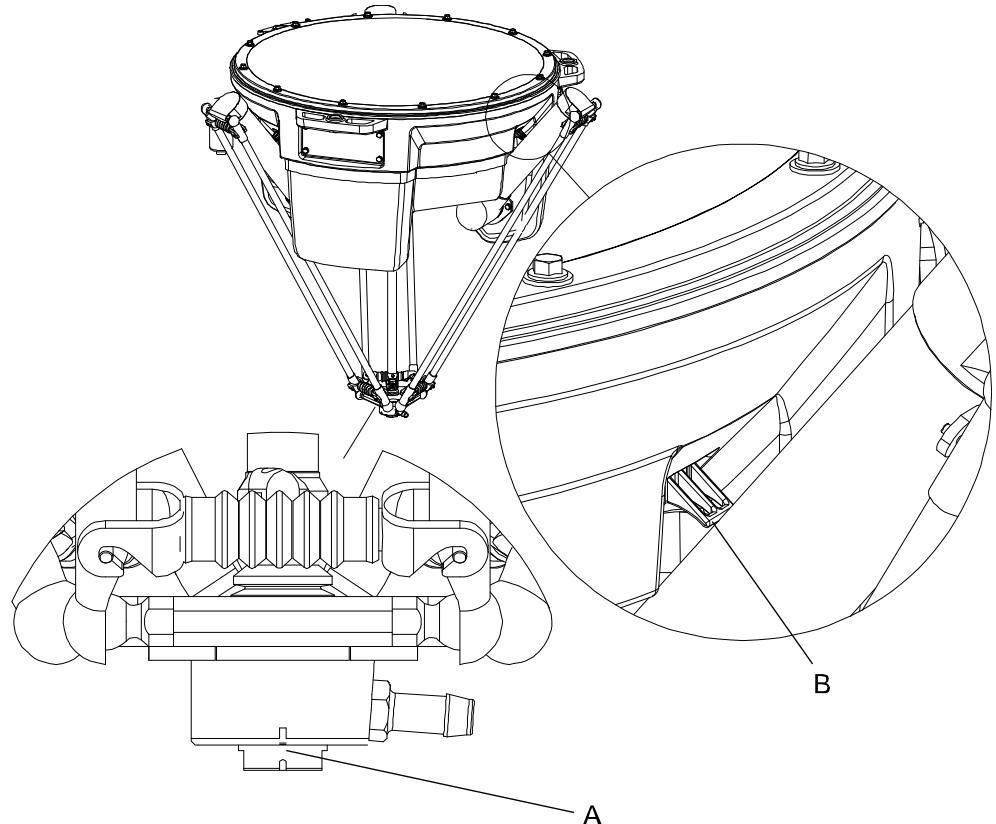
5.4 Synchronization marks and synchronization position for axes

Introduction

This section shows the position of the synchronization marks and the synchronization position for each axis.

Synchronization marks, IRB 360

The figure below shows the calibration marks of the axes 1-4.



xx0700000569

| | |
|---|----------------------------|
| A | Calibration mark axis 4 |
| B | Calibration marks axis 1-3 |

5 Calibration information

5.5 Calibrating axis 1-3

General

This section is valid for IRB 360 all models. It describes how to perform the actual fine calibration of axis 1-3.

If the robot needs to have a factory reset instead, please contact ABB. See [Calibration method on page 238](#).

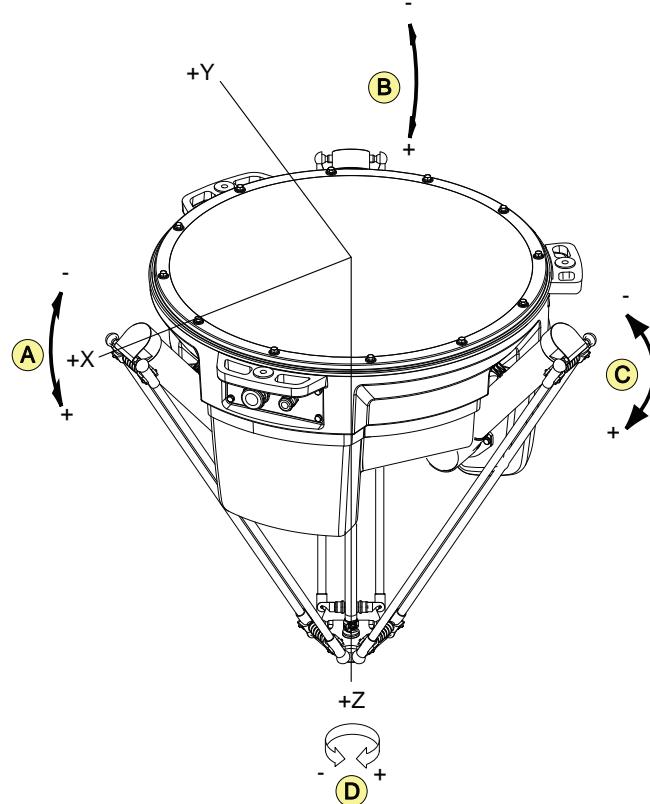
The calibration positions are shown in [Checking the synchronization position on page 254](#)



Note

Calibration should be performed by specially trained personnel.

Axis moving directions

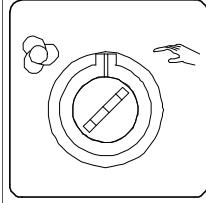
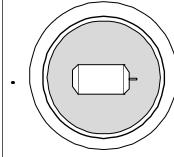
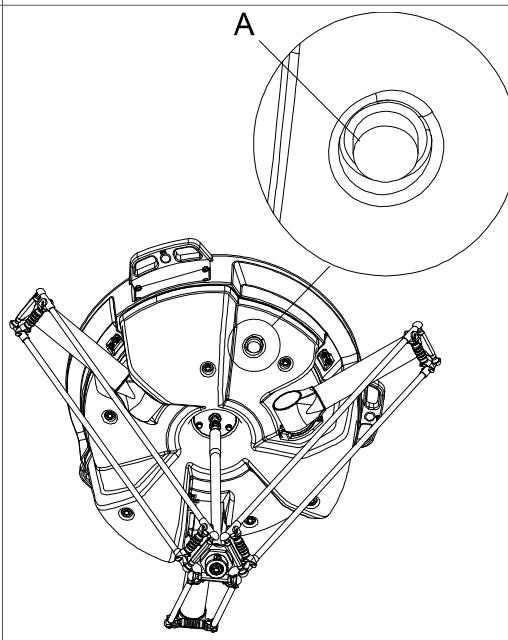


xx0700000448

| | |
|---|--------|
| A | Axis 1 |
| B | Axis 2 |
| C | Axis 3 |
| D | Axis 4 |

Continues on next page

Calibrating axes 1-3

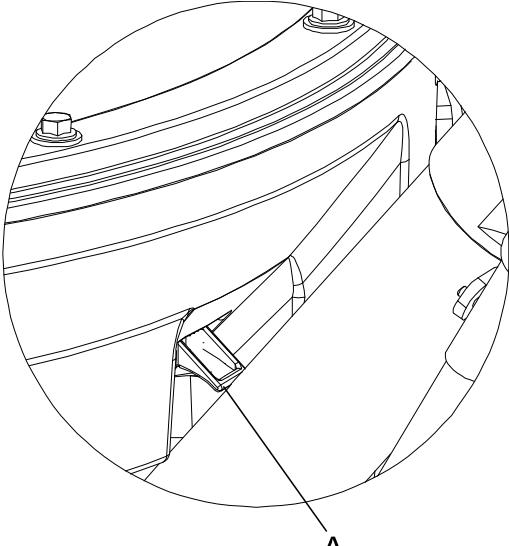
| | Action | Note |
|---|---|---|
| 1 | On the FlexPendant, press the stop button. | |
| 2 | On the controller, set the key switch into manual position. |  xx0700000625 |
| 3 | Check the motors off button, make sure that the button flashes. |  en0400000795 |
| 4 | Press the brake release button to release the brakes. |  xx0700000435 A Brake release button |

Continues on next page

5 Calibration information

5.5 Calibrating axis 1-3

Continued

| Action | Note |
|--|--|
| 5 Push the upper arm very gently against the calibration device. |  Note Always calibrate one axis a time, starting with axis 1.  xx0700000626 A Calibration device |
| 6 When the upper arm reaches the calibration device, apply the brake. | The upper arm is now in calibration position. |
| 7 Store the resolver value by doing a fine calibration. | Described in section Fine calibration procedure on FlexPendant on page 247 |
| 8 Release the brakes and gently pull the calibrated upper arm in to a horizontal position. | |
| 9 Return to step 4, and proceed with axis 2 and 3. | |

5.6 Calibrating axis 4

General

This section is valid for IRB 360 all models. It describes how to perform the actual fine calibration of axis 4.

The calibration positions are shown in [Checking the synchronization position on page 254](#)

The axes moving directions are shown in [Calibrating axis 1-3 on page 242](#).

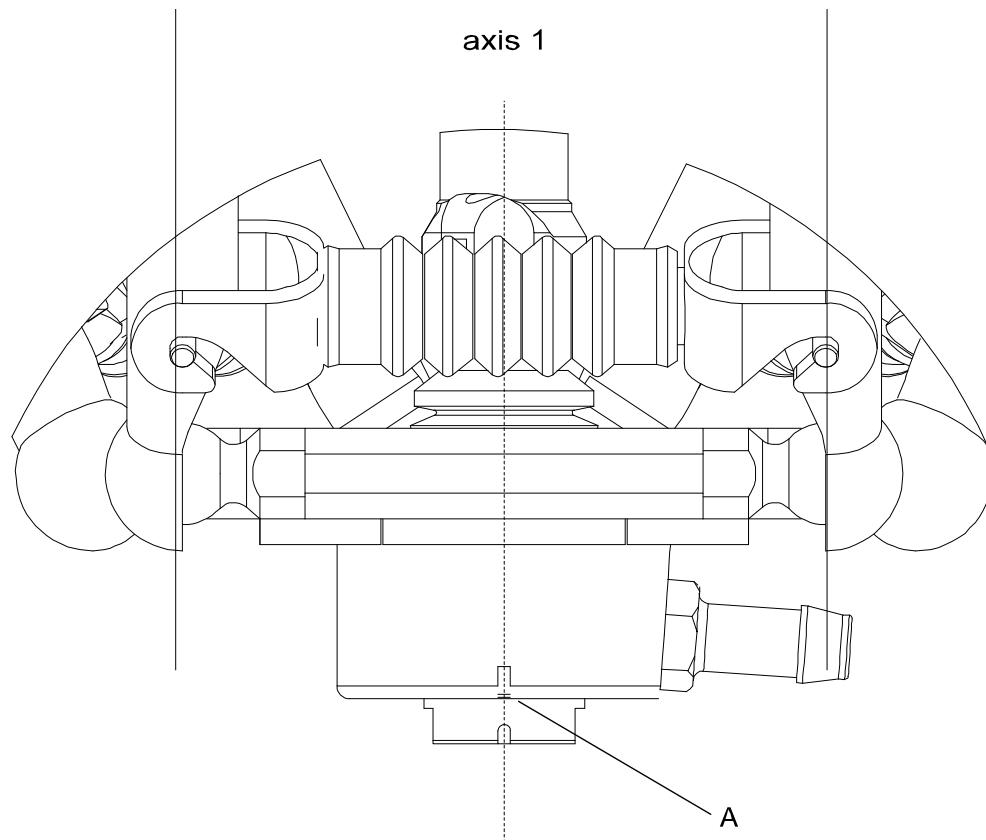


Note

Calibration should be performed by specially trained personnel.

Location

IRB 360 - 1/1130, IRB 360 - 3/1130, IRB 360 - 1/800, IRB 360 - 1/1600



xx0700000629

| | |
|---|-------------------------|
| A | Axis 4 calibration mark |
|---|-------------------------|

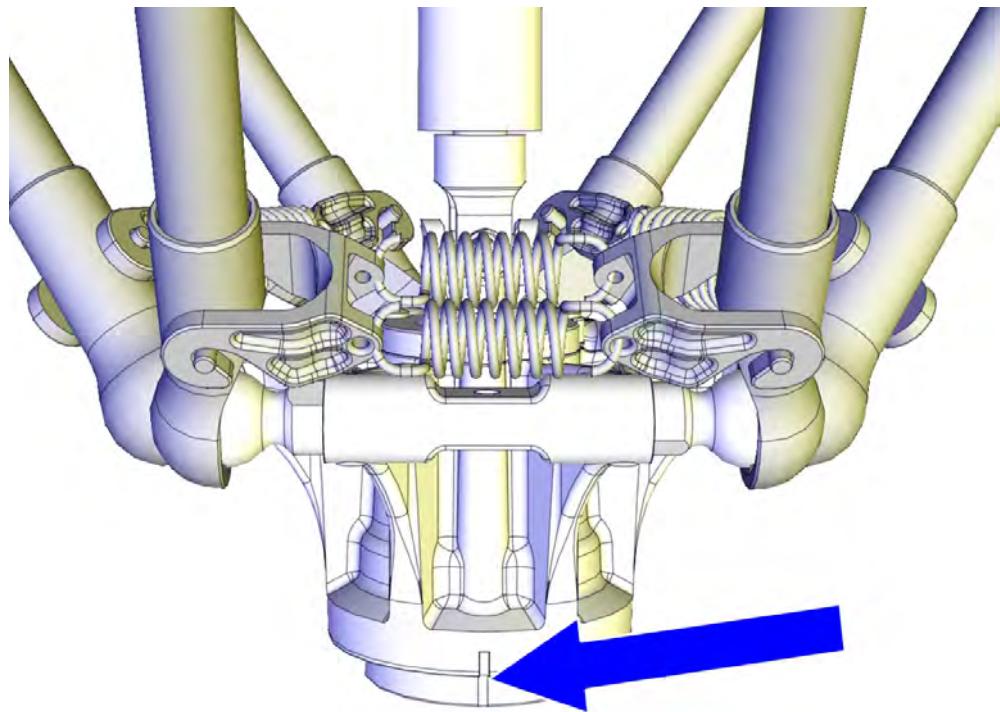
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5 Calibration information

5.6 Calibrating axis 4

Continued

IRB 360 - 8/1130, IRB 360 - 6/1600



Calibrating axis 4

| Action | Note |
|---|--|
| 1 In manual mode, tap Jogging in the ABB menu. | |
| 2 Tap Motion mode to choose group of axes to jog. | |
| 3 Tap Axis 4-6 to jog axis 4. | |
| 4 Jog axis 4 so that the calibration marks See figure in Location on page 245 . | |
| 5 Store the resolver value by doing a fine calibration. | Described in section Fine calibration procedure on FlexPendant on page 247 . |
| 6 Check the position. | Described in section Checking the synchronization position on page 254 |

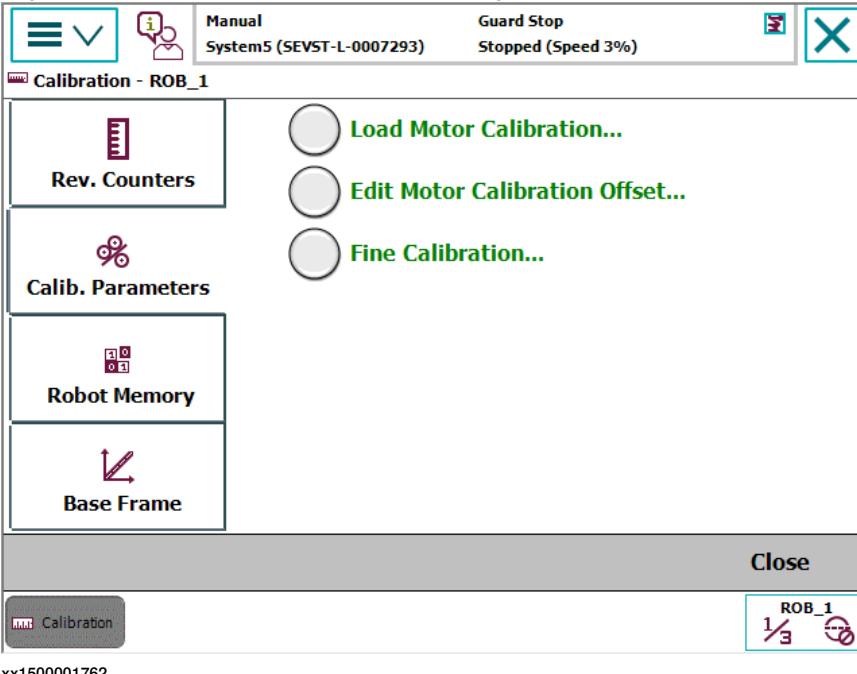
5.7 Fine calibration procedure on FlexPendant

Overview

This section describes how to use the FlexPendant when performing a fine calibration of the robot.

Fine calibration procedure

Use this procedure to fine calibrate using the FlexPendant.

| Action |
|--|
| 1 On the ABB menu, tap Calibration. All mechanical units connected to the system are shown along with their calibration status. |
| 2 Tap to select the mechanical unit and then tap Calib. Parameters.  |
| 3 Tap Fine Calibration.... A dialog box is displayed, warning that updating the revolution counters may change programmed robot positions: <ul style="list-style-type: none">• Tap Yes to proceed.• Tap No to cancel. |
| 4 Select the check-box for the axis to calibrate. |
| 5 Tap Calibrate. A dialog box is displayed, warning that calibration of the selected axes will be changed, which cannot be undone: <ul style="list-style-type: none">• Tap Calibrate to proceed.• Tap Cancel to cancel. Tapping Calibrate results in briefly displaying a dialog box, announcing that the calibration process has started. The axis is calibrated and the system returns to the list of available mechanical units. |

5 Calibration information

5.8 Updating revolution counters

5.8 Updating revolution counters

Introduction

This section describes how to do a rough calibration of each manipulator axis by updating the revolution counter for each axis, using the FlexPendant.

Step 1 - Manually moving the manipulator to the synchronization position

Use this procedure to manually move the manipulator to the calibration position.



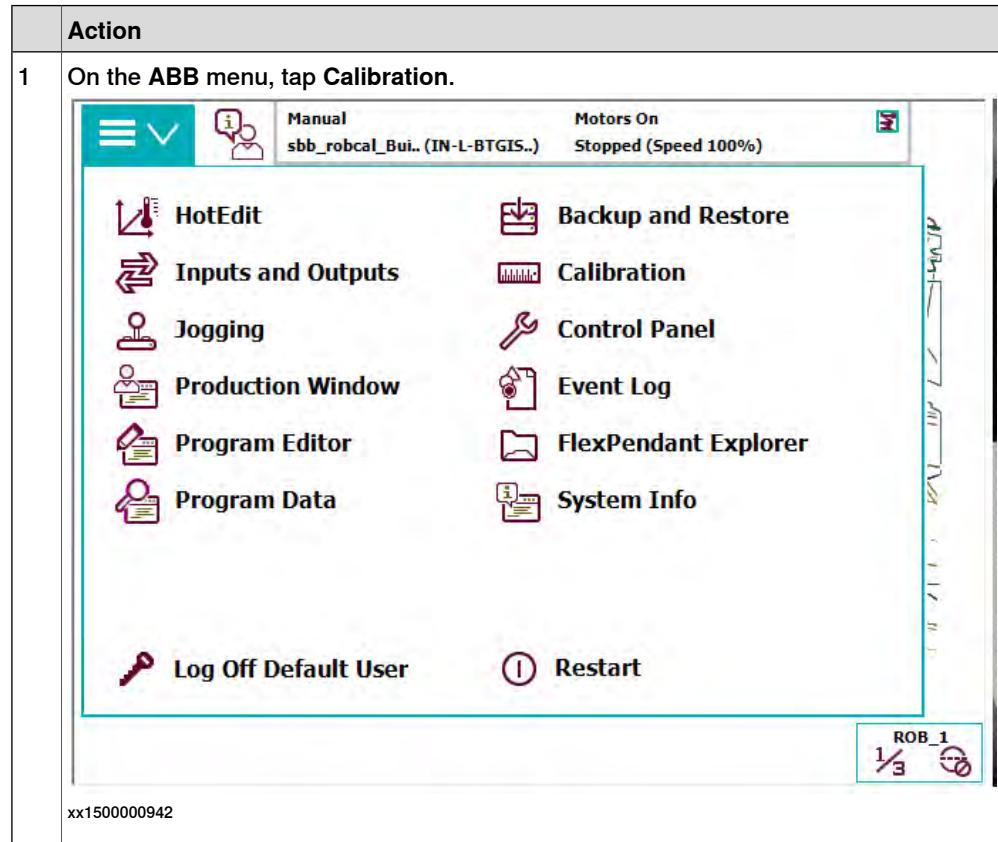
Note

Calibration should be performed by specially trained personnel.

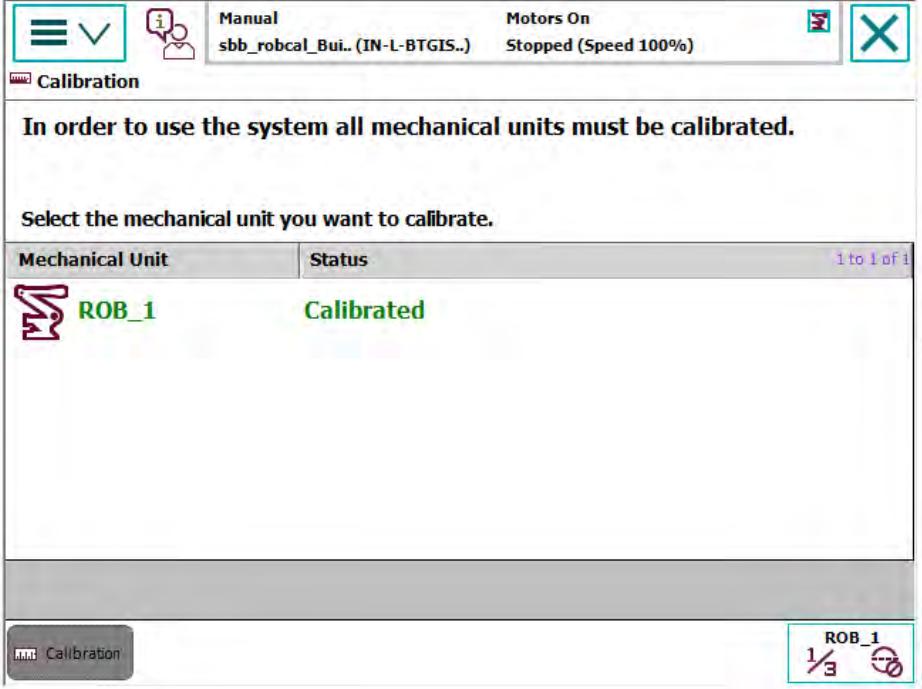
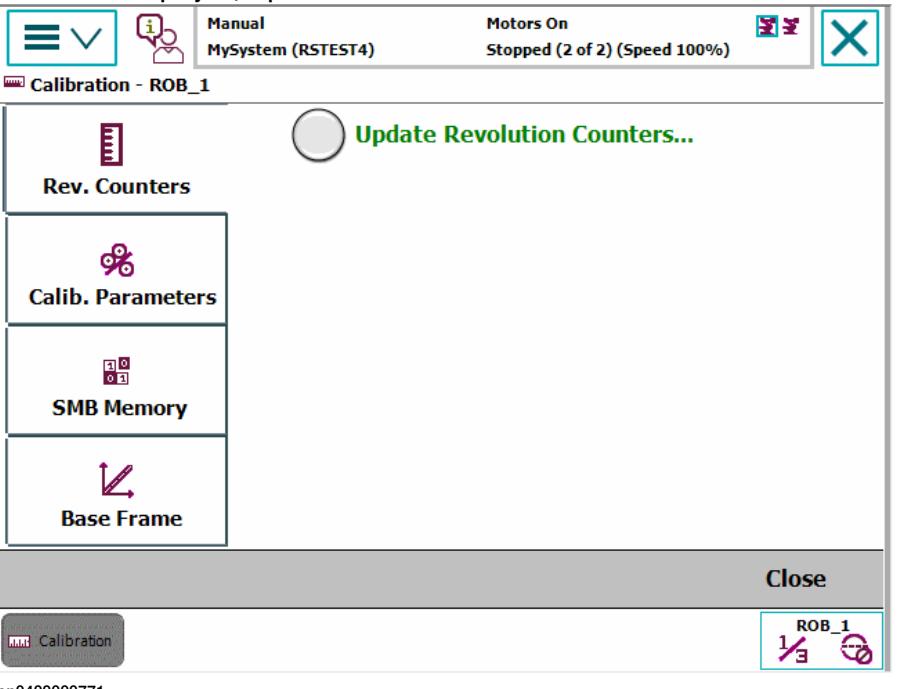
| | Action | Note |
|---|---|--|
| 1 | Manually move the manipulator to the calibration position for axes 1-3 | See Calibrating axis 1-3 on page 242 , steps 1 to 6. |
| 2 | Manually move the manipulator to the calibration position for axis 4 | See Calibrating axis 4 on page 245 , steps 1 to 4. |
| 3 | Continue with step 2, Step 2 - Updating the revolution counter with the FlexPendant on page 248 . | |

Step 2 - Updating the revolution counter with the FlexPendant

Use this procedure to update the revolution counter with the FlexPendant (IRC5).



Continues on next page

| | Action |
|---|---|
| 2 | <p>All mechanical units connected to the system are shown with their calibration status. Tap the mechanical unit in question.</p>  |
| 3 | <p>A screen is displayed, tap Rev. Counters.</p>  |

Continues on next page

5 Calibration information

5.8 Updating revolution counters

Continued

| | Action |
|---|---|
| 4 | <p>Tap Update Revolution Counters....</p> <p>A dialog box is displayed, warning that updating the revolution counters may change programmed robot positions:</p> <ul style="list-style-type: none">• Tap Yes to update the revolution counters.• Tap No to cancel updating the revolution counters. <p>Tapping Yes displays the axis selection window.</p> |
| 5 | <p>Select the axis to have its revolution counter updated by:</p> <ul style="list-style-type: none">• Ticking in the box to the left• Tapping Select all to update all axes. <p>Then tap Update.</p> |
| 6 | <p>A dialog box is displayed, warning that the updating operation cannot be undone:</p> <ul style="list-style-type: none">• Tap Update to proceed with updating the revolution counters.• Tap Cancel to cancel updating the revolution counters. <p>Tapping Update updates the selected revolution counters and removes the tick from the list of axes.</p> |
| 7 | <p> CAUTION</p> <p>If a revolution counter is incorrectly updated, it will cause incorrect manipulator positioning, which in turn may cause damage or injury!</p> <p>Check the synchronization position very carefully after each update. See Checking the synchronization position on page 254.</p> |

5.9 Serial measurement board memory

Serial measurement board (SMB)

The serial measurement board (SMB) primarily gathers resolver data from the robot's (or additional axes) motors. This data is used to measure the speed and position of each axis. Each SMB is capable of measuring up to 7 axes. It also stores a number of data pertaining to each robot.

This data is used by the controller and can be transferred between the SMB and the controller. Normally, the data is transferred automatically, but it can also be done manually.

The SMB data is affected when:

- The robot is replaced
- The SMB is replaced
- The controller (or its flash disk or mass memory unit) is replaced.
- Updating with new calibration data

The following data is stored on the SMB:

- Serial number for the mechanical unit
- Joint calibration data
- SIS data (Service Information System)

Note that if the IRC5 controller is to be connected to a robot with an older SMB, not equipped with data storage capability, the SMB must be replaced.

SMB data update

| If... | then... |
|---|---|
| the flash disk or mass memory or the complete controller is new or replaced by an unused spare part... | the data stored in the SMB is automatically copied to the controller memory. |
| the SMB is replaced by a new, unused, spare part SMB ... | the data stored in the controller memory is automatically copied to the robot SMB memory. |
| the flash disk or the complete controller is replaced by a spare part, previously used in another system... | the data in the controller memory and the robot SMB memory is different. You must update the controller memory manually from the the robot SMB memory. |
| the SMB is replaced by a spare part SMB , previously used in another system... | the data in the controller memory and the robot SMB memory is different. You must first clear the data in the new robot SMB memory , and then update the robot SMB memory with the data from the controller memory. |
| new calibration data has been loaded via RobotStudio or using the FlexPendant and the system has been restarted... | the data in the controller memory and the robot SMB memory is different. You must update the robot SMB memory manually from the controller memory. Check that the new calibration values belong to a manipulator with the serial number defined in your system. |

Continues on next page

5 Calibration information

5.9 Serial measurement board memory

Continued

View SMB data status

This section describes how to view the data status in the serial measurement board and the controller.

| Action | |
|--------|--|
| 1 | On the ABB menu, tap Calibration and select a mechanical unit. |
| 2 | Tap Robot Memory and then tap Show status . The data is displayed with status on the controller memory and on the robot SMB memory. |

Update controller data from robot SMB memory

This section describes how to load data from the serial measurement board to the controller.

| | Action | Information |
|---|--|--|
| 1 | On the ABB menu, tap Calibration and select a mechanical unit. | |
| 2 | Tap Robot Memory and then tap Update . | |
| 3 | Tap the button Cabinet or manipulator has been exchanged . A warning is displayed. Tap Yes to proceed or No to cancel. | It is vital that you load calibration data correctly. |
| 4 | The data is loaded. Tap Yes to acknowledge and restart the robot system. | The following data is updated: <ul style="list-style-type: none">• Serial numbers for mechanical units• Calibration data• SIS data |

Update data in robot SMB memory

This section describes how to update data on the serial measurement board from the controller. This is e.g. after calibration data has been loaded to the controller via RobotStudio or using the FlexPendant.

If the SMB already contains data, you must first clear the memory, see [Delete SMB data on page 253](#).

| | Action | Information |
|---|---|---|
| 1 | On the ABB menu, tap Calibration and select a mechanical unit. | |
| 2 | Tap Robot Memory and then tap Update . | |
| 3 | Tap the button Serial measurement board has been replaced . A warning is displayed. Tap Yes to proceed or No to cancel. | It is vital that you load calibration data correctly. |
| 4 | The data is updated. | |

Continues on next page

Delete SMB data

This section describes how to delete the data stored on the robot SMB memory or the controller memory when creating spare parts.

| | Action |
|---|---|
| 1 | On the ABB menu, tap Calibration and tap to select a mechanical unit. |
| 2 | Tap Robot Memory and then tap Advanced . The following functions are available: <ul style="list-style-type: none">• Clear controller memory• Clear robot memory |
| 3 | Tap Clear Controller Memory if the controller should be replaced and used as a spare part. A list of the SMB data stored in the controller is displayed. Tap Clear to delete the controller memory for the selected robot. Repeat the procedure for all robots in the controller memory. |
| 4 | Tap Clear Robot Memory if the SMB should be replaced and used as a spare part. A list of the SMB data stored in the robot SMB memory is displayed. Tap Clear to delete the memory for the selected robot. Repeat the procedure for all robots using this SMB board. |

Related information

Operating manual - RobotStudio.

Operating manual - Service Information System.

Application manual - Controller software IRC5

5 Calibration information

5.10 Checking the synchronization position

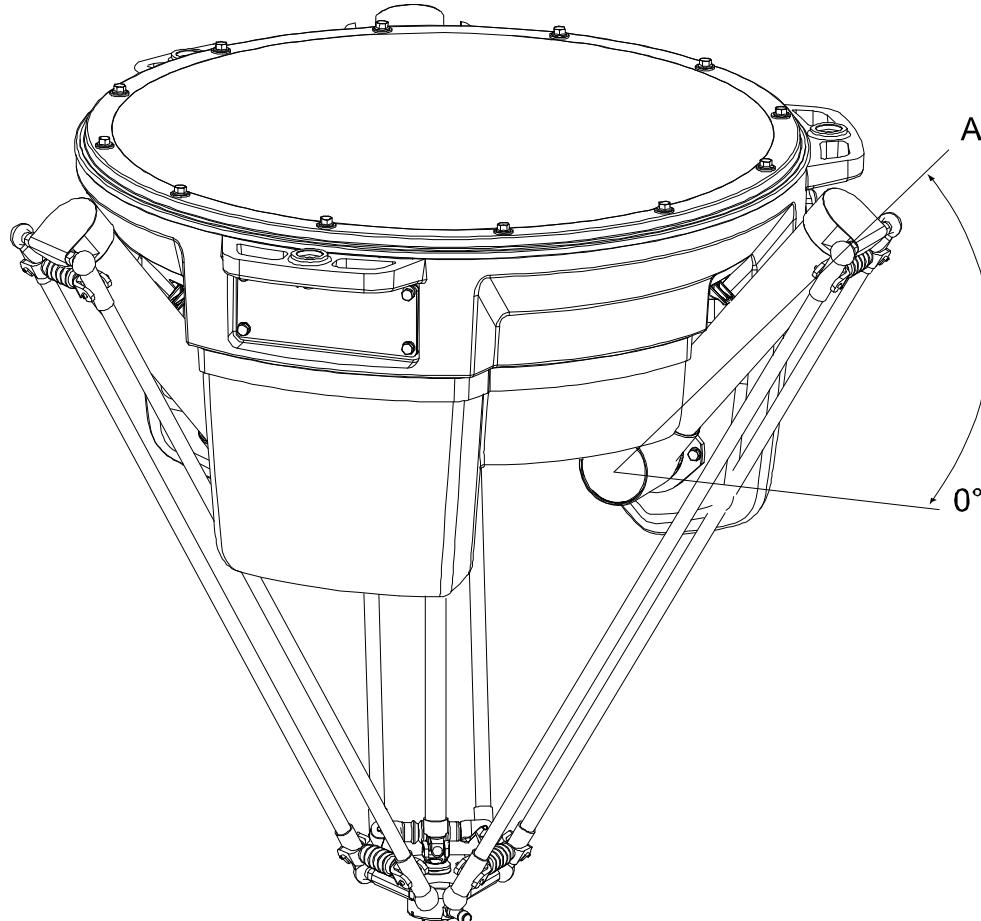
5.10 Checking the synchronization position

Introduction

Check the synchronization position of the robot before beginning any programming of the robot system. This may be done:

- In manual mode using brake release and move all axis by hand.

Using the jogging window on the FlexPendant



xx0700000627

| | |
|---|------------------------------------|
| A | Calibration position for axis 1-3. |
|---|------------------------------------|

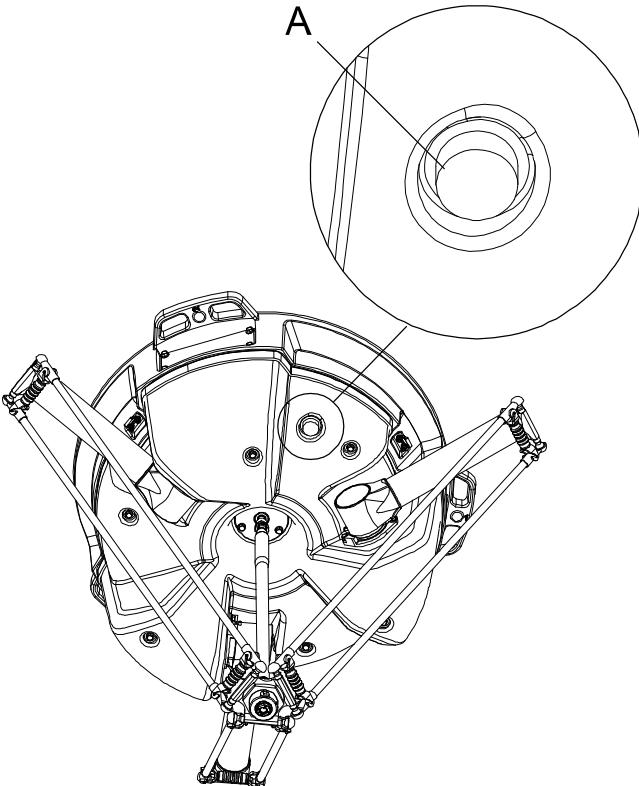


Note

A position where all three axes are in calibration position at the same time (like in figure) is not possible. Check or calibrate one axis a time, then set the calibrated axis horizontal.

| | Action | Note |
|---|--|---|
| 1 | In manual mode, tap Jogging in the ABB menu. | Manual mode described in the section Calibrating axis 1-3 on page 242 . |

Continues on next page

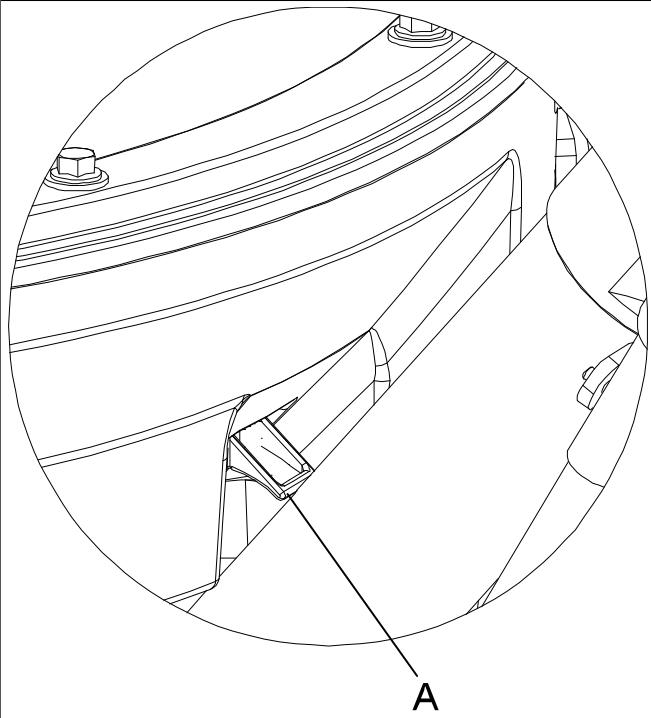
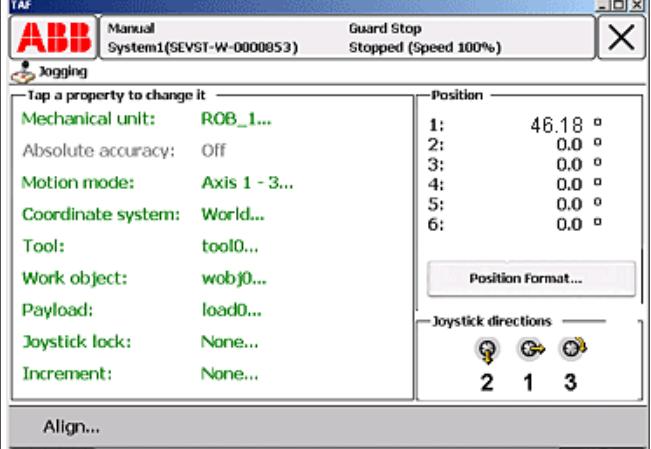
| Action | Note |
|---|---|
| 2 Tap Motion mode to select group of axes to jog. | |
| 3 Tap to select the axis to jog, axis 1, 2, or 3. | |
| 4 Press the brake release button to release the brakes. |  <p>A detailed technical line drawing of a robotic arm's base assembly. It shows a central vertical shaft with various mechanical components attached. A small rectangular button, labeled 'A' with a leader line, is located on the side of the base. An inset circle provides a magnified view of the button area. The entire diagram is labeled with the code 'xx0700000435' at the bottom.</p> <p>A Brake release button</p> |

Continues on next page

5 Calibration information

5.10 Checking the synchronization position

Continued

| Action | Note |
|---|--|
| 5 Push the upper arm very gently against the calibration device. |  Note Always check one axis at a time, starting with axis 1.  xx0700000626 A Calibration device |
| 6 Check the position of axis 1 in jogging window and compare with parameter <i>Calibration Position</i> . |  xx0700000628 The parameter <i>Calibration Position</i> (cal_position) is set at the ABB factory, and is a robot specific parameter. For more information about parameter <i>Calibration Position</i> , see topic <i>Motion</i> , type <i>Arm</i> in <i>Technical reference manual - System parameters</i> . |
| 7 The value in the jogging window should be within the tolerance $\pm 0.1^\circ$. If the axis position is not ok, calibrate the axis again, see Ring calibration on page 239 . | |

Continues on next page

| | Action | Note |
|---|---|------|
| 8 | If the axis position is ok return to step 4 and check axes 2 and 3. | |

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6 Decommissioning

6.1 Introduction

Introduction

This section contains information to consider when taking a product, robot or controller, out of operation.

It deals with how to handle potentially dangerous components and potentially hazardous materials.

General

All used grease/oils and dead batteries **must** be disposed of in accordance with the current legislation of the country in which the robot and the control unit are installed.

If the robot or the control unit is partially or completely disposed of, the various parts **must** be grouped together according to their nature (which is all iron together and all plastic together), and disposed of accordingly. These parts **must** also be disposed of in accordance with the current legislation of the country in which the robot and control unit are installed.

6 Decommissioning

6.2 Environmental information

6.2 Environmental information

Hazardous material

The table specifies some of the materials in the product and their respective use throughout the product.

Dispose components properly to prevent health or environmental hazards.

| Material | Example application |
|-----------------------------|--|
| Batteries, NiCad or Lithium | Serial measurement board |
| Copper | Cables, motors |
| Cast iron/nodular iron | Gear housings, base box (standard, WD) |
| Steel | Gears, screws, joints, brackets, and so on. |
| Stainless steel | Base box (WDS), telescopic shafts (WDS) |
| Neodymium | Brakes, motors |
| Plastic/rubber | Cables, connectors, transmission cover, and so on. |
| Oil, grease | Gearboxes |
| Aluminium | Motor housings, telescopic shafts (standard, WD) |
| Carbon fiber | Upper arms, tube bars |

Oil and grease

Where possible, arrange for oil and grease to be recycled. Dispose of via an authorized person/contractor in accordance with local regulations. Do not dispose of oil and grease near lakes, ponds, ditches, down drains, or onto soil. Incineration must be carried out under controlled conditions in accordance with local regulations.

Also note that:

- Spills can form a film on water surfaces causing damage to organisms.
Oxygen transfer could also be impaired.
- Spillage can penetrate the soil causing ground water contamination.

6.3 Scrapping of robot

Important when scrapping the robot



DANGER

When a robot is disassembled while being scrapped, it is very important to remember the following before disassembling starts, in order to prevent injuries:

- Always remove all batteries from the robot. If a battery is exposed to heat, for example from a blow torch, it will explode.
- Always remove all oil/grease in gearboxes. If exposed to heat, for example from a blow torch, the oil/grease will catch fire.
- When motors are removed from the robot, the robot will collapse if it is not properly supported before the motor is removed.

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7 Reference information

7.1 Introduction

General

This chapter includes general information, complementing the more specific information in the different procedures in the manual.

7 Reference information

7.2 Applicable standards

7.2 Applicable standards



Note

The listed standards are valid at the time of the release of this document. Phased out or replaced standards are removed from the list when needed.

Standards, EN ISO

The product is designed in accordance with the requirements of:

| Standard | Description |
|------------------------------------|--|
| EN ISO 12100 | Safety of machinery - General principles for design - Risk assessment and risk reduction |
| EN ISO 13849-1 | Safety of machinery, safety related parts of control systems - Part 1: General principles for design |
| EN ISO 13850 | Safety of machinery - Emergency stop - Principles for design |
| EN ISO 10218-1 | Robots for industrial environments - Safety requirements -Part 1 Robot |
| EN ISO 9787 | Robots and robotic devices -- Coordinate systems and motion nomenclatures |
| EN ISO 9283 | Manipulating industrial robots, performance criteria, and related test methods |
| EN ISO 14644-1 ⁱ | Classification of air cleanliness |
| EN ISO 13732-1 | Ergonomics of the thermal environment - Part 1 |
| EN IEC 61000-6-4 (option 129-1) | EMC, Generic emission |
| EN IEC 61000-6-2 | EMC, Generic immunity |
| EN IEC 60974-1 ⁱⁱ | Arc welding equipment - Part 1: Welding power sources |
| EN IEC 60974-10 ⁱⁱ | Arc welding equipment - Part 10: EMC requirements |
| EN IEC 60204-1 | Safety of machinery - Electrical equipment of machines - Part 1 General requirements |
| IEC 60529 | Degrees of protection provided by enclosures (IP code) |

ⁱ Only robots with protection Clean Room.

ⁱⁱ Only valid for arc welding robots. Replaces EN IEC 61000-6-4 for arc welding robots.

European standards

| Standard | Description |
|----------|--|
| EN 614-1 | Safety of machinery - Ergonomic design principles - Part 1: Terminology and general principles |
| EN 574 | Safety of machinery - Two-hand control devices - Functional aspects - Principles for design |

Continues on next page

Other standards

| Standard | Description |
|------------------|---|
| ANSI/RIA R15.06 | Safety requirements for industrial robots and robot systems |
| ANSI/UL 1740 | Safety standard for robots and robotic equipment |
| CAN/CSA Z 434-14 | Industrial robots and robot Systems - General safety requirements |

7 Reference information

7.3 Unit conversion

7.3 Unit conversion

Converter table

Use the following table to convert units used in this manual.

| Quantity | Units | | |
|-----------------|--------------|--------------|----------|
| Length | 1 m | 3.28 ft. | 39.37 in |
| Weight | 1 kg | 2.21 lb. | |
| Weight | 1 g | 0.035 ounces | |
| Pressure | 1 bar | 100 kPa | 14.5 psi |
| Force | 1 N | 0.225 lbf | |
| Moment | 1 Nm | 0.738 lbf-ft | |
| Volume | 1 L | 0.264 US gal | |

7.4 Weight specifications

Definition

In installation, repair, and maintenance procedures, weights of the components handled are sometimes specified. All components exceeding 22 kg (50 lbs) are highlighted in this way.

To avoid injury, ABB recommends the use of a lifting accessory when handling components with a weight exceeding 22 kg. A wide range of lifting accessories and devices are available for each manipulator model.

Example

Following is an example of a weight specification in a procedure:

| Action | Note |
|---|------|
|  CAUTION The robot weighs 120 kg. All lifting accessories used must be sized accordingly! | |

7 Reference information

7.5 Standard toolkit

7.5 Standard toolkit

General

All service (repairs, maintenance, and installation) procedures contains lists of tools required to perform the specified activity.

All special tools required are listed directly in the procedures while all the tools that are considered standard are gathered in the standard toolkit and defined in the following table.

This way, the tools required are the sum of the standard toolkit and any tools listed in the instruction.

Contents, standard toolkit

| Qty | Tool |
|------------|------------------------------------|
| 1 | Ring-open-end spanner 7-35mm |
| 1 | Socket head cap 3, 5, 8 mm |
| 1 | Torque wrench 4-33 Nm |
| 1 | Small screwdriver |
| 1 | Plastic mallet |
| 1 | Ratchet head for torque wrench 1/2 |
| 1 | Cut-off pliers |
| 1 | 90° angled bit holder |
| | Spirit level |

7.6 Special tools

General

All service instructions contain lists of tools required to perform the specified activity. The required tools are a sum of standard tools, defined in the section [Standard toolkit on page 268](#), and of special tools, listed directly in the instructions and also gathered in this section.

Special tools

The following table specifies the special tools required during service procedures. The tools are also specified directly in concerned procedures for repair.

| Description | Art.no. | Robot variant |
|--|------------|--|
| Press tool for bearing (Drifter for mounting bearing rings.) | 3HAC4184-1 | IRB 360 - 1/1130, IRB 360 - 3/1130, IRB 360 - 1/800, IRB 360 - 1/1600 |
| Press tool (Dolly for joint socket when inserting new bearing rings.) | 3HAC4182-1 | IRB 360 - 1/1130, IRB 360 - 3/1130, IRB 360 - 1/800, IRB 360 - 1/1600 |
| Pliers for parallel arms | 3HAC6194-1 | All variants. |

7 Reference information

7.7 Lifting accessories and lifting instructions

General

Many repair and maintenance activities require different pieces of lifting accessories, which are specified in each procedure.

The use of each piece of lifting accessories is *not* detailed in the activity procedure, but in the instruction delivered with each piece of lifting accessories.

This implies that the instructions delivered with the lifting accessories should be stored for later reference.

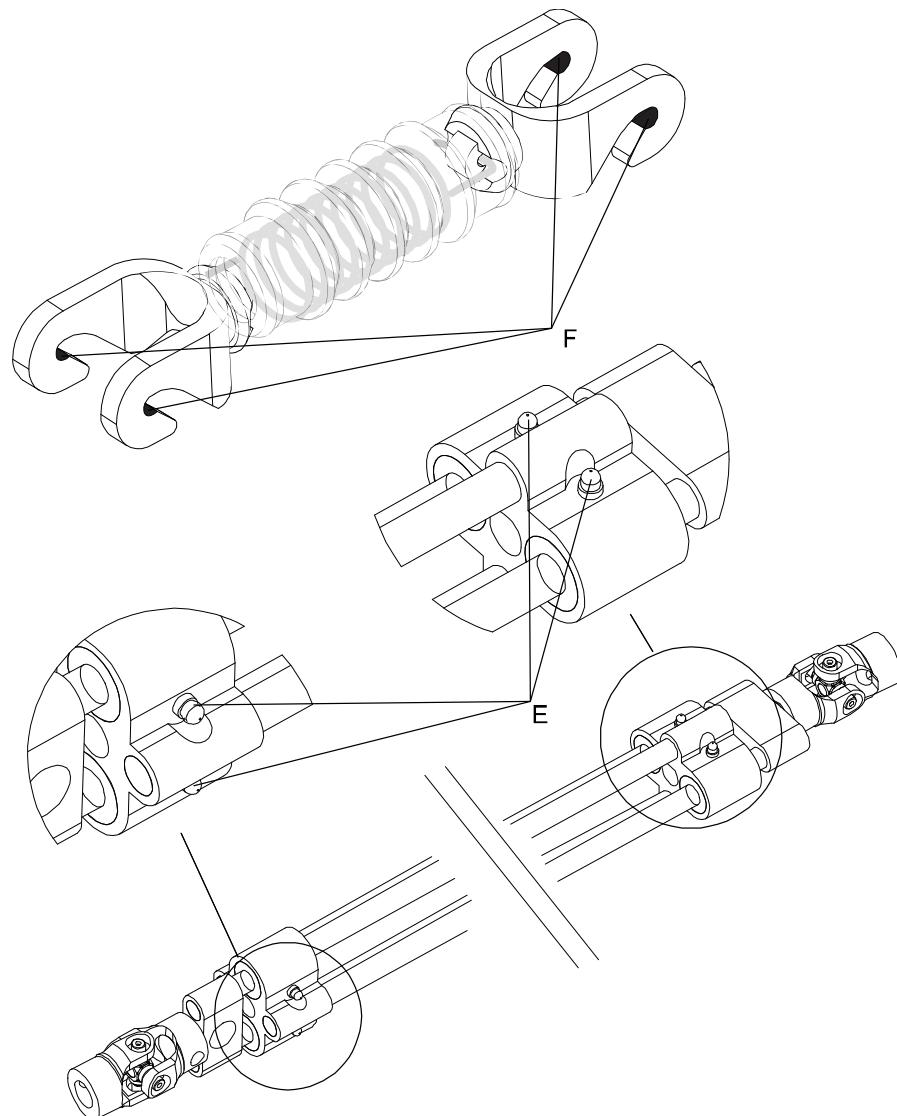
7.8 Grease specification

Oil in gearboxes

The types and volumes of oil in the gearboxes are defined in the *Technical reference manual - Lubrication in gearboxes - 3HAC042927-001*.

This is detailed in section [Type of lubrication in gearboxes on page 140](#).

Grease in robot



xx0700000725

| Pos. | For: | Type | Spare part no. | Amount |
|------|----------------------|----------------------|----------------|--------|
| E | Telescopic shaft WDS | Food accepted FM 222 | 3HAC029132-001 | |
| F | Spring units | Food accepted FM 222 | 3HAC029132-001 | |

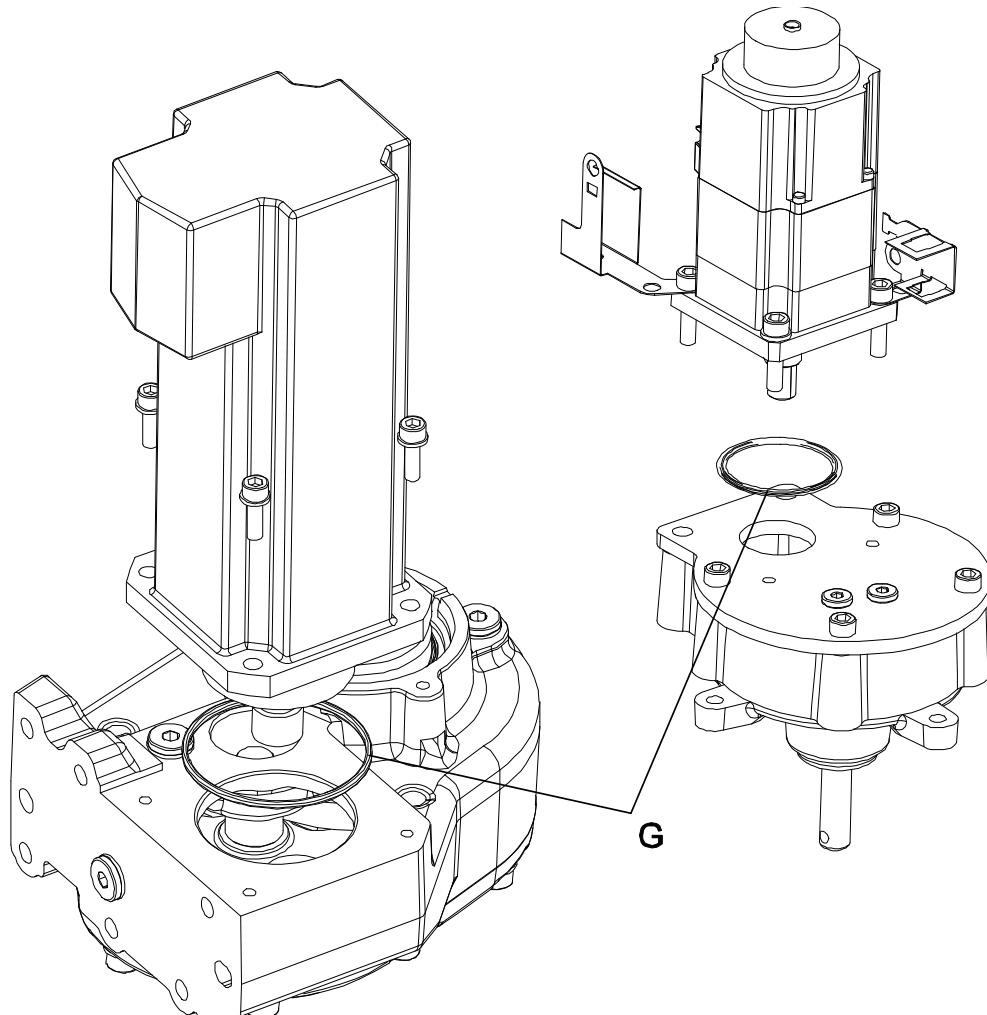
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7 Reference information

7.8 Grease specification

Continued

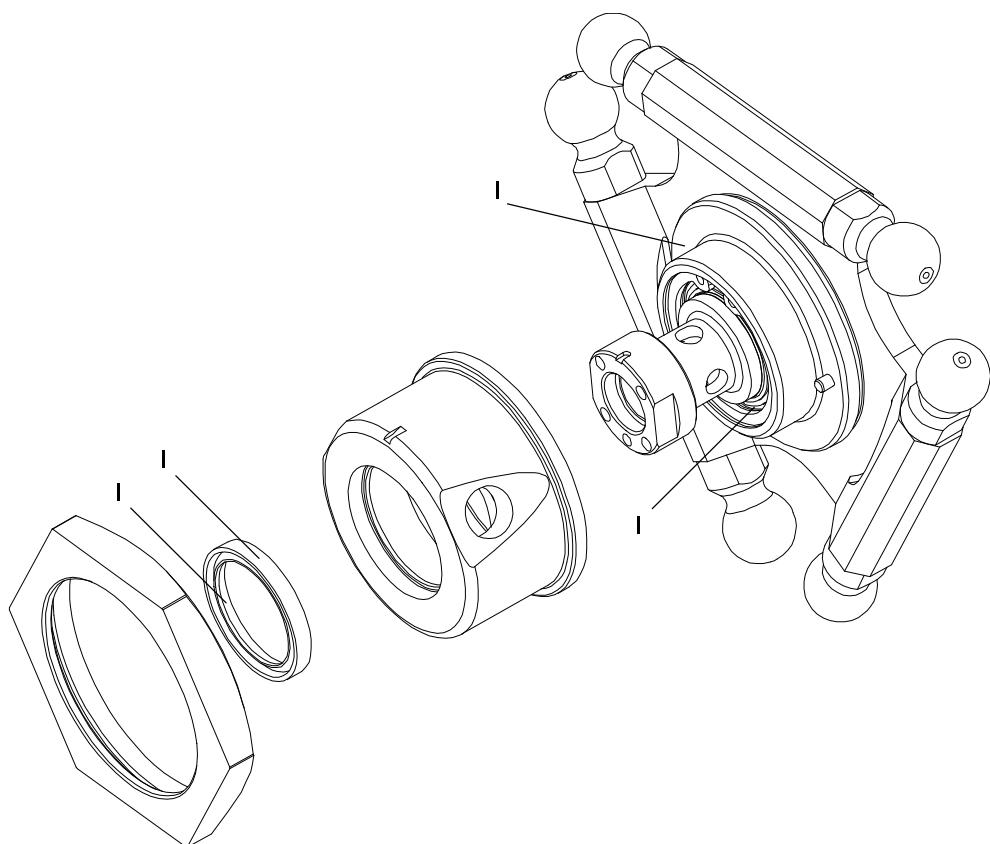
Grease on sealings



xx0700000706

| Pos. | For: | Type | Spare part no. | Amount |
|------|-----------------------|----------------------|----------------|--------|
| G | O-rings in gear units | Food accepted FM 222 | 3HAC029132-001 | |

Continues on next page



xx0800000003

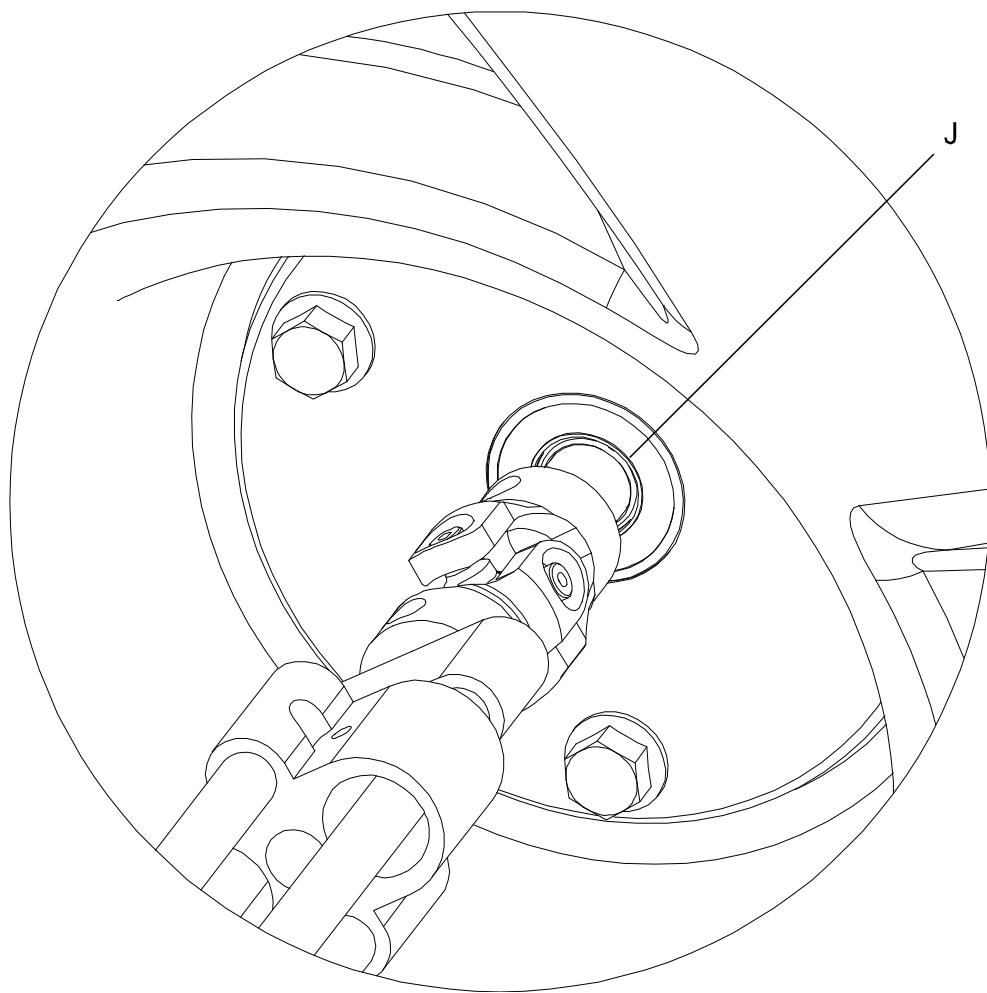
| Pos. | For: | Type | Spare part no. | Amount |
|------|------------------|----------------------|----------------|--------|
| I | Grease in swivel | Food accepted FM 222 | 3HAC029132-001 | |

Continues on next page

7 Reference information

7.8 Grease specification

Continued



| Pos. | For: | Type | Spare part no. | Amount |
|------|----------------|----------------------|----------------|--------|
| J | Grease in ax 4 | Food accepted FM 222 | 3HAC029132-001 | |

Grease on bearing rings



Note

Only lubricate bearing rings 3HAC2091-1. Bearing rings 3HAC028087-001 must not be lubricated!

Read about the difference in *Different versions of bearing rings require different maintenance procedures on page 122*.

| Required equipment | Article number | Note |
|--------------------|----------------|--|
| Grease | - | Required for non-maintenance free bearing rings. <ul style="list-style-type: none">• Mobilgrease FM 102• Optimol Obeen UF 2 See <i>Different versions of bearing rings require different maintenance procedures on page 122</i> . |

8 Spare part lists

8.1 Spare part lists and illustrations

Location

Spare parts and exploded views are not included in the manual but delivered as a separate document on the documentation DVD.

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9 Circuit diagrams

9.1 Circuit diagrams

Overview

The circuit diagrams are not included in this manual, but delivered as separate documents on the documentation DVD. See the article numbers in the tables below.

Controllers

| Product | Article numbers for circuit diagrams |
|--|--------------------------------------|
| <i>Circuit diagram - IRC5</i> | <i>3HAC024480-011</i> |
| <i>Circuit diagram - IRC5 Compact</i> | <i>3HAC049406-003</i> |
| <i>Circuit diagram - IRC5 Panel Mounted Controller</i> | <i>3HAC026871-020</i> |
| <i>Circuit diagram - Euromap</i> | <i>3HAC024120-004</i> |
| <i>Circuit diagram - Spot welding cabinet</i> | <i>3HAC057185-001</i> |

Robots

| Product | Article numbers for circuit diagrams |
|--|---------------------------------------|
| <i>Circuit diagram - IRB 120</i> | <i>3HAC031408-003</i> |
| <i>Circuit diagram - IRB 140 type C</i> | <i>3HAC6816-3</i> |
| <i>Circuit diagram - IRB 260</i> | <i>3HAC025611-001</i> |
| <i>Circuit diagram - IRB 360</i> | <i>3HAC028647-009</i> |
| <i>Circuit diagram - IRB 460</i> | <i>3HAC036446-005</i> |
| <i>Circuit diagram - IRB 660</i> | <i>3HAC025691-001</i> |
| <i>Circuit diagram - IRB 760</i> | <i>3HAC025691-001</i> |
| <i>Circuit diagram - IRB 1200</i> | <i>3HAC046307-003</i> |
| <i>Circuit diagram - IRB 1410</i> | <i>3HAC2800-3</i> |
| <i>Circuit diagram - IRB 1600/1660</i> | <i>3HAC021351-003</i> |
| <i>Circuit diagram - IRB 1520</i> | <i>3HAC039498-007</i> |
| <i>Circuit diagram - IRB 2400</i> | <i>3HAC6670-3</i> |
| <i>Circuit diagram - IRB 2600</i> | <i>3HAC029570-007</i> |
| <i>Circuit diagram - IRB 4400/4450S</i> | <i>3HAC9821-1</i> |
| <i>Circuit diagram - IRB 4600</i> | <i>3HAC029038-003</i> |
| <i>Circuit diagram - IRB 6400RF</i> | <i>3HAC8935-1</i> |
| <i>Circuit diagram - IRB 6600 type A</i> | <i>3HAC13347-1 3HAC025744-001</i> |
| <i>Circuit diagram - IRB 6600 type B</i> | <i>3HAC13347-1 3HAC025744-001</i> |
| <i>Circuit diagram - IRB 6620</i> | <i>3HAC025090-001</i> |

Continues on next page

9 Circuit diagrams

9.1 Circuit diagrams

Continued

| Product | Article numbers for circuit diagrams |
|--|--|
| <i>Circuit diagram - IRB 6620 / IRB 6620LX</i> | <i>3HAC025090-001</i> |
| <i>Circuit diagram - IRB 6640</i> | <i>3HAC025744-001</i> |
| <i>Circuit diagram - IRB 6650S</i> | <i>3HAC13347-1</i> <i>3HAC025744-001</i> |
| <i>Circuit diagram - IRB 6660</i> | <i>3HAC025744-001</i> <i>3HAC029940-001</i> |
| <i>Circuit diagram - IRB 6700</i> | <i>3HAC043446-005</i> |
| <i>Circuit diagram - IRB 7600</i> | <i>3HAC13347-1</i> <i>3HAC025744-001</i> |
| <i>Circuit diagram - IRB 14000</i> | <i>3HAC050778-003</i> |
| <i>Circuit diagram - IRB 910SC</i> | <i>3HAC056159-002</i> |

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Contact us

ABB AB, Robotics
Robotics and Motion
S-721 68 VÄSTERÅS, Sweden
Telephone +46 (0) 21 344 400

ABB AS, Robotics
Robotics and Motion
Nordlysvegen 7, N-4340 BRYNE, Norway
Box 265, N-4349 BRYNE, Norway
Telephone: +47 22 87 2000

ABB Engineering (Shanghai) Ltd.
Robotics and Motion
No. 4528 Kangxin Highway
PuDong District
SHANGHAI 201319, China
Telephone: +86 21 6105 6666

ABB Inc.
Robotics and Motion
1250 Brown Road
Auburn Hills, MI 48326
USA
Telephone: +1 248 391 9000

www.abb.com/robotics